SYSTEM

OF

MINERALOGY.

A

SYSTEM

OF

MINERALOGY,

IN WHICH

MINERALS ARE ARRANGED ACCORDING TO THE NATURAL HISTORY METHOD.

BY

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THIRD EDITION, ENLARGED AND IMPROVED.

VOL. I.

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TO

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MEMBER OF THE GEOLOGICAL SOCIETY, OF THE
WERNERIAN NATURAL HISTORY SOCIETY, &c.

IN TESTIMONY

OF HIS

DISTINGUISHED TALENTS AS A MINERALOGIST,

BY HIS

FAITHFUL AND SINCERE FRIEND

THE AUTHOR.

PREFACE.

Mineralogy, although a science of comparatively modern date, has, within a short period of time, made rapid advances. It was first successfully cultivated in Germany and Sweden, and afterwards in France. In Great Britain, so distinguished in all the other sciences and arts of life, it was, until lately, almost entirely neglected. Now, however, it has become with us a subject of general interest and attention, and, like Chemistry, is considered as a necessary branch of education. The establishment of Lectureships and Societies, having Mineralogy as one of their principal objects, is a strong proof of the public feeling of the importance and utility of this science. Within a few years, several of the Universities have founded Professorships of Mineralogy; and that munificent and patriotic association, the Honourable Dublin Society, has lately added to its establishment a Lecturer on this science. This example has been followed by other public bodies, and also by private associations.

The establishment of the Wernerian Natural History Society of Edinburgh in 1808, directed, in this part of the

 empire,

empire, the particular attention of naturalists to Mineralogy; the labours of the Geological Society of London have created a new era in the geology of England; and the lately established Royal Geological Society of Cornwall, is making us acquainted with the mineralogical structure of one of the most interesting portions of England. But the present enthusiasm displayed throughout this country in the study of Mineralogy, is not entirely owing to the exertions of teachers, and the spirit excited by Societies: it has been also fostered, encouraged, and directed, by the writings of individuals. Of these, the most eminent is Kirwan, whose System of Mineralogy excited very general attention, was long the standard book on this subject, and has been of infinite benefit to Mineralogy. Since the publication of the second and most valuable edition of that work, and which contained the first English account of the Wernerian System, several other authors have, by their writings, directed the studies, and assisted the labours of mineralogists. Among these, Dr Kid of Oxford has distinguished himself, as the author of a treatise, entitled, "Outlines of Mineralogy." Dr Thomson, in his System of Chemistry, has dedicated a volume to the science of Mineralogy, in which that distinguished chemist has proposed several judicious improvements in the prevailing mineralogical systems; and Dr Murray, in his System of Chemistry, gives a view of the natural characters and chemical properties of the different species, adopting the chemical arrangement. Arthur Aikin, Esq. Secretary to the Society

ciety of Arts of London, has published a useful "Manual of Mineralogy." And the work now presented to the public attention, professes to have the same claims and intentions.

The arrangement adopted in this edition of the System, is nearly that of my celebrated friend MOHS, who now fills the Mineralogical Chair of the illustrious WERNER. It is founded on what are popularly called the External Characters of Minerals, and is totally independent of any aid from Chemistry. This, which may be termed the *Natural History Method*, I have always considered as the only one by which minerals could be scientifically arranged, and the species accurately determined *. In my Lectures on Mineralogy, I have been in the practice of grouping minerals together, according to their forms, lustre, streak, hardness, and specific gravity, with the view of shewing to my pupils how they could thus be arranged and determined, without the assistance of chemistry, and in conformity with the Natural

 History

* "The want of a true systematic arrangement of minerals, is still to be regretted; for although mineralogists, from the days of THEOPHRASTUS to the present time, have been engaged in this undertaking, their success has been very limited. In Botany and Zoology, regular methods have been proposed and followed; in Mineralogy, however, the greater number of writers, excepting LINNÆUS and Dr WALKER, have discarded the idea of a strict natural history arrangement, from its supposed insufficiency. This opinion, there can be no question, is ill-founded; for, it will be found on a strict investigation, that minerals can be admirably arranged into Classes, Orders, Genera, and Species."—*Introduction to Mineralogy of the Shetland Islands*, p. 2. and 3.

History method employed by Zoologists and Botanists *. According to this view, I separated all the earthy-looking minerals, such as Olivenite, Copper-mica, Lead-spar, Malachite, &c. from the Metalliferous Class, and arranged them with those Earthy Minerals to which they were most nearly allied in lustre, hardness, specific gravity, and other characters; and in the metalliferous class, arranged the different genera into groupes, or orders, forming the native metals into one order, the pyrites into another, and other metalliferous minerals into similar groupes. I was proceeding in this mode of arranging all the minerals in the System, when Professor Mohs paid me a visit in Edinburgh, and there explained to me his profound views on classification. I found they were of the same general nature with those I entertained, but that he had advanced much further, and, by the discovery of a system of Crystallography, eminently distinguished by its originality and simplicity, had been enabled to give to the Natural History Method a certainty even superior to that which exists in Botany and Zoology †.

In

* A consistent and satisfactory chemical arrangement of minerals, notwithstanding the late ingenious attempt of Berzelius, is still a desideratum in Mineralogy. It would seem that our knowledge of the chemistry of minerals is very far from being perfect; and various facts render it probable that many of the analyses must be again repeated, before any satisfactory arrangement can be proposed.

† The Mineral System, as it appears in this work, is to be considered as realising those views which Werner entertained in regard to the mode of arranging and determining minerals. He was convinced of the utter impossibility of constructing a truly philosophical mineralogical system, in which the External and Chemical Characters were to be conjoined, and considered the mixed method he delivered in his lectures, as merely a tempora-

ry

In another Treatise which I purpose laying before the public, a full statement will be given of Professor Mohs's views. In the mean time, the few observations prefixed to the *Characteristic View* of the Classes, Orders, Genera, and Species, will enable the reader to understand the nature of the system, as far as it is employed in the present work.

The *Descriptions* of the Species, Subspecies, and Kinds, are on the same plan as in the former editions, but are considerably improved, particularly in what regards cleavage, hardness, and specific gravity; in which details I have much pleasure in acknowledging the valuable information I derived from Professor Mohs.

As the Geognostical Characters of the Species lead to very interesting views in regard to the formation of Simple Minerals, and also to that of the Globe in general, I have carefully enumerated all that is known in regard to their distribution in the crust of the Earth; and to complete this view, their geographical distributions are also delineated. Although the Chemical Characters and composition of simple minerals are not employed in arranging and determining the species, still it is necessary for the mineralogist to be acquainted with them, and therefore, these also are enumerated. The Uses of Minerals are as fully detailed as is required in a work like the present; and the account

ry arrangement. He felt that the Natural History Method must be introduced into Mineralogy, if Oryctognosy was to hold the same rank in the classifications of science as Botany and Zoology.

count of each Species is concluded by a statement of its popular distinctive characters and various miscellanious particulars, in regard to its name, discoverer, &c.

I have again, as in former editions of this work, the pleasure of acknowledging the advantages I derived from the information and communications of friends, particularly from the numerous facts transmitted to me by Mr HEULAND.

EDINBURGH,
November 1819.

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OF

WORKS

Quoted in this Treatise, and of the Abbreviated Titles employed.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Theophrastus.	Περι λιθων, History of Stones, with an English version, and notes, including the modern history of the gems described by that author. By Sir John Hill. London, 1774.	Theophrastus.
Plinius.	C. Plinii sec. Historiæ Naturalis libri xxxvii.; quos interpretatione et notis illustravit J. Harduinus, Paris 1732, t. iii. fol. C. Plinii sec. Hist. Nat. libri xxxvii. ex recensione J. Harduine, Studius Societ. Bipont. 1783, 1784. Basil, 1546, fol.	Plin.
Agricola.	G. Agricola de Re Metallica l. xii. et de natura Fossilium l. x. &c.. Basil, 1546, fol.	Agricola.
Bacci.	De Gemmis et Lapidibus pretiosis, 1611.	
Boetius de Boot.	Gemmarum et Lapidum Historia, 1647,	
Boyle.	An Essay about the original Virtues of Gems, wherein are proposed, and historically illustrated, some conjectures about the consistence of the matter of precious stones, and the subjects wherein their chiefest virtues reside. By the Honourable Robert Boyle, Esq. Fellow of the Royal Society, London, 1672.	

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Wallerius.	Jo. Gottschalk Wallerii Systema mineralogicum, 8vo.	Wall.
Linnæus.	Linné System. Naturæ, t. iii. cura J. F. Gmelin, Leipsiæ, 1793.	Lin.
Brückmann.	Urban Friederick Benedict Brückmann's Abhandlung von Edelsteinen, 2te Ausgabe. Braunschweig, 1773.	
	U. F. B. Brückmann's Beitræge zu seiner Abhandlung von Edelsteinen. Braunschweig, 1778,	
	U. F. B. Bruckmann's Gesammlete und eigene Beiträge zu seiner Abhandlung von Edelsteinen. Braunschweig, 1783.	
Dutens.	Dutens des Pierres precieuses, et des Pierres fines, avec les moyens de les connoître. A Paris & Bâle, 1778, 8vo.	
Romé de Lisle.	Cristallographie ou Description des formes propres à tous les corps du regne mineral. Avec figures et tableaux synoptiques de tous les cristaux connu. Par M. De Romé de Lisle, 2de edit. Paris 1783, 4. t. 8vo.	R. de L.
Bergmann.	Torb. Bergmann's Sciagraphia regni mineralis, secundum principia proxima digesti. Manuel du Mineralogiste, ou Sciagraphie du regne mineral, distribué d'après l'analyse chimique, par M. Torb. Bergmann, traduite et augmentée des notes par Monge. A Paris, 1784.	Bergmann.
La Metherie	Theorie de la Terre, t. i. et ii. 1797.	Lam.
Kirwan.	Elements of Mineralogy, by Richard Kirwan, Esq. President of the Royal Irish Academy, &c. 2 vols 8vo. 1794—96.	Kirw.
Napione.	Elementi di Mineralogia, 1 vol. 8vo. Turin, 1797.	Nap.
Werner.	Cronstedt's Versuch einer Mineralogie übersetzt, 1 vol. 8vo. Leipsic, 1780.	Wern. Cronst.
Idem.	Ausführliches und systematisches Verzeichniss des Mineralien-kabinet des Pabst von Ohain, 2 vols 8vo. Freyberg, 1791, 1792.	Wern. Pabst.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
De Born.	Catalogue methodique et raisonné de la collection des Fossiles de Mademoiselle Eleonore de Raab. Vienne, 1790.	De Born.
Saussure.	Voyages dans les Alpes, par Horace Benedict Saussure. 4 vols 4to, 1779, 1796.	Saussure.
Wiedenman	Weiedenman's Haudbuch der Oryctognostischen Theils der Mineralogie. Leipzig, 1794, 8vo.	Wid.
Reuss.	Lehrbuch der Mineralogie nach des H. O. B. R. Karsten Tabellen, von F. Ambros Reuss, 4 vols 1803, 1808.	Reuss.
Haüy.	Traité de Mineralogie par Haüy, 4 vols. Paris 1801.	Haüy.
Brochant.	Traité elementaire de Mineralogie, suivant les principes du Professor Werner, 2 vols. Paris, an ix.	Broch.
Ludwig.	Handbuch der Mineralogie nach Werner, von C. F. Ludwig, Professor in Leipzig, 2 vols, 1803, 1804.	Lud.
Suckow.	Suckow's Anfangsgründe der Mineralogie nach der neuesten Endeckungen. Leipzig, 1803.	Suck.
Bertele.	Bertele's Handbuch der Minerographie. Landshut, 1804.	Bert.
Mohs.	Der Herrn von der Null mineralien-kabinet nach einem, durchaus auf aussere Kennziechen gegrundeten Systeme geordenet, Beschrieben, &c. von F. Mohs, 3 bände. Vien. 1804,	Mohs.
Haberle.	Characterisende Darstellung der Mineralien mit hinsicht auf Werner et Hauy's Beobachtungen, von Dr Carl Const. Haberle. Weimer, 1806, 8vo.	Hab.
Lucas.	Tableau Methodique des Especes Minerales, par J. A. Lucas. Premiere partie, Paris 1806. Seconde partie. Paris 1813.	Lucas.
Leonhard.	Systematisch-tabellarische, Übersicht et Characteristik der Mineral Körper, von C. C. Leonhard, K. F. Merz, et Dr J. H. Kopp. Frankfurt am Maine, 1806, fol.	Leonhard, Tabel.
Brongniart.	Traité Elementaire de Mineralogie, par Alexandre Brongniart. 2 vols, Paris 1806.	Brong.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Brard.	Manuel du Voyager et du Geologue Voyager, par C. P. Brard, 8vo, Paris 1808.	Brard.
	Traité des Pierres Précieuses, &c. 8vo, Paris 1808.	
Karsten.	Mineralogische Tabellen mit Rucksicht auf die neuesten Entdeckungen aufgestellt und mit erlauternden anmerkungen verschen, von D, L. G, Karsten. Berlin, 1808, fol.	Karsten, Tabel.
Hausmann.	Entwurf eines Systems der unorganischen Natur Kör-per, von J. F. L. Hausmann. Cassel, 1809, 8vo.	Haus.
Kidd.	Outlines of Mineralogy, by J. Kidd, M.D. Professor of Chemistry in the University of Oxford. 2 vols 8vo. Oxford, 1809.	Kidd.
Haüy.	Tableau Comparatif des Resultats de la Cristallographie et de l'analyse chimique relativement à la Classification des Mineraux, par M. l'Abbé Haüy. 8vo, Paris 1809.	Haüy, Tabl.
Lenz.	Erkenntnisslehre der anorgischen Natur Körper, von Dr J. G. Lenz. Giessen, 1813.	Lenz.
Hoffmann.	Handbuch der Mineralogie, von C. A. S. Hoffman, 1811, 1818, 4 bände.	Hoff.
Oken.	Oken's Lehrbuch der Naturgeschichte 1ter Theil Mineralogie. 8vo, Leipzig, 1813.	Oken.
Bournon.	Catalogue de la Collection Mineralogique du Comte de Bournon. Londres, 8vo, 1813.	Bournon.
Hausmann.	Handbuch der Mineralogie von Joh. Friedr. Ludw. Haussmann, 3 bände 8vo. Göttingen 1813.	Haus. Handb.
Aikin.	A Manual of Mineralogy. By Arthur Aikin, Secretary to the Geological Society, London, 1815.	Aikin.
Steffens.	Vollständiges Handbuch du Oryktognosie. Halle, 1811, 1815.	Steff.
Cleaveland.	Cleaveland's System of Mineralogy and Geology, 1 vol. Boston, 1816.	Cleav.

Names of Authors.	Titles of the Works.	Abbreviated Titles.
	JOURNALS, &c. referred to.	
Gehlen,	A. F. Gehlen's Newes allgemeines Journal der Chemie. Berlin, 1803, 1806, 6 bände 8vo.	Gehlen.
Schweigger.	J. C. Schweigger's Journal für Chemie und Physik. Nürenberg, since 1811, 8vo.	Schweigger.
Journal de Physique.	J. C. de Lamethrie, Journal de Physique, de Chimie, et d'Histoire Naturelle. A Paris.	Journ. d. Phys.
Bergmännishe's Journal.	Bergmännishe's Journal, herausgegeben von Köhler und Hoffman. Freyberg.	Bergm. Journ.
Leonhard.	Leonhard's Taschenbuch für die gesammte Mineralogie, 1807 to 1815.	Leonhard, Taschenbuch.
Moll's.	Ehrenberg. Freiherrn von Moll's Jahrbücher der Berg und Hüttenkunde, Salzburg, 1797, 1801, 5 bände 8vo.	
	——— Annalen der Berg und Hüttenkunde, Salzburg, 1801—1805, 3 bde 8vo.	
	——— Ephemeriden der Berg und Hüttenkunde, Nürnberg, 1805—1809, 5 bde.	
	——— Neue Jahrbücher der Berg und Hüttenkunde, Nürnberg, since 1808, 8vo.	
Journal des Mines.	Journal des Mines, publié par le Conseil des Mines à Paris. Since 1794, in 8vo numbers.	Journ. d. Min.
Annales du Museum.	Annales du Museum d'Histoire Naturelle; à Paris. Since 1802, in 4to numbers.	Annal. d. Mus.
Weber & Mohr.	Friedr. Weber's und D. M. H. Mohr's Archiv für die Systematische Naturkunde. Leipzig, 1804, 8vo. As continuation of this work,	Weber & Mohr.
	——— Beiträge zur Naturkunde, Kiel, 1805—1810, 2 bde 8vo.	

Names of Authors.	Titles of the Works.	Abbreviated Titles.
Hisinger and Berzelius.	Afhandlingar i Fysik, Kemi, och Mineralogi, Utgifne af W. Hisinger och J. Berzelius, Stockholm, 1806—1810.	
Magazin Naturforschender Freunde.	Magazin der Gesellschaft Naturforschender Freunde zu Berlin. Since 1807, in 4to numbers.	Magaz. Gesel. Nat. f. Fr.
Klaproth.	Klaproth's Beiträge zur Chemischen Kenntniss der Mineral Körper, Berlin. 1795—1810, 5 bde 8vo.	Klap. Beit.
	J. F. John, Zwei Fortsetzungen des Chemischen Laboratoriums, unter d. Titel. Chemische untersuchungen mineralischer, vegetabilischer, und animalischer Substanzen. Berlin, 1810, 1811, 2 bde 8vo.	
	Thomson's Annals of Philosophy.	
	Transactions of the Royal Society of London.	
	Transactions of the Geological Society.	
	Transactions of the Royal Society of Edinburgh.	
	Memoirs of the Wernerian Natural History Society.	
	Transactions of the Royal Geological Society of Cornwall.	

TABULAR

TABULAR VIEW

OF

SYSTEMS

OF

MINERALOGY,

Since the first Publication of the Arrangement of LINNÆUS, A. D. 1736.

LINNÆI *(Car.)* SYSTEMA NATURÆ, *Lugdb.* 1736, 1748.

I. PETRÆ.

1. VITRESCENTES.
Cos
Quartzum
Silex

2. CALCARIÆ.
Marmor
Spatum
Schistus

3. APYRÆ.
Mica
Talcum
Amiantus
Asbestus

II. MINERÆ.

1. SALIA.
Natrum
Selenites
Nitrum
Muria
Alumen
Vitriolum

2. SULPHURA.
Electrum
Bitumen
Pyrites
Arsenicum

3. MERCURIALIA.
Hydrargyrum
Stibium
Zincum
Vismuthum
Ferrum
Stannum
Plumbum
Cuprum
Argentum
Aurum

III. FOSSILIA.

1. CONCRETA.
Saxum
Tophus
Stalactites
Pumex
Aëtites
Tartarus
Calculus

2. PETRIFICATA.
Helmintholithus
Entomolithus
Ichthyolithus
Ornitholithus
Zoolithus
Phytolithus
Graptolithus

3. TERRÆ.
Marga
Ochra
Creta
Argilla
Arena
Humus

LINNÆI

LINNÆI (*Car.*) Systema Naturæ, *Holm.* 1768.

I. PETRÆ.	II. MINERÆ.	III. FOSSILIA.
I. Humosæ.	I. Salia.	I. Petrificata.
1. Schistus	13. Nitrum	36. Zoolithus
	14. Natrum	37. Ornitholithus
	15. Borax	38. Amphibiolithus
	16. Muria	39. Ichthyolithus
	17. Alumen	40. Entomolithus
	18. Vitriolum	41. Helmintholithus
		42. Phytolithus
		43. Graptolithus
II. Calcariæ.	II. Sulphura.	II. Concreta.
2. Marmor	19. Ambra	44. Calculus
3. Gypsum	20. Succinum	45. Tartarus
4. Stirium	21. Bitumen	46. Aëtites
5. Spatum	22. Pyrites	47. Pumex
	23. Arsenicum	48. Stalactites
		49. Tophus
III. Argillaceæ.	III. Metalla.	III. Terræ.
6. Talcum	24. Hydragyrum	50. Ochra
7. Amiantus	25. Molybdænum	51. Arena
8. Mica	26. Stibium	52. Argilla
	27. Zincum	53. Calx
	28. Vismuthum	54. Humus
	29. Cobaltum	
	30. Stannum	
	31. Plumbum	
IV. Arenatæ.	32. Ferrum	
9. Cos.	33. Cuprum	
10. Quartzum	34. Argentum	
11. Silex	35. Aurum	
V. Aggregatæ.		
12. Saxum		

WALLERII *(J. G.)* MINERALOGIA, *Stockh.* 1747, 8vo.

I. TERRÆ.

1. MACRÆ.
   Humus
   Creta

2. PINGUES.
   Argilla
   Marga

3. MINERALES.
   Salinæ
   Sulphureæ
   Metallicæ

4. ARENACEÆ
   Arena
   Glarea
   Metallicæ
   Animales

II. LAPIDES.

1. CALCARII.
   Calcareus
   Marmor
   Gypsum
   Spatum

2. VITRESCENTES.
   Fissilis
   Cos
   Silex
   Petrosilex
   Quartzum
   Crystallus

3. APYRI.
   Mica
   Talcum
   Ollaris
   Corneus
   Amiantus
   Asbestus

4. SAXA.
   Simplicia
   Mixta
   Grisea
   Petrosa

III. MINERÆ.

1. SALIA.
   Vitriolum
   Alumen
   Nitrum
   Muria
   Alcalia
   Acida
   Neutra
   Ammoniacum
   Borax

2. SULPHURA.
   Bitumen
   Succinum
   Ambra
   Sulphura

3. SEMIMETALLA.
   Hydrargyrum
   Arsenicum
   Cobaltum
   Antimonium
   Wismuthum
   Zincum

4. METALLA.
   Ferrum
   Cuprum
   Plumbum
   Stannum
   Argentum
   Aurum

IV. CONCRETA.

1. PORI.
   Ignei
   Aquei

2. PETRIFICATA.
   Vegetabilia
   Corallia
   Animalia
   Testacea

3. FIGURATA.
   Lithomorphi
   Lithoglyphi
   Lithotomi

4. CALCULI.
   Vegetabilium
   Animalium

WALLERII

WALLERII *(J. G.)* Systema Mineralogicum, *Holm.*, 1772, 8vo.

I. TERRÆ.

1. Macræ.
   Humus
   Calcareæ
   Gypseæ
   Manganenses

2. Tenaces.
   Argilla
   Marga

3. Minerales.

4. Duræ.
   Glarea
   Tripela
   Carmentum
   Arena
   Ar. metallica
   Ar. animalis

II. LAPIDES.

1. Calcarei.
   Calcareus
   Marmor
   Spatum
   Gypsum
   Fluor mineralis

2. Vitrescentes.
   Cos
   Spat. scintillans
   Quartzum
   Gemma
   Granatus
   Silex
   Petrosilex
   Achates
   Jaspis

3. Fusibiles.
   Zeolithus
   Basaltes
   Magnesia
   Schistus
   Margodes
   Corneus

4. Apyri.
   Mica
   Talcum
   Steatites
   Serpentinus
   Ollaris
   Asbestus
   Amiantus

5. Saxa.
   Mixta
   Aggregata

III. MINERÆ.

1. Salia.
   Acida
   Vitriolum
   Alumen
   Nitrum
   Muria
   Natron
   Alc. volatile
   Neutra
   Ammoniacum
   Borax

2. Sulphura.
   Bitumen
   Succinum
   Ambra
   Sulphur

3. Semimetalla.
   Mercurius
   Arsenicum
   Cobaltum
   Niccolum
   Antimonium
   Wismuthum
   Zincum

4. Metalla.
   Ferrum
   Cuprum
   Plumbum
   Stannum
   Argentum
   Aurum
   Platina

IV. CONCRETA.

1. Pori.
   Ignei
   Aquei

2. Petrificata.
   Vegetabilia
   Corallia
   Zooli
   Helmintholithi
   — testaceorum
   Entomolothi
   Amphibiolithi
   Ichthyolithi
   Ornitholithi
   Zoolithi
   Anthropolithi

3. Figurata.
   Lithomorphi
   Lithoglyphi
   Lithotomi

4. Calculi.
   Vegetabilium
   Animalium

CRONSTEDT

CRONSTEDT Mineralogia, *Stockh.* 1758, 8vo.

I. TERRÆ.

1. *Calcareæ.*
   Puræ
   Vitriolaceæ
   Phlogisticæ
   Argillaceæ

2. *Siliciæ.*
   Adamas
   Sapphirus
   Topazius
   Smaragdus
   Quartzum
   Silex
   Jaspis

3. *Granatinæ.*
   Granatus
   Basaltes

4. *Argillaceæ.*
   Porcellana
   Lithomarga
   Bolus
   Tripolitana
   Argilla

5. *Micaceæ.*
   Mica pura
   Mica martialis

6. *Fluores.*
   Indurati

7. *Asbestinæ.*
   Asbestus
   Amiantus

8. *Zeolithicæ.*
   Zeol. purus
   Zeol. metallicus

9. *Magnesiæ.*
   Magnesia terrea
   Magnesia indurata

II. SALIA.

1. *Acida.*
   Vitriolum
   Muria

2. *Alcalina.*
   Fixa
   Volatilia

III. PHLOGISTICA.

Ambra
Succinum
Petroleum
Sulphur
Phlogist. terreum
—— metallicum

IV. METALLA.

1. *Perfecta*
   Aurum
   Argentum
   Platina
   Stannum
   Plumbum
   Cuprum
   Ferrum

2. *Semimetalla.*
   Hydrargyrum
   Wismuthum
   Zincum
   Antimonium
   Arsenicum
   Cobaltum
   Niccolum.

WALKER

WALKER

CLASSIS FOSSILIUM.—*Edin.* 1789.

Classis I.—*Terræ.*

Ord. 1. Figulinæ. Ord. 2. Fimosæ. Ord. 3. Calcareæ. Ord. 4. Absorbentes. Ord. 5. Gypsea. Ord. 6. Siliceæ. Ord. 7. Asperæ. Ord. 8. Steatiticæ. Ord. 9. Apyræ. Ord. 10. Lapideæ. Ord. 11. Inflammabiles. Ord. 12. Ochræ.

Classis II.—*Calcarea.*

Ord. 1. Cementaria. Ord. 2. Dædalea. Ord. 3. Stiriacea. Ord. 4. Spata.

Classis III.—*Gypsea.*

Ord. 1. Plastica. Ord. 2. Selenitica.

Classis IV.—*Phosphorea.*

Classis V.—*Zeolitica.*

Classis VI.—*Ponderosa.*

Classis VII.—*Amandina.*

Ord. 1. Shorlacea. Ord. 2. Garamantica. Ord. 3. Ignigena.

Classis VIII.—*Silicea.*

Ord. 1. Quartzosa. Ord. 2. Jaspidea. Ord. 3. Lithidea. Ord. 4. Gemmæ.

Classis IX.—*Steatitica.*

Ord. 1. Saponacea. Ord. 2. Ollaria.

Classis X.

Classis X.—*Apyra.*

Ord. 1. Amiantina. Ord. 2. Asbestina.

Classis XI.—*Micacea.*

Classis XII.—*Petræ.*

Ord. 1. Quadrinæ. Ord. 2. Cotaceæ. Ord. 3. Schistosæ. Ord. 4. Siliciæ.

Classis XIII.—*Saxa.*

Ord. 1. Calcarea. Ord. 2. Arenaria. Ord. 3. Porphyria. Ord. 4. Granitæ. Ord. 5. Schistosa. Ord. 6. Amandina. Ord. 7. Steatitica. Ord. 8. Amiantina. Ord. 9. Micacea. Ord. 10. Metallica.

Classis XIV.—*Concreta.*

Ord. 1. Terrestria. Ord. 2. Aquea. Ord. 3. Ignea. Ord. 4. Metallica.

Classis XV.—*Salia.*

Ord. 1. Acida. Ord. 2. Alcalina. Ord. 3. Acido-alcalina. Ord. 4. Acido-terrea. Ord. 5. Alcalino-terrea. Ord. 6. Vitriola.

Classis XVI.—*Inflammabilia.*

Ord. 1. Acria. Ord. 2. Sulphurea. Ord. 3. Bitumina. Ord. 4. Carbonaria. Ord. 5. Electrica.

Classis XVII.—*Pyritæ.*

Ord. 1. Sulphureæ. Ord. 2. Arsenicales. Ord. 3. Ferreæ. Ord. 4. Amandinæ.

Classis XVIII.—*Semi-metalla.*

Ord. 1. Arsenicalia. Ord. 2. Sulphurea. Ord. 3. Fluida. Ord. 4. Dubia.

Classis XIX.—*Metalla.*

Ord. 1. Dura. Ord. 2. Flexilia. Ord. 3. Fixa.

WERNER'S

WERNER'S

MINERAL SYSTEM IN 1789.

CLASS I.—EARTHY and STONY SUBSTANCES.

a. FLINTY MINERALS (Kiesel-Arten.)

1. Diamond
2. Chrysoberyl
3. Zircon
4. Hyacinth
5. Chryrosolite
6. Garnet, *without subspecies*
7. Ruby
8. Sapphire
9. Topaz
10. Emerald
11. Beryl
    common
    schorlous
12. Schorl
    black
    electrical
13. Thumerstone
14. Quartz
    a. Amethyst
    b. Rock-crystal
    c. Rose quartz
    d. Common quartz
    e. Prase
15. Hornstone
16. Flint
17. Calcedony
    a. common
    b. carnelian
18. Woodstone
19. Heliotrope
20. Chrysoprase
21. Flinty-slate
    a. Common
    b. Lydian-stone
22. Obsidian
23. Cat's-eye
24. Prehnite
25. Zeolite
26. Azure-stone

b. CLAYEY MINERALS.

27. Pure clay
28. Porcelain earth
29. Co mmnoclay
    (1.) Potters' clay
    (2.) Indurated clay
    (3.) Slate-clay

30. Jasper

30. Jasper
    (1.) Egyptian jasper
    (2.) Striped jasper
    (3.) Porcelain jasper
    (4.) Common jasper
31. Opal
32. Pitchstone
33. Adamantine spar
34. Felspar
    (1.) Common
    (2.) Labrador
    (3.) Moonstone
35. Clay-slate
36. Bituminous shale
37. Alum-earth
38. Alum-slate
    a. Common
    b. Shining
39. Alum-stone
40. Black chalk
41. Whet-slate
42. Tripoli
43. Mica
44. Chlorite
    a. Chlorite-earth
    b. Common chlorite
    c. Chlorite-slate
45. Chalkolite
46. Hornblende
    a. Common
    b. Hornblende-slate
    c. Labrador hornblende
    d. Basaltic
47. Wacke
48. Basalt
49. Lava
50. Pumice
51. Green earth
52. Lithomarge
    a. Friable
    b. Indurated
53. Mountain-soap
54. Yellow earth.

c. TALCKY MINERALS.

55. Steatite
56. Nephrite
57. Fuller's earth
58. Meerschaum
59. Bole
60. Serpentine
61. Talc
    a. Earthy
    b. Common
    c. Indurated
62. Asbestus
    a. Mountain-cork
    b. Amianthus
    c. Common asbestus
    d. Mountain-wood
63. Kyanite
64. Actynolite
    a. Common
    b. Glassy
    c. Asbestous

d. CALCAREOUS

d. Calcareous Minerals.

A. Carbonates.

65. Rock-milk
66. Chalk
67. Limestone
    a. Compact
        α. Common
        β. Roestone
    b. Foliated
        α. Granular
        β. Calcareous-spar
    c. Radiated and Fibrous Limestone or Calc-sinter
    d. Peastone
68. Slate Spar
69. Brown Spar
70. Stinkstone
71. Marl
    Earthy
    Indurated
72. Bituminous Marl-Slate

B. Phosphates.

73. Apatite

C. Fluates.

74. Fluor
    a. Fluor-Earth
    b. Compact Fluor
    c. Fluor-Spar

D. Sulphates.

75. Gypsum
    a. Earthy
    b. Compact
    c. Foliated
    d. Fibrous
76. Selenite

E. Borate.

77. Boracite

F. Barytic Minerals.

78. Witherite
79. Heavy-spar
    a. Earthy Heavy-spar
    b. Compact Heavy-spar
    c. Foliated Heavy-spar
    d. Lamellar Heavy-spar
    e. Bolognese Spar

Class II.—SALINE MINERALS.

a. Alkaline Salts.

80. Native Mineral Alkali

b. Nitrous Salts.

81. Native Saltpetre

c. Muriatic Salts.

82. Common Rock-Salt
    Common
    Fibrous
83. Native Sal-Ammoniac

d. Vitriolic Salts.

84. Native Vitriol
85. Hair-Salt
86. Rock-Butter
87. Native Bitter-Salt.

Class III.—INFLAMMABLE MINERALS.

a. Sulphureous Minerals.

88. Native sulphur
    a. Common
    b. Volcanic

b. Bituminous Minerals.

89. Naphtha
90. Mineral oil
91. Bituminous wood
    a. Common
    b. Earthy
92. Stone coal
    a. Glance-coal
    b. Pitch-coal
    c. Slate-coal

c. Graphite.

93. Graphite

d. Amber.

94. Amber
    a. White
    b. Yellow
95. Honeystone

Class IV.—METALLIFEROUS MINERALS.

1. *Platina.*

96. Native platina

2. *Gold.*

97. Native Gold
    a. Gold-yellow
    b. Brass-yellow
    c. Greyish-yellow
98. Nagiaker ore

3. *Mercury.*

99. Native Mercury
100. Native amalgam
101. Mercurial horn-ore
102. Mercurial hepatic ore
    a. Compact
    b. Slaty
103. Cinnabar
    a. Dark red
    b. Bright red

4. *Silver.*

104. Native silver
105. Nagiaker silver
106. Arsenical silver
107. Horn-ore
108. Black silver-ore
109. Vitreous silver-ore
110. Brittle silver-ore
111. Red silver-ore
    a. Dark
    b. Bright
112. White silver-ore

5. *Copper.*

113. Native copper
114. Copper-glance
    a. Compact
    b. Foliated
115. Variegated copper-ore
116. Copper-pyrites
117. White copper-ore
118. Grey copper-ore
119. Black copper

120. Red

120. Red copper-ore
a. Compact
b. Foliated
c. Capillary
121. Tile-ore
a. Earthy
b. Compact
122. Azure copper
a. Earthy
b. Radiated
123. Malachite
a. Fibrous
b. Compact
124. Copper-green
125. Iron-shot copper-green
a. Earthy
b. Slaggy
126. Olivine ore

6. *Iron.*

127. Native iron
128. Iron-pyrites
a. Common
b. Radiated
c. Liver
d. Capillary
129. Magnetical pyrites
130. Magnetical iron-ore
1. Common
2. Iron-sand
131. Iron-glance
a. Common
b. Iron-mica
132. Red ironstone
a. Red iron-froth
b. Compact red ironstone
c. Red hematite
d. Red iron-ochre
133. Brown ironstone
a. Brown iron-froth
b. Compact br. ironstone
c. Brown hematite
d. Brown iron-ochre
134. Sparry ironstone
135. Clay-ironstone
a. Columnar
b. Lenticular
c. Reddle
d. Common
e. Reniform
f. Pea-ore
136. Bog iron-ore
a. Morass
b. Marsh
c. Meadow
137. Blue iron-earth
138. Green iron-earth
139. Emery
140. Pitchblende

7. *Lead.*

141. Lead-glance
a. Common
b. Compact
142. Blue lead-ore
143. Brown lead-ore
144. White lead-ore
145. Green lead-ore
146. Black lead-ore
147. Red lead-ore
148. Yellow lead-ore
149. Yellow lead-earth
a, Friable

a. Friable
b. Indurated
150. Grey lead-earth
a. Friable
b. Indurated
151. Red lead-earth
a. Friable
b. Indurated
8. *Tin.*
152. Tin-pyrites
153. Tinstone
154. Cornish tin-ore
9. *Bismuth.*
155. Native bismuth
156. Bismuth-glance
157. Bismuth-ochre
10. *Zinc.*
158. Blende
a. Yellow
b. Brown
c. Black
159. Calamine
11. *Antimony.*
160. Native antimony
161. Grey antimony-ore
a. Compact
b. Foliated
c. Radiated
d. Plumose
162. Red antimony-ore
163. White antimony-ore
12. *Manganese.*
164. Grey Manganese-ore
165. Black Manganese-ore
166. Red Manganese-ore
13. *Nickel.*
167. Copper-nickel
168. Nickel-ochre
14. *Cobalt.*
169. Grey cobalt-ore
170. Glance cobalt
171. Black earthy cobalt
a. Loose
b. Indurated
172. Brown earthy cobalt
173. Yellow earthy cobalt
174. Red cobalt
a. Cobalt-bloom
b. Cobalt-crust
15. *Arsenic.*
175. Native arsenic
176. Arsenical pyrites
a. Common
b. Argentiferous
177. Orpiment
a. Yellow
b. Red
16. *Molybdena.*
178. Molybdena
17. *Scheelium.*
179. Tungsten
180. Wolfram

KIRWAN'S

MINERAL SYSTEM IN 1794.

I. EARTHY SUBSTANCES.

I. *Calcareous Genus.*

1. Native Lime
2. Carbonat of Lime
3. Agaric Mineral
4. Chalk
5. Ganil
6. Testaceous Tufa
7. Limestone, Compact
    - Splintery fracture
    - Conchoidal fracture
    - Earthy fracture
    - Slaty fracture
    - Foliated and granular
    - Sparry
    - Arragon-spar
    - Striated or fibrous
8. Swinestone
9. Oviform
10. Baryto-calcite
11. Muri-calcite
12. Argillo-calcite
13. Marl, semi-indurated
    - Indurated
    - Siliciferous
14. Marlites
    - Argilliferous
    - Siliciferous
    - Bituminous
15. Pyritaceous Limestone
16. Argentine
17. Sidero-calcite
18. Ferri-calcite
19. Dolomite
20. Elastic Marble
21. Gypsum
    - Farinaceous
    - Compact
    - Fibrous or striated
    - Foliated
    - Specular
22. Fluor
    - Sandy
    - Compact
    - Foliated or sparry
23. Phosphorate
24. Tungsten
    - Grey
    - Brown

2. *Barytic*

2. *Barytic Genus.*

1. Barolite, or Aerated Barytes
2. Baroselenite
   Earthy
   Compact
   Baroselenite
   Foliated
   Striated or Fibrous
   Acicular
3. Liver-stone

3. *Muriatic Genus.*

1. Kiffekill
2. Martial Muriatic-spar
3. Calci-muriate
4. Argillo-muriate
5. Chlorite
   Indurated
   Slaty
6. Talcite
7. Talc
   Shistose
8. Steatites, Common
   Indurated
   Foliated
9. Potstone
10. Serpentine
11. Asbestus
    Ligniform
12. Amianthus
13. Suber montanum
14. Amianthinite
15. Asbestinite
16. Asbestoid, Common
    Metalliform
17. Actinolyte
    Lamellar
    Shorlaceous
    Glassy
18. Jade
19. Boracite

4. *Argillaceous Genus.*

1. Native Argil
2. Porcelain Clay
3. Potter's Clay
4. Indurated Clay
5. Shistose Clay
6. Shale, Bituminous
7. Fuller's Earth
8. Lithomarga
   Friable
   Indurated
9. Bole
10. Argillaceous Marl
11. Chalk
    Red

Chalk

Chalk, yellow
Black
13. Green Earth
14. Umber
15. Tripoli
16. Phospholite
17. Lepidolite
18. Sappare
19. Mica
20. Micarelle
21. Hornblende
22. Basaltine
23. Labrador Hornblende
24. Schiller-spar
25. Shistose Hornblende
26. Wacken
27. Mullen
28. Kragg
29. Trap
30. Basalt
31. Calp
32. Argillite
33. Novaculite

5. Siliceous Genus.

1. Mountain Crystal & Quartz
2. Amethyst
3. Emerald
4. Beryl
5. Prasium
6. Oriental Ruby
   Topaz
   Sapphire
7. Spinel and Balas Rubies
8. Occidental Ruby
   Topaz or Brazilian Sapphire
9. Hyacinth
10. Garnet
    Oriental
    Common
    Amorphous
11. Chrysoberyl
12. Chrysolite
13. Oliven
14. Obsidian
15. Shorl
16. Tourmaline
17. Thumerstone
18. Prehnite
19. Ædilite, or Siliceous Zeolite
20. Zeolite
21. Staurolite, or Cross-stone of St Andreasberg in the Hartz
22. Lapis Lazuli
23. Chrysoprasium
24. Vesuvian, or White Garnet of Vesuvius
25. Shorlite
26. Rubellite
27. Opal
28. Semi-opal
29. Pitchstone
30. Hydrophane
31. Hyalite, Muller's Glass of the Germans

32. Calcedony

32. Calcedony
    Common
    Carnelian
33. Cat's-Eye
34. Flint
35. Hornstone
36. Schistose Hornstone
37. Siliceous Shistus
38. Basanite
39. Hornslate
40. Jasper
    Common
    Striped
41. Egyptian Pebble
42. Sinople
43. Porcellanite
44. Heliotropium
45. Woodstone
46. Elastic Quartz
47. Felspar
    Common
    Moonstone
    Continuous
48. Labrador Stone
49. Petrilite
50. Argentine Felspar
51. Red-stone of Rawenstein
52. Siliceous Spar
53. Agates

6. *Strontian Genus.*

1. Strontianite.

7. *Jargon Genus.*

1. Jargon or Zircon.

8. *Sydneia Genus,*

9. *Adamantine Genus.*

1. Adamantine Spar.

II. SALINE SUBSTANCES.

1. Acids
2. Alkalies
3. Neutral Salts
   Spec. 1. Tartar Vitriolate
   2. Glauber's Salt
   3. Vitriolic Ammoniac
4. Epsom Salt
5. Alum
6. Aluminous ores
   Stony
   Earthy

1st Family

1st Family, Slaty
2d, Compact
3d, Ligneous
7. Vitriol of Iron
8. —— of Copper
9. —— of Zinc
10. Mixed Iron, Copper, and Zinc
11. Nitre
12. Nitrated Soda
13. Nitrous Ammoniac
14. Nitrated Lime
15. Nitrated Magnesia
16. Muriated Tartarin
17. Common Salt
Var. 1. Lamellar
2. Fibrous
18. Sal Ammoniac
19. Muriated Barytes
20. ——— Lime
21. ——— Magnesia
22. ——— Argil
23. ——— Iron
24. ——— Copper
25. ——— Manganese
26. Tincal

III. INFLAMMABLES.

Genus 1. *Inflammable Air*
2. *Bituminous*
Species 1. Naphtha
2. Petrol
3. Mineral Tar
4. ——— Pitch
Var. 1. Cohesive
2. Maltha
3. Asphalt
5. Mineral Tallow
—— Cahoutchou
Genus 3. *Carbonaceous Substances*
Spec. 1. Native Carbon
2. Bituminous Carbon
Fam. 1. Cannel Coal
Var. 1. Compact
2. Slaty
Fam. 2. Impregnated with Asphalt and Maltha
Var. 1. From Whitehaven
2. — Wigan
3. — Swansea
4. — Leitrim
5. — Irvine
Fam. 3. Spurious Coal
Spec. 3. Antracolite
4. Plumbago
Genus 4. *Vegeto-Carbonated Substances*
Spec. 1. Carbonated Wood
Var. 1. Ligniform
2. Scaly or Earthy
3. Compact

Spec. 2. Turf and Peat
Genus 5. *Vegeto-Bituminous*
Spec. 1. Jet
2. Amber
Ambergris and Copal
Appendix. Mellilite
Genus 6. *Sulphur and its Ores*
Spec. 1. Native Sulphur
2. Hepatic Air
3. Sulphur combined with Argil
4. — mixed with Argil
5. United with Calcareous Earth
6. United to Fixed Alkalies
7. —— to Metallic Substances
8. Martial Pyrites
Fam. 1. United to Iron in its metallic state
Var. 1. Common Sulphur Pyrites
2. Striated
3. Capillary
4. Magnetic
Fam. 2. United to Calx of Iron
Hepatic Pyrites

IV. METALLIC SUBSTANCES.

1. *Gold.*

Species 1. Native Gold
Auriferous Ores

2. *Platina.*

3. *Silver and its Ores.*

Spec. 1. Native Silver
Fam. 1. Pure
2. Auriferous
3. Cupriferous
4. Antimoniated
5. Arsenicated
Spec. 2. Calciform
3. Mineralised by Acids
Fam. 1. Corneous
2. Argillo-Muriated
Spec. 4. Sulphurated Silver-ore
5. Light Lamellar Silver-ore
6. Sooty Silver-ore
Spec. 7. Antimoniated Silver-ore
8. Plumbiferous Antimoniated Silver-ore
Fam. 1. Light Grey
2. Dark Grey
9. Cupriferous Sulphurated Silver-ore
10. Red Silver-ore
Fam. 1. Light Red
2. Dark Red
11. Scoriaceous
12. Bismuthic
13. Greenish and Reddish-black Silver-ore
Subsidiary

4. *Copper*

4. *Copper and its Ores.*

Spec. 1. Native Copper
Var. 1. —— ——
2. Cement Copper
Spec. 2. Calciform Copper-ores
Tribe i. Blue
Var. 1. Mountain Blue
2. Striated
Tribe ii. Green
Fam. 1. Malachite
Var. 1. Fibrous
2. Compact
Fam. 2. Mountain Green
Tribe iii. Red
Fam. 1. Cochineal Red
Var. 1. Compact
2. Foliated
3. Fibrous
Fam. 2. Brick Red
Var. 1. Earthy
2. Indurated

Spec. 3. Mineralised by Sulphur
Fam. 1. Copper-Pyrites
2. Purple
3. Black
4. Vitreous
Var. 1. Compact
2. Foliated
Fam. 5. Grey
Spec. 4. Mineralised by Muriatic Acid
5. Mineralised by Arsenical Acid
Olive Copper-ore
Earthy Iron shot Mountain Green
Glassy Iron shot Mountain Green
6. Mineralised by Arsenic
White Copper
Various Cupriferous Compounds

5. *Iron and its Ores.*

Spec. 1. Native Iron
2. Mineralised by pure Air
Tribe i.
Fam. 1. Common Magnetic Ironstone
2. Fibrous
3. Magnetic Sand
Tribe ii.
Fam. 1. Specular Iron-ore
2. Brown Hæmatites.
3. Compact Brown Ironstone
4. Brown scaly Ore
5. Brown Iron-ochre
6. Black Ironstone
Tribe iii.
Fam. 1. Red Hæmatites
2. Compact Red Ironstone
3. Red Ochre
4. Red scaly Iron-ore
Tribe iv. Argillaceous Iron-ores
Fam. 1. Upland Argillaceous

Var. 1.

Var. 1. Common Argillaceous Ironstone
2. Columnar Iron-ore
3. Acinose
4. Nodular
5. Pisiform
Fam. 2. Lowland Argillaceous Iron-ore
Siderite
Sideritic Calx
Var. 1. Lowland Ores
Meadow
Var. 2. Swampy
3. Morassy
Spec. 3. Mineralised by Carbon
Plumbaginous
4. Blue Martial Earth
5. Blue Iron-ore of Vorau
6. Green Martial Earth
7. Mineralised by Sulphur
8. Mineralised by Arsenic
9. Mineralised by the Arsenical Acids
10. Sparry Iron-ore
11. Emery
12. Tungstenic Iron-ore

6. *Tin and its Ores.*

Spec. 1. Native Tin
2. Mineralised by Oxygen
Fam. 1. Common Tinstone
Fam. 2. Fibrous, or Wood Tin-ore
3. Tin-Pyrites

7. *Lead and its Ores.*

Spec. 1. Native Lead
2. Mineralised by Oxygen and Fixed Air
Fam. 1. White Lead-ore
2. Earthy, Yellowish, Greenish, &c. Lead-ore
3. Earthy Red Lead-ore
Spec. 3. Phosphorated Lead-ore
4. Arsenicated Lead-ore
5. Arsenico-phosphorated
Spec. 6. Vitriolated
7. Yellow Molybdenated Lead-ore
8. Red Lead-spar
9. Mineralised by Sulphur
Fam. 1. Common Galena
2. Compact
3. Blue Lead-ore
4. Black Lead-ore
Brown Lead-ore of Werner

8. *Mercury*

8. *Mercury and its Ores.*

Spec. 1. Native
2. Natural Amalgama
3. Mineralised by Oxygen
Fam. 1. Compact
2. Slaty
4. Corneous Mercurial Ore

5. Mineralised by Sulphur
Fam. 1. Native Æthiops
2. Native Cinnabar
Dark Red
Bright Red
3. Greyish Black

9. *Zinc and its Ores.*

Spec. 1. Calamine
Fam. 1. Loose
2. Compact
3. Striated

Spec. 2. Blende
Fam. 1. Yellow
2. Brown
3. Black

10. *Antimony and its Ores.*

Spec. 1. Native
2. Sulphurated
Fam. 1. Compact
2. Foliated
3. Striated

Spec. 3. Sulphurated and Arsenicated Plumose
4. Red Antimonial Ore
5. Muriated
Antimonial Ochre
Supposed Phosphorated Antimony

11. *Arsenic and its Ores.*

Spec. 1. Native Arsenic
2. Do. Alloyed with Iron
3. Do. with Sulphurated Iron

Spec. 4. Mineralised by Oxygen
Loose
Indurated
5. Mineralised by Sulphur
Fam. 1. Orpiment
2. Realgar.

12. *Bismuth and its Ores.*

Spec. 1. Native Bismuth
2. Bismuth Ochre
Earthy
Crystallised

3. Mineralised by Sulphur

13. *Cobalt*

13. Cobalt and its Ores.

Spec. 1. Dull grey Cobalt-ore
2. Bright white Cobalt-ore
3. Mineralised by Oxygen
Fam. 1. Black Cobalt-ore
Loose
Indurated
2. Brown
Fam. 3. Yellow
Spec. 4. Red Cobalt-ore
Fam. 1. Cobalt Germinations
2. Cobaltic Incrustations
Green and Violet Cobalt-ores.

14. Nickel and its Ores.

Spec. 1. Native Nickel alloyed by Iron
2. Nickel Ochre, and Vitriol, Loose
Indurated
Spec. 3. Arsenicated Nickel
4. Sulphurated Nickel

15. Manganese and its Ores.

Spec. 1. Native
2. Mineralised by Oxygen
Fam. 1. Grey
2. Black
Earthy
Indurated
Spec. 3. Mineralised by Oxygen and fixed air
Fam. 1. White
2. Red
4. Vitriolated Manganese

16. Uranite and its Ores.

Spec. 1. Mineralised by Acids
Fam. 1. Uranitic Ochre
2. Micaceous
Spec. 2. Sulphurated

17. Tungstenite and its Ores.

Spec. 1. Tungsten
Fam. 1. White or Grey
2. Brown
Spec. 2. Wolfram

18. Molybdenite.

Molybdena

19. Sylvanite.

20. Menachanite.

21. Titanite.

Calcareo Siliceous-ore.

MOHS'

MINERAL SYSTEM IN 1804.

CLASS I.—EARTHY MINERALS.

1. Diamond family
2. Zircon family
3. Chrysoberyl family
4. Augite family
5. Garnet family
6. Spinel family
7. Hardstone (Hartstein) family
8. Schorl family
9. Quartz family
10. Opal family
11. Obsidian family
12. Zeolite family
13. Felspar family
14. Clay family
15. Clay-slate family
16. Mica family
17. Trap family
18. Lithomarge family
19. Bole family
20. Talc family
21. Actynolite family
22. Limestone family
23. Brown-spar family
24. Marl family
25. Apatite family
26. Fluor family
27. Gypsum family
28. Baryte family
29. Saltstone family

CLASS. II.—SALINE MINERALS.

30. Family of carbonats
31. Family of nitrats
32. Family of muriats
33. Family of sulphats

CLASS III.—INFLAMMABLE MINERALS.

34. Sulphur family
35. Amber family
36. Coal family
37. Graphite family

CLASS IV.

CLASS IV.—METALLIC MINERALS.

38. Family, Native Gold
39. ——— Mercurial-ores
40. ——— Native Silver
41. ——— Silver-ores
42. ——— Native Copper
43. ——— of Copper-pyrites
44. ——— Malachite
45. ——— Copper-emerald
46. ——— Native Iron
47. ——— Iron-pyrites
48. ——— Ironstone
49. Family, Iron-earth
50. ——— Manganese
51. ——— Manakan
52. ——— Lead-ore
53. ——— Tinstone
54. ——— Speiss-cobalt
55. ——— Cobalt-ochre
56. ——— Earthy Cobalt-ores
57. ——— Native Arsenic
58. ——— Antimony-ores
59. ——— Uranium-ores

APPENDIX.

262. Needle-ore
263. Chrome-ochre

BRONG-

BRONGNIART'S
MINERAL SYSTEM IN 1807.

Classe I.—*Les Oxigénés non Metalliques.*

L'oxigêne combiné avec des bases non metalliques.

Ord. 1.—Les Oxigénés non Acides.

L'oxigêne formant avec ces bases des corps non acides.
Generes, Air, Eau.

Ord. 2.—Les Oxigénés non Acides.

L'oxygêne formant avec ces bases des corps acides.
Acides Sulphurique, Muriatique, Carbonique et Boracique.

Classe II.—*Les Sels non Metalliques.*

Une base non metallique combinée avec un acide.

Ord. 1.—Les Sels Alcalins.

Une base alcaline avec un acide.

Ord. 2.—Les Sels Terreux.

Une base terreuse avec un acide.

Ord. 3.—Les Sels Terreux.

Une base terreuse combinée avec un acide.

Classe III.—*Les Pierres.*

Les terres combinées entr'elles, et quelquefois avec des principes accessoires alcalins, acides ou metalliques.

Ord. 1.—Les Pierres dures.

Seches et apres au toucher, une dureté assez considerable pour rayer le verre à vitre blanc.

Ord. 2.

Ord. 2.—Les Pierres Onctueuses.

Ne rayant point le verre, le plus tendre, douces, et même onctueuses au toucher.

Ord. 3.—Les Pierres Argilloides.

Aspect argilleux, odeur argilleuse, souvent douces au toucher.

Classe IV.—*Les Combustibles.*

Mineraux qui peuvent se combiner immediatement avec l'oxigêne.

Ord. 1.—Les Combustibles Composés.

Donnant de la fumée huileuse en brulant.

Ord. 2.—Les Combustibles Simples.

Ne donnant point de fumée huileuse dans leur combustion.

Classe V.—*Les Metaux.*

Mineraux ayant pour base une substance metallique.

Ord. 1.—Les Metaux Fragiles.

N'etant susceptibles de s'alonger ni sous le marteu ni sous le laminoir.

Ord. 2.—Les Metaux Ductiles.

Susceptibles de s'étendre sous le laminoir ou sous le marteau.

KARSTEN's

KARSTEN's

MINERAL SYSTEM IN 1808.

I. Class.—*Earthy Minerals.*

1. Order, Zirconia.
2. ——— Yttria.
3. ——— Glucina.
4. ——— Silica.
   a. Silica and glucina.
   b. Silica, with a very slight intermixture of other substances.
   c. Silica with water.
   d. Silica with water and alumina.
   e. Silica, alumina, and lime, or an alkali.
   f. Silica and magnesia.
   g. Silica and lime.
   h. Silica, lime, alumina, and gypsum.
5. Order, Alumina.
6. ——— Magnesia.
7. ——— Lime.
   a. Lime with carbonic acid.
   b. ——— phosphoric acid.
   c. ——— fluoric acid.
   d. ——— sulphuric acid.
   e. ——— boracic acid.
8. Order, Strontian.
9. ——— Barytes.

II. Class.—

II. Class.—*Saline Minerals.*

1. Order, Carbonates.
2. —— Borates.
3. —— Nitrates.
4. —— Muriates.
5. —— Sulphates.

III. Class.—*Inflammable Minerals.*

IV. Class.—*Metallic Minerals.*

1. Order, Platina
2. —— Gold
3. —— Mercury
4. —— Silver
5. —— Copper
6. —— Iron
7. —— Lead
8. —— Molybdena
9. —— Tin
10. —— Zinc
11. —— Bismuth
12. —— Tellurium
13. Order, Antimony
14. —— Manganese
15. —— Nickel
16. —— Cobalt
17. —— Arsenic
18. —— Uranium
19. —— Titanium
20. —— Scheel
21. —— Chrome
22. —— Tantalum
23. —— Cerium
24. —— Columbium

THOMSON's

THOMSON'S
MINERAL SYSTEM IN 1810.

CLASS I.—STONES.

Order I.—*Earthy Stones.*

Families.—Diamond, Zircon, Chrysolite, Garnet, Ruby, Topaz, Schorl, Quartz, Pitchstone, Zeolite, Felspar, Clay-slate, Mica, Trap, Lithomarge, Soapstone, Talc, Actynolite, and Gadolinite.

Order 2.—*Saline Stones.*

i. Genus, Calcareous Salts.

1. Family of Carbonates
2. Family of Phosphates
3. Family of Fluates
4. Family of Sulphates
5. Family of Borates

ii. Genus, Barytic Salts.

Carbonate
Sulphate

iii. Genus, Strontian Salts.

Carbonate
Sulphate

iv. Genus, Magnesian Salts.

Sulphate
Borate
Carbonate

v. Genus, Aluminous Salts.

CLASS II.—SALTS.

Genus i. Potash
ii. Soda
Genus iii. Ammonia

CLASS III.—COMBUSTIBLES.

Genus i. Sulphur
ii. Resin
Genus iii. Bitumen
iv. Graphite

CLASS IV.

CLASS IV.—ORES.

Order i *Gold*

1. Alloys

Order ii. *Platinum*

1. Alloys

Order iii. *Iridium*

1. Alloys

Order iv. *Silver*

1. Alloys. 2. Sulphurets. 3. Oxides. 4. Salts

Order v. *Mercury*

1. Alloys. 2. Sulphurets. 3. Salts

Order vi. *Copper*

1. Alloys. 2. Sulphurets. 3. Oxides. 4. Salts

Order vii. *Iron*

1. Alloys. 2. Sulphurets. 3. Oxides. 4. Salts

Oder viii. *Nickel*

1. Alloys. 2. Oxides

Order ix. *Tin*

1. Sulphurets. 2. Oxides

Order x. *Lead*

1. Sulphurets. 2. Oxides. 3. Salts

Order xi. *Zinc*

1. Sulphurets. 2. Oxides. 3. Salts

Order xii. *Bismuth*

1. Alloys. 2. Sulphurets. 3. Oxides

Order xiii. *Antimony*

1. Alloys. 2. Sulphurets. 3. Oxides. 4. Salts

Order xiv. *Arsenic*

1. Alloys. 2. Sulphurets. 3. Oxides. 4. Salts

Order xv. *Cobalt*

1. Alloys. 2. Oxides 3. Salts

Order xvi. *Manganese*

1. Oxides. 2. Salts

Order xvii. *Chromium*

1. Alloys. 2. Oxides. 3. Salts

Order xviii. *Uranium*

1. Oxides

Order xix. *Molybdenum*

1. Sulphurets

Order xx. *Tungsten*

1. Salts

Order xxi. *Titanium*

1. Oxides

Order xxii. *Columbium*

1. Oxides

Order xxiii. *Cerium*

1. Oxides.

MURRAY'S

MINERAL SYSTEM IN 1812.

I. *Saline Minerals.*

1. Native Salts, with a base of Ammonia
2. Native Salts, with a base of Potash
3. Native Salts, with a base of Soda.

II. *Earthy Minerals.*

1. Barytic Fossils
2. Strontitic Fossils
3. Calcareous Fossils
4. Magnesian Fossils
5. Argillaceous Fossils
6. Glucine Fossils
7. Siliceous Fossils
8. Zircon Fossils
9. Gadolinite.

III. *Metallic Minerals.*

1. Native Gold
2. Native Platina
3. Ores of Silver
4. ——— Quicksilver
5. ——— Copper
6. ——— Iron
7. ——— Lead
8. ——— Tin
9. ——— Zinc
10. ——— Nickel
11. ——— Cobalt
12. ——— Manganese
13. Ores of Arsenic
14. ——— Bismuth
15. ——— Antimony
16. ——— Tellurium
17. ——— Chrome
18. ——— Molybdena
19. ——— Tungsten
20. ——— Titanium
21. ——— Uranium
22. ——— Tantalum
23. ——— Cerium.

IV. *Inflammable Minerals.*

1. Native Sulphur.
2. Carbonaceous Minerals.
3. Inflammable Minerals, in which Hydrogen predominates.

HAUSMANN's

HAUSMANN's

MINERAL SYSTEM IN 1813.

Class I.—COMBUSTIBLES.

1. Order. Inflammables.

Non-Metallic Combustibles,

1. Sub-Order,—*Simple,*—Ex. *Diamond,* &c.
2. Sub-Order,—*Compound.*

Combinations of two or more non-Metallic Combustibles, —Ex. *Graphite,* &c.

2. Order. Metals.

Native Metals and Alloys.—Ex. *Native Silver* and *Antimonial Silver.*

3. Order. Ores.

Combinations of Metals and Sulphur.—Ex. *Copper-Pyrites.*

CLASS II.—INCOMBUSTIBLES.

Oxidised Minerals, and Combinations of these.

1. Order. OXIDES.

1. Sub-Order. *Metallic Oxides.* Oxidised Metals, either simple, or in combination with each other, and sometimes also combined with earths or with water.—Ex. *Magnetic Ironstone,* and *Brown Ironstone.*

2. Sub-Order. *Earths,* variously combined with each other, and with metallic oxides and water.

1. Series. Simple, *Quartz.*

Indeterminate combinations of earths with each other, or with other matters.

2. Series. Compound, *Opal.*

Determinate combinations of earths with each other, or with other substances.

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2. Order. OXYDOIDS.

Combinations of combustible bodies with oxygen, which possess neither the properties of bases nor of acids. —Ex. *Water.*

3. Order. ACIDS.

4. Order. SALTS.

Combinations of Bases with Acids.

1. Sub-Order. *Earthy.*

With Earthy Bases,

1. Series. Aluminous Salts.
2. ——— Magnesian Salts.

2. Sub-

2. Sub-Order. *Alkaline.*

With Alkaline Bases.

1. Series. Salts of Soda
2. —— Salts of Potash
3. —— Salts of Ammonia
4. —— Salts of Lime
5. —— Salts of Strontian
6. —— Salts of Barytes

3. Sub-Order. *Metallic.*

With Metallic Oxide Bases.

1. Series. Salts of Silver
2. —— Salts of Mercury
3. —— Salts of Copper
4. —— Salts of Iron
5. —— Salts of Manganese
6. —— Salts of Lead
7. —— Salts of Zinc
8. —— Salts of Cobalt
9. —— Salts of Nickel

AIKIN'S

AIKEN'S

MINERAL SYSTEM IN 1815.

Class I.—*Non-Metallic Combustible Substances.*

1. Combustible with flame. Mineral Oil.
2. Combustible without flame. Graphite.

Class II.—*Native Metals, and Metalliferous Minerals.*

Order I.—Volatilisable, wholly or in part, by the blowpipe on charcoal, into a vapour, which condenses in a pulverulent form on a piece of charcoal held over it.

1. Entirely, or almost entirely volatilisable.
   Lustre metallic. Native Arsenic.
   Lustre non-metallic. Cinnabar.

2. Partly volatilisable; the residue affording metallic grains with borax, on charcoal.
   Lustre metallic. Silver-white Cobalt-ore.
   Lustre non-metallic. Red Silver-ore.

3. Partly volatilisable; the residue not reducible to the metallic state.
   Lustre metallic. Common Iron-pyrites.
   Lustre non-metallic. Red Cobalt-ochre.

Order II.

Order II.—Fixed; not volatilisable except at a white heat.

1. Assume or preserve the metallic form, after roasting on charcoal while any thing is dissipated, and subsequent fusion with borax.

   Lustre metallic. Native Copper.
   Lustre non-metallic. Malachite.

2. Not reducible to the metallic state before the blowpipe on charcoal, either with or without borax.

   Magnetic after roasting. Common Pyrites.
   Not magnetic after roasting. Blende.

Class III.—*Earthy Minerals.*

Order I.—Soluble with effervescence, either wholly, or in considerable proportion, in cold and moderately dilute muriatic acid; yield to the knife.

1. Effervesce vigorously. Marl.
2. Effervesce very feebly in cold, but more vigorously in warm, muriatic acid. Carbonate of Magnesia.

Order II.—Fusible before the Blowpipe.

1. Hardness equal or superior to that of quartz. Garnet.
2. Hardness superior to that of common window-glass; generally yield in some degree to the knife. Felspar.
3. Yield to the knife; and sometimes feebly scratch glass. Tremolite.
4. Yield easily to the knife, and sometimes to the nail. Heavy-spar.
5. Very soft; yield to the nail. Gypsum.

Order III.

Order III.—Infusible before the Blowpipe.

1. Hardness equal or superior to that of quartz. Flint.
2. Scratch glass; sometimes yield to the knife. Opal.
3. Yield to the knife. Serpentine.
4. Yield to the nail. Mountain-cork.

Class IV.—*Saline Minerals.*

Soluble in Water; Sapid.

Order I.—Afford a precipitate with carbonated alkali. Blue Vitriol.

Order II.—Do not afford a precipitate with carbonated alkali. Natron.

HAUY'S

HAUY'S MINERAL SYSTEM IN 1813.

PREMIERE CLASSE.

SUBSTANCES ACIDIFERES.

PREMIERE ORDRE.

Substances acidifères libres.

1. I. Acide sulfurique
2. II. Acide boracique

SECOND ORDRE.

Substances acidifères terreuse.

† A BASE SIMPLE.

1. Genre.—*Chaux.*

3. 1. Chaux carbonatée
   i. Chaux carb. *ferrifère*
   ii. Chaux carb. *manganèsifère rose*
   iii. Chaux carb. *ferro-manganèsifère*
   iv. Chaux carb. *quarzifère*
   v. Chaux carb. *magnésifère*
   vi. Chaux carb. *nacrée*
   vii. Chaux carb. *fétide*
   viii. Chaux carb. *bituminifére*
4. 2. Arragonite
5. 3. Chaux phosphatée
   Chaux phosphatée *quarziféré*
6. 4. Chaux fluatée
   Chaux fl. *aluminifère*
7. 5. Chaux sulfatée
   Chaux sul. *calcarifère*
8. 6. Chaux anhydro-sulphatée
   i. Chaux an.-sul. *muriatifère*
   ii. Chaux an.-sul. *quarzifère*
   iii. Chaux an.-sul. *épigène*
9. 7. Chaux nitratée
10. 8. Chaux arseniatée

II. Genre.

II. Genre.—*Baryte.*

11. 1. Baryte sulfatée
Baryte sulfatée *fétide*

12. 2. Baryte carbonatée

III. Genre.—*Strontiane.*

13. 1. Strontiane sulfatée
Strontiane sul. *calcarifère*

14. 2. Strontiane carbonatée

IV. Genre.—*Magnesie.*

15. 1. Magnésie sulphatée
i. Magnésie sul. *ferrifére*
ii. Magnésie sul. *cobaltifère*

16. 2. Magnésie boratée
Magnésie bor. *calcarifère*

17. 3. Magnésie carbonatée
Magnésie carb. *silicifère*

†† A BASE DOUBLE.

V. Genre.—*Chaux et Silice.*

18. Chaux boratée siliceuse.

VI. Genre.—*Silice et Alumine.*

19. Silice fluatée alumineuse *ou* Topaze.

TROISIEME ORDRE.

Substances acidifères alkalines.

1. Genre.—*Potasse.*

20. Potasse nitratée

II. Genre.—*Soude.*

21. 1. Soude sulfatée
22. 2. Soude muriatée
23. 3. Soude boratée
24. 4. Soude carbonatée

III. Genre.—*Ammoniaque.*

25. 1. Ammoniaque sulfatée
26. 2. Ammoniaque muriatée

QUATRIEME ORDRE.

Substances acidifères alkalino-terreuses.

Genre unique.—*Alumine.*

27. 1. Alumine sulfatée alkaline
28. 2. Alumine fluatée alkaline

Appendice.—Glauberite.

SECONDE

SECONDE CLASSE.

SUBSTANCES TERREUSES.

29. 1. Quarz
  i. Quarz-*hyalin*
  ii. Quarz-*agathe*
  iii. Quarz-*résinite*
  iv. Quarz-*jaspe*
  v. Quarz-*pseudomorphique*
30. 2. Zircon
31. 3. Corindon
  i. Corindon-*hyalin*
  ii. Corindon-*harmophane*
  iii. Corindon-*granulaire*
32. 4. Cymophane
33. 5. Spinelle
34. 6. Emeraude
35. 7. Euclase
36. 8. Grenat
  Grenat *ferrifère*
37. 9. Amphigène
38. 10. Idocrase
39. 11. Meïonite
40. 12. Feld-spath
  i. Feld-spath *tenace*
  ii. Feld-spath *décomposé*
41. 13. Apophyllite
42. 14. Triphane
43. 15. Axinite
44. 16. Tourmaline
  Tourmaline *apyre*
45. 17. Amphibole
46. 18. Pyroxène
47. 19. Yenite
48. 20. Staurotide
49. 21. Epidote
  Epidote *manganesifère*
50. 22. Hypersthène
51. 23. Wernerite
52. 24. Paranthine
53. 25. Diallage
54. 26. Gadolinite
55. 27. Lazulite
56. 28. Mésotype
  Mésotype *altérée*
57. 29. Stilbite
58. 30. Laumonite
59. 31. Prehnite
60. 32. Chabasie
61. 33. Analcime
  Analcime *cubo-octaèdre*
62. 34. Népheline
63. 35. Harmotome
64. 36. Péridot
  Péridot *décomposé*
65. 37. Mica
66. 38. Pinite
67. 39. Disthène
68. 40. Dipyre
69. 41. Asbeste
70. 42. Talc
  Talc *pseudomorphique*
71. 43. Macle

TROISIEME

TROISIEME CLASSE.

SUBSTANCES COMBUSTILBES.

PREMIERE ORDRE.

Substances combustibles simples.

72. 1. Soufre
73. 2. Diamant
74. 3. Anthracite

SECOND ORDRE.

Substances combustibles composées.

75. 1. Graphite
76. 2. Bitume
77. 3. Houille
78. 4. Jayet
79. 5. Succin
80. 6. Mellite

QUATRIEME CLASSE.

SUBSTANCES METALLIQUES.

PREMIERE ORDRE.

Non oxydables immédiatement, si ce n'est à un feu très violent, et réductibles immédiatement.

I. Genre.—*Platine.*

81. Platine natif *ferrifère*

II. Genre.—*Or.*

82. Or natif.

III. Genre.—*Argent.*

83. 1. Argent natif
84. 2. Argent antimonial
    Argent antimonial *ferro-arsenifère*
85. 3. Argent sulfuré
86. 4. Argent antimonié sulfuré
    Argent antimonié sulfuré *noir*
87. 5. Argent carbonaté
88. 6. Argent muriaté

SECOND

SECOND ORDRE.

Oxydables et réductibles immédiatement.

Genre Unique.—*Mercure.*

89. 1. Mercure natif
90. 2. Mercure argental
91. 3. Mercure sulfuré
    Mercure sulfuré *bituminifère*
92. 4. Mercure muriaté

TROISIEME ORDRE.

Oxydables, mais non réductibles immédiatement.

SENSIBLEMENT DUCTILES.

I. Genre.—*Plomb.*

93. 1. Plomb natif *volcanique*
94. 2. Plomb sulfuré
    i. Plomb sulfuré *antimonifère*
    ii. Plomb sulfuré *antimonio-arsenifère*
95. 3. Plomb oxydé rouge
96. 4. Plomb arsenié
97. 5. Plomb chromaté
98. 6. Plomb carbonaté
    i. Plomb carbonaté *noir*
    ii. Plomb carbonaté *cuprifère*
99. 7. Plomb phosphaté
    i. Plomb phosphaté *arsenifère*
    ii. Plomb sulfuré *épigène*
100. 8. Plomb molybdaté
101. 9. Plomb sulfaté

II. Genre.—*Nickel.*

102. 1. Nickel natif
103. 2. Nickel arsenical
    Nickel arsenical *argentifère*
104. 3. Nickel oxydé

III. Genre.—*Cuivre.*

105. 1. Cuivre natif
106. 2. Cuivre pyriteux
    Cuivre pyriteux *hépatique*
107. 3. Cuivre gris
    i. Cuivre gris *arsenifère*
    ii. Cuivre gris *antimonifère*
    iii. Cuivre gris *platinifère*

108. 4. Cuivre

108. 4. Cuivre sulfuré
Cuivre sulfuré *hépatique*
109. 5. Cuivre oxydulé
Cuivre oxydulé *arsenifère*
110. 6. Cuivre muriaté
111. 7. Cuivre carbonaté bleu
Cuivre carbonaté vert *épigène*
112. 8. Cuivre carbonaté vert
113. 9. Cuivre arseniaté
i. Cuivre arseniaté *altéré*
ii. Cuivre arseniaté *ferrifère*
114. 10. Cuivre dioptase
115. 11. Cuivre phosphaté
116. 12. Cuivre sulfaté

IV. Genre.—*Fer.*

117. 1. Fer natif
i. Fer natif *volcanique*
ii. Acier natif *pseudo-volcanique*
iii. Fer natif *météorique*
118. 2. Fer oxydulé
Fer oxydulé *titanifère*
119. 3. Fer oligiste
120. 4. Fer arsenical
Fer arsenical *argentifère*
121. 5. Fer sulfuré
i. Fer oxydé *épigène*
ii. Fer sulfuré *ferrifère*
iii. Fer sulfuré *aurifère*
iv. Fer sulfuré *titanifère*
122. 6. Fer oxydé
i. Fer oxydé noir *vitreux*
ii. Fer oxydé *résinite*
iii. Fer oxydé *carbonaté*

V. Genre.—*Etain.*

123. 1. Etain oxydé
124. 2. Etain sulfuré

VI. Genre.—*Zinc.*

125. 1. Zinc oxydé
126. 2. Zinc carbonaté
Zinc carbonaté *pseudomorphique*
127. 3. Zinc sulfuré
128. 4. Zinc sulfaté

NON DUCTILES.

VII. Genre.—*Bismuth.*

129. 1. Bismuth natif
130. 2. Bismuth sulfuré
    Bismuth sulfuré *plumbo-cuprifère*
131. 3. Bismuth oxydé

VIII. Genre.—*Cobalt.*

132. 1. Cobalt arsenical
133. 2. Cobalt gris
134. 3. Cobalt oxydé noir
135. 4. Cobalt arseniaté
    Cobalt arseniaté *terreux argentifère*

IX. Genre.—*Arsenic.*

136. 1. Arsenic natif
137. 2. Arsenic oxydé
138. 3. Arsenic sulfuré
    Arsenic sulfuré *rouge*
    Arsenic sulfuré *jaune*

X. Genre.—*Manganese.*

139. 1. Manganèse oxydé
    i. Manganèse oxydé *noirâtre barytifère*
    ii. Manganèse oxydé *carbonaté*
140. 2. Manganèse sulfuré
141. 3. Manganèse phosphaté *ferrifère*

XI. Genre.—*Antimoine.*

142. 1. Antimoine natif
    Antimoine natif *arsenifère*
143. 2. Antimoine sulfuré
    i. Antimoine sulfuré *argentifère*
    ii. Antimoine oxydé *épigène*
    iii. Antimoine oxydé sulfuré *épigène*
144. 3. Antimoine oxydé
145. 4. Antimoine oxydé sulfuré

XII. Genre.—*Urane.*

146. 1. Urane oxydulé
147. 2. Urane oxydé

XIII. Genre.

XIII. Genre.—*Molybdène,*

148. Molybdène sulfuré.

XIV. Genre.—*Titane.*

149. 1. Titane oxydé
i. Titane oxydé *chromifère*
ii. Titane oxydé *ferrifère*

150. 2. Titane anatase

151. 3. Titane siliceo-calcaire

XV. Genre.—*Schéelin.*

152. 1. Schéelin ferruginé

153. 2. Schéelin calcaire

XVI. Genre.—*Tellure.*

154. Tellure natif
i. Tellure natif *auro-ferrifère*
ii. Tellure natif *auro-argentifère*
iii. Tellure natif *auro-plombifère*

XVII. Genre.—*Tantale.*

155. Tantale oxydé
i. Tantale oxydé *ferro-manganesifère*
ii. Tantale oxydé *yttrifère*

XVIII. Genre.—*Cerium.*

156. Cerium oxydé *silicifère*

XIX. Genre.—*Chrome.*

WERNER'S
MINERAL SYSTEM IN 1815.

CLASS I.—EARTHY FOSSILS.

1. DIAMOND GENUS.

1. Diamond.

2. ZIRCON GENUS.

Zircon Family.

2. Zircon
3. Hyacinth
4. Cinnamon-stone.

3. FLINT GENUS.

Augite Family.

5. Chrysoberyl
6. Chrysolite
7. Olivine
8. Coccolite
9. Augite
   a. granular
   b. foliated
   c. conchoidal
   d. common
10. *Baikalite*
11. Sahlite
12. Diopside
13. *Fassaite.*

Garnet Family.

14. Vesuvian
15. Grossulare
16. Leucite
17. *Pyrenite*
18. Melanite
19. Allochroite
20. *Colophonite*
21. Garnet
    a. Precious
    b. Common
22. Staurolite or Grenatite
23. Pyrope

Ruby Family.

24. Automalite
25. Ceylanite
26. Spinel
27. Sapphire
28. Emery
29. Corundum
30. Diamond-spar

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31. Topaz

Beryl Family.

32. Iolite
33. Euclase
34. Emerald
35. Beryl
    a. Precious beryl
    b. Common
36. Schorlous Beryl
37. Tourmaline

Pistacite Family.

38. Lievrite
39. Pistacite
40. Diaspore
41. Zoisite
42. Anthophylite
    a. Radiated
    b. Foliated
43. Axinite

Quartz Family.

44. Quartz
    a. Amethyst
        α. Common
        β. Thick fibrous
    b. Rock crystal
    c. Milk quartz
    d. Common quartz
    e. Prase
45. Iron-flint
46. Hornstone
    a. Splintery
    b. Conchoidal
    c. Woodstone
47. Flinty-slate
    a. Common
    b. Lydian-stone
48. Flint

48. Flint
49. Chalcedony
 a. Common
 b. Carnelian
  α. Common
  β. Fibrous
50. Hyalite
51. Opal
 a. Precious
 b. Common opal
 c. Semi-opal
 d. Wood-opal
52. Menilite
 a. Brown menilite
 b. Grey menilite
53. Jasper
 a. Egyptian jasper
  α. Red
  β. Brown
 b. Striped jasper
 c. Porcelain jasper
 d. Common jasper
  α. Conchoidal
  β. Earthy
 e. Opal jasper
 f. Agate jasper
54. Heliotrope
55. Chrysoprase
56. Plasma
57. Cat's-eye
58. *Faser Kiesel*
59. Elaolite

Pitchstone Family.

60. Obsidian
61. Pitchstone
62. Pearlstone
63. Pumice

Zeolite Family.

64. Prehnite
 a. Fibrous
 b. Foliated
65. Natrolite
66. Zeolite
 a. Mealy Zeolite
 b. Fibrous do.
 c. Radiated Zeolite
 d. Foliated do.
67. Ichthyophthalm
68. Cubicite
69. Cross-stone or Crucite
70. Laumonite
71. Schmelzstein

Azurestone Family.

72. Azurestone
73. Azurite
74. Blue-spar

Felspar Family.

75. Andalusite
76. Felspar
    a. Adularia
    b. Labrador
    c. Glassy
    d. Common felspar
        α. Fresh
        β. Disintegrated
    e. Hollow spar
    f. Compact felspar
        α. Common
        β. Variolite
77. Spodumene
78. Scapolite
    a. Red scapolite
    b. Grey scapolite
        α. Radiated
        β. Foliated
79. Meionite
80. Nepheline
81. Ice-spar

4. CLAY GENUS.

Clay Family.

82. Pure clay
83. Porcelain earth
84. Common clay
    a. Loam
    b. Potter's clay
        α. Earthy
        β. Slaty
    c. Variegated clay
    d. Slate clay
85. Claystone
86. Adhesive slate
87. Polishing or polier slate
88. Tripoli
89. Floatstone
90. Alum-stone

Clay-Slate Family.

91. Alum-slate
    a. Common
    b. Glossy
29. Bituminous shale
93. Drawing-slate
94. Whet-slate
95. Clay-slate

Mica Family.

96. Lepidolite
97. Mica
98. Pinite
99. Potstone
100. Chlorite

100. Chlorite
 a. Chlorite earth
 b. Common chlorite
 c. Chlorite-slate
 d. Foliated chlorite

Trap Family.

101. *Paulite*
102. Hornblende
 a. Common
 b. Basaltic
 c. Hornblende-slate
103. Basalt
104. Wacke
105. Clinkstone
106. Iron-clay

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107. Lava

Lithomarge Family.

108. Green earth
109. Lithomarge
 a. Friable
 b. Indurated
110. Rock-soap
111. Umber
112. Yellow earth

5. Talc Genus.

Soapstone Family.

113. Native magnesia, or talc-earth
114. Meerschaum
115. Bole
116. Fuller's-earth
117. Steatite
118. Figurestone

Talc Family.

119. Nephrite
 a. Common nephrite
 b. Axe-stone
120. Serpentine
 a. Common
 b. Precious
  α. Conchoidal
  β. Splintery
121. Schillerstone
122. Talc
 a. Earthy
 b. Common
 c. Indurated
123. Asbestus
 a. Rock-cork
 b. Amianthus
 c. Common asbestus
 d. Rock-wood

Actynolite

Actynolite Family.

124. Kyanite
125. Actynolite
    a. Asbestous
    b. Common
    c. Glassy
    d. Granular
126. *Spreustein or Chaff-stone*
127. Tremolite
    a. Asbestous
    b. Common
    c. Glassy
128. Sahlite
129. *Rhœtizite*

6. Calcareous Genus.

A. *Carbonates.*

130. Rock-milk
131. Chalk
132. Limestone
    a. Compact
        α. Common
        β. Roestone
    b. Foliated
        α. Granular
        β. Calcareous-spar
    c. Fibrous
        α. Common
        β. Calc-sinter
    d. Pea-stone
133. Calc-tuff
134. Schaum-earth, or foam-earth
135. Slate-spar
136. Brown-spar
    a. Foliated
    b. Fibrous
137. Schaalstone
138. Dolomite
139. Rhomb-spar
140. *Anthracolite*
141. Stinkstone
142. Marl
    a. Marl earth
    b. Indurated marl
143. Bituminous marl-slate
144. Arragon
    a. Common
    b. Prismatic

B. *Phosphates.*

145. Appatite
146. Asparagus stone

C. *Fluates.*

147. Fluor
    a. Compact
    b. Fluor-spar

D. *Sulphates.*

148. Gypsum
    a. *Spumous gypsum*
    b. Earthy gypsum
    c. Compact gypsum
    d. Foliated gypsum
    e. Fibrous gypsum
149. Selenite

150. Muriacite

150. Muriacite
   a. Anhydrite
   b. *Gekröstein*
   c. Conchoidal Mur.
   d. Fibrous Mur.
   e. Compact Mur.

E. *Borates.*

151. Datolite
152. Boracite
153. Botryolite

7. Baryte Genus.

154. Witherite
155. Heavy-spar
   a. Earthy heavy-spar
   b. Compact heavy-spar
   c. Granular heavy-spar
   d. Curved lamellar heavy-spar
   e. Straight lamellar heavy-spar
      α. Fresh
      β. Disintegrated
   f. Columnar spar
   g. Prismatic spar
   h. Bolognese, or Bolognian spar

8. Strontian Genus.

156. Strontian
   a. Compact
   b. Radiated
157. Celestine
   a. Fibrous
   b. Radiated
   c. Lamellar
   d. Prismatic

9. Hallite Genus.

158. Cryolite.

Class II.—

Class II.—FOSSIL SALTS.

1. *Carbonates.*
159. Natural Soda or natron

2. *Nitrates.*
160. Natural nitre

3. *Muriates.*
161. Natural rock-salt
  a. Stone-salt
    α. Foliated
    β. Fibrous
  b. Lake-salt
162. Natural sal-ammoniac

4. *Sulphates.*
163. Natural vitriol
164. Hair-salt
165. Rock-butter
166. Natural Epsom-salt
167. Natural Glauber-salt

Class III.—INFLAMMABLE FOSSILS.

1. Sulphur Genus.

168. Natural sulphur
  a. Crystallised
  b. Common
    α. Earthy
    β. Conchoidal
  c. Mealy
  d. Volcanic

2. Bituminous Genus.

169. Mineral or fossil oil
170. Mineral pitch
  a. Elastic
  b. Earthy
  c. Slaggy
171. Brown coal
  a. Bituminous wood
  b. Earth coal
  c. Alum earth
  d. *Paper coal*
  e. Common brown coal
  f. Moor coal
172. Black coal

a. Pitch

a. Pitch coal
b. Columnar coal
c. Slate coal
d. Cannel coal
e. Foliated coal
f. Coarse coal

3. Graphite Genus.

173. Glance-coal
a. Conchoidal
b. Slaty
174. Graphite
a. Scaly
b. Compact
175. Mineral charcoal

4. Resin Genus.

176. Amber
a. White
b. Yellow
177. Honey stone

Class IV.—METALLIC FOSSILS.

1. Platina Genus.

178. Native Platina.

2. Gold Genus.

179. Native gold
a. Gold yellow
b. Brass yellow
c. Greyish yellow

3. Mercury Genus.

180. Native mercury
181. Natural amalgam
a. Semi-fluid
b. Solid
182. Mercurial horn-ore
183. Mercurial liver-ore
a. Compact
b. Slaty
184. Cinnabar
a. Dark-red
b. Light-red

4. Silver

4. Silver Genus.

185. Native silver
 a. Common
 b. Auriferous
186. Antimonial silver
187. Arsenical silver
188. *Molybdena-silver*
189. Corneous silver-ore, or horn-ore
190. Silver-black
191. Silver-glance
192. Brittle silver-glance
193. Red silver-ore
 a. Dark
 b. Light
194. White silver-ore

5. Copper Genus.

195. Native copper

Family of Copper Sulphurets.

196. Copper-glance
 a. Compact
 b. Foliated
197. Variegated copper-ore
198. Copper-pyrites
199. White copper-ore
200. Grey copper-ore
201. Black copper-ore

202. Red copper-ore
 a. Compact
 b. Foliated
 c. Capillary
203. Tile-ore
 a. Earthy
 b. Indurated
284. Azure copper-ore
 a. Earthy
 b. Indurated or radiated
205. *Velvet copper-ore*
206. Malachite
 a. Fibrous
 b. Compact
207. Copper-green
208. Ironshot copper-green
 a. Earth
 b. Slaggy
209. Emerald copper-ore
210. Copper mica
211. Lenticular-ore
212. Oliven-ore
213. Muriat of copper
214. Phosphat of copper

6. Iron Genus.

215. Native iron
216. Iron-pyrites
 a. Common pyrites
 b. Radiated pyrites
 c. Liver or hepatic pyrites
 d. Cock's-comb pyrites
 e. Cellular pyrites
217. Capillary

217. Capillary pyrites
218. Magnetic pyrites
219. Magnetic ironstone
    a. Common
    b. Iron-sand
220. *Chrome-ironstone*
221. *Menac ironstone*
222. Iron-glance
    a. Common
        α. Compact
        β. Foliated
    b. Iron-mica
223. Red ironstone
    a. Red iron-froth
    b. Ochry red ironstone
    c. Compact
    d. Red hematite
224. Brown ironstone
    a. Brown iron-froth
    b. Ochry brown ironstone
    c. Compact
    d. Brown hematite
225. Sparry ironstone.
226. Black ironstone
    a. Compact
    b. Black hematite
227. Clay-ironstone
    a. Reddle
    b. Columnar clay-ironstone
    c. Lenticular clay-ironstone
    d. Jaspery clay-ironstone
    e. Common clay-ironstone
    f. Reniform clay-ironstone
    g. Pea-ore, or pisiform ironstone
228. Bog iron-ore
    a. Morass-ore
    b. Swamp-ore
    c. Meadow-ore
229. Blue iron-earth
230. Pitchy iron-ore
231. Green iron-earth
232. Cube-ore
233. Gadolinite

7. LEAD GENUS.

234. Galena or Lead-glance
    a. Common
    b. *Disintegrated*
    c. Compact
235. Blue lead-ore
236. Brown lead-ore
237. Black lead-ore
238. White lead-ore
239. Green lead-ore
240. Red lead-ore
241. Yellow lead-ore
242. Lead-vitriol.
243. Earthy lead-ore, or Lead-earth.
    a. Coherent
    b. Friable

8. TIN

8. Tin Genus.

244. Tin pyrites
245. Tinstone.
246. Cornish tin-ore

9. Bismuth Genus.

247. Native bismuth
248. Bismuth-glance
249. Bismuth-ochre
250. *Arsenical bismuth-ore*

10. Zinc Genus.

251. Blende
    - *a.* Yellow
    - *b.* Brown
        - *α.* Foliated
        - *β.* Fibrous
        - *γ.* Radiated
    - *c.* Black
252. Calamine

11. Antimony Genus.

253. Native antimony
254. Grey antimony-ore
    - *a.* Compact
    - *b.* Foliated
    - *c.* Radiated
    - *d.* Plumose
255. Black antimony-ore
256. Red antimony-ore
257. White antimony-ore
258. Antimony-ochre

12. Sylvan Genus.

259. Native sylvan
260. Graphic-ore
261. White sylvan-ore
262. Nagyag-ore

13. Manganese Genus.

263. Grey manganese-ore
    - *a.* Radiated
    - *b.* Foliated
    - *c.* Compact
    - *d.* Earthy
264. Black manganese-ore
265. *Piedmontese manganese-ore*
266. Red manganese-ore
267. *Manganese-spar*

14. Nickel Genus.

268. Copper-nickel
269. *Capillary-pyrites*
270. Nickel-ochre

15. Cobalt

2

15. Cobalt Genus.

Family of Speiss-Cobalt.

271. White cobalt-ore
272. Grey cobalt-ore
273. Glance-cobalt

Family of Cobalt-Ochre.

274. Black cobalt-ochre
    a. Earthy
    b. Indurated
275. Brown cobalt-ochre
276. Yellow cobalt-ochre
277. Red cobalt-ochre
    a. Cobalt-crust
    b. Cobalt-bloom

16. Arsenic Genus.

278, Native arsenic
279. Arsenic pyrites
    a. Common
    b. Argentiferous
280. Orpiment
    a. Yellow
    b. Red
281. Arsenic bloom

17. Molybdena Genus.

282. Molybdena

18. Sheele Genus.

283. Tungsten
284. Wolfram

19. Menachine Genus

285. Menachan
286. Octahedrite
287. Rutile
288, Nigrine
289. Iserine
290. Brown menachine-ore
291, Yellow menachine-ore

20. Uran Genus.

292. Pitch-ore
293, Uran-mica
294. Uran-ochre

21. Chrome Genus.

295. Acicular-ore
296. Chrome-ochre

22. Cerium Genus.

297. Cerium-stone.

CLARKE's

CLARKE'S

MINERAL SYSTEM IN 1818*.

CLASS I.—METALLIC COMBUSTIBLES.

Order I. *Existing only as Oxides in our Atmosphere.*

Genus 1. OXIDE OF CALCIUM OR LIME.

Spec. 1. Oxide of Calcium with Carbonic Acid
Calcareous Spar, &c.
2. Oxide of Calcium with Sulphuric Acid
Gypsum, &c.
3. Oxide of Calcium with Fluoric Acid
Fluor Spar, &c.

Spec. 4. Oxide of Calcium with Phosphoric Acid
Apatite, &c.
5. Oxide of Calcium with Arsenic Acid
Pharmacolite

Genus 2. OXIDE OF MAGNESIUM.

Spec. 1. Oxide of Magnesium with Water

Spec. 2. Oxide of Magnesium with Boracic Acid
Boracite

Genus 3. OXIDE OF BARIUM.

Spec. 1. Oxyde of Barium with Sulphuric Acid
Heavy Spar, &c.

Spec. 2. Oxyde of Barium with Carbonic Acid
Witherite

Genus 4.

* This View is extracted from Dr Clarke's Syllabus to his Lectures on Mineralogy.

Genus 4. Oxide of Strontium.

Spec. 1. Oxide of Strontium with Carbonic Acid
Strontianite

Spec. 2. Oxide of Strontium with Sulphuric Acid
Celestine

Genus 5. Oxide of Aluminum.

Spec. 1. Oxide of Aluminum with Sulphuric Acid
Subsulphate of Alumine.

2. Oxide of Aluminum, Mellitic Acid and Water
Honeystone

3. Oxide of Aluminum, with Fluoric Acid, and Oxide of Sodium
Cryolite

4. Oxide of Aluminum, Water, Fluoric Acid, and Oxide of Calcium
Wavellite, &c.

Spec. 5. Oxide of Aluminum, and Oxide of Silicium, with Fluoric Acid
Topaz, &c.

6. Oxide of Aluminum, Oxide of Magnesium, and Chromic Acid
Spinelle, &c.

7. Oxide of Aluminum, with Oxide of Silicium
Sapphire, &c.

8. Oxides of Aluminum, Silicium, and Iron
Tourmaline, &c.

9. Oxides of Aluminum, Magnesium, and Silicium
Cyanite

Genus 6. Oxide of Zirconium.

Spec. 1. Oxides of Zirconium and Silicium.
Zircon

Genus 7. Oxide of Yttrium.

Spec. 1, Oxides of Yttrium, Silicium, and Iron.
Gadolinite

Genus 8.

Genus 8. Oxide of Silicium.

Spec. 1. Oxide of Silicium almost pure
Quartz, &c.
2. Oxide of Silicium and Water
Opal, &c.
3. Oxides of Silicium, Aluminum, Iron, and Potassium or Sodium
Mica, &c.
4. Oxides of Silicium, Aluminum, and Glucinum
Emerald, &c.
5. Oxides of Silicium, Aluminum, and Barium
Harmotome, &c.
6. Oxides of Silicium, Calcium, Potassium, and Water
Apophyllite, &c.
7. Oxides of Silicium, Aluminum, Potassium or Sodium, and Water
Mesotype, &c.

Spec. 8. Oxides of Silicium, Calcium, Aluminum, and Iron
Garnet, &c.
9. Oxides of Silicium, Calcium, Aluminum, Magnesium, and Chromate of Iron
Diallage
10. Oxides of Silicium, Magnesium, Calcium, and Water
Meerschaum, &c.
11. Oxides of Silicium, Magnesium, Calcium, and Aluminum
Asbestus, &c.
12. Oxides of Silicium, Calcium, Magnesium, Aluminum, and Iron
Pyroxene, &c.
13. Oxides of Silicium, Copper, and Water
Dioptase

Order II. *Reguline in our Atmosphere.*

Genus 1. Gold.

Spec. 1. Gold with minute proportions of Silver and Copper.
Native Gold, &c.

Genus 2.

Genus 2. Platinum.

Spec. 1. Platinum with Palladium, Rhodium, Iridium, Osmium, and minute proportions of other metals.

Genus 3. Silver.

Spec. 1. Silver, with very minute proportions of other metals
Native Silver
2. Silver with Gold
Auriferous Native Silver
3. Silver with Antimony
White Silver-ore

Spec. 4. Silver with Arsenic
Arsenical Silver-ore
5. Silver with Sulphur
Vitreous Silver, &c.
6. Silver with antimony, Sulphur, and Oxygen
Red Silver
7. Silver with Muriatic Acid
Horn Silver

Genus 4. Mercury.

Spec. 1. Mercury almost pure
Native Quicksilver
2. Mercury with Silver
Native Amalgam

Spec. 3. Mercury with Sulphur
Native Cinnabar
4. Mercury with Muriatic Acid
Horn Quicksilver

Genus. 5. Copper.

Spec. 1. Copper almost pure
Native Copper
2. Copper with Arsenic
White Copper-ore of Freyberg
3. Copper with Sulphur and Iron
Vitreous Copper-ore, &c.

Spec. 4. Copper with Iron and Sulphur
Grey Copper
5. Copper with Oxygen
Ruby Copper
6. Copper with Carbonic Acid, Oxygen, and Water
Azure Copper, &c.

7. Copper with Oxygen Muriatic Acid, and Water
Green Sand of Peru
8. Copper with Oxygen and Phosphoric Acid
Green Phosphate of Copper
9. Copper with Oxygen, Arsenic Acid, and Water
Arseniated Copper, &c.

Genus 6. IRON.

Spec. 1. Iron with Nickel
Native Iron
2. Iron with Arsenic
Mispickel, &c.
3. Iron with Oxygen
Magnetic Ironstone, &c.
4. Iron with Arsenic Acid, Oxygen, Copper, Water, and Silex
Green Cubic Iron
5. Iron with Phosphoric Acid, Oxygen, and Manganese
Native Prussian Blue, &c.
6. Iron with Oxygen and Carbonic Acid
Spathose, or Sparry Iron

Genus 7. TIN.

Spec. 1. Tin with Oxygen
Tinstone
Spec. 2. Tin with Sulphur and Copper
Pyritous Tin

Genus 8. LEAD.

Spec. 1. Lead with Oxygen
Native Minium
2. Lead with Sulphur
Galena
3. Lead with Antimony, Copper, and Sulphur
Triple Sulphuret of Lead

Spec. 4. Lead with Oxygen and Carbonic Acid
White Lead-spar
5. Lead with Muriatic Acid, and Carbonic Acid
Murio-carbonate of Lead
6. Lead with Oxygen and Sulphuric Acid
Sulphate of Lead
7. Lead with Oxygen, Phosphoric Acid, and a small portion of Muriatic Acid
Green Lead
Spec. 8. Lead with Oxygen and Molybdic Acid
Yellow Lead
9. Lead with Oxygen and Chromic Acid
Red Lead of Siberia
10. Lead with Oxygen, and Oxide of Chromium
Green Chromal Lead

Genus 9. Nickel.

Spec. 1. Nickel almost pure
Capillary Native Nickel
2. Nickel with Arsenic
Kupfer Nickel
3. Nickel with Oxygen
Nickel-ochre
Spec. 4. Nickel with Arsenic Acid, Cobalt, and Alumine
Arseniate of Nickel

Genus 10. Zinc.

Spec. 1. Zinc with Oxygen, and the Oxides of Manganese and Iron
Red Oxide of Zinc
2. Zinc with Sulphur and Iron
Blende
3. Zinc with Oxygen and Silex
Siliciferous Oxide of Zinc
4. Zinc with Oxygen and Carbonic Acid
Calamine
5. Zinc with Oxygen, Carbonic Acid, and Water
Hydrous Carbonate

Genus 11. Bismuth.

Spec. 1. Bismuth with a small portion of Cobalt, or Arsenic
Native Bismuth

Spec. 2. Bismuth with Sulphur
Common Sulphuret

3. Bismuth with Lead, Copper, and Sulphur
Nadel-erz

Genus 12. Antimony.

Spec. 1. Antimony with a small portion of Silver
Native Antimony

2. Antimony with Sulphur
Grey Antimony

Spec. 3. Antimony with Oxygen
White Antimony

4. Antimony with Oxygen and Sulphur
Red Antimony

Genus 13. Tellurium.

Spec. 1. Tellurium with Iron and Gold.
Native Tellurium, &c.

Genus 14. Arsenic.

Spec. 1. Arsenic with Iron, Silver, or Gold
Native Arsenic

2. Arsenic with Sulphur
Realgar

Spec. 3. Arsenic with Oxygen
Native Oxide of Arsenic

4. Arsenic with Cobalt, Iron, and Sulphur
Arsenical Cobalt, &c.

Genus 15. Cobalt.

Spec. 1. Cobalt with Oxygen
Black, Brown, and Yellow Cobalt-ore

Spec. 2. Cobalt with Arsenic Acid
Red Cobalt-ore

Genus 16. Manganese.

Spec. 1. Manganese with Oxygen
Radiated Grey Ore of Manganese

Spec. 2. Manganese with Oxygen and Sulphur
Black Ore of Manganese

Spec. 3.

Spec. 3. Manganese with Oxygen, Oxide of Iron, and Phosphoric Acid
Phosphate of Manganese

4. Manganese with Oxygen, Oxide of Silicium, and Oxide of Iron
Red Ore of Manganese of Nagyag

Genus 17. TUNGSTEN.

Spec. 1. Tungsten with Oxygen and Oxide of Calcium
Tungspar

Spec. 2. Tungsten with Oxygen, Manganese, and Iron
Wolfram

Genus 18. MOLYBDENUM.

Spec. 1. Molybdenum with Sulphur.
Molybdena

Genus 19. URANIUM.

Spec. 1. Uranium with Oxygen.
Pechblende, &c.

Genus 20. TITANIUM,

Spec. 1. Titanium with Oxygen
Titanite, &c.

2. Titanium Oxide, with Oxides of Iron, and minute portions of other metals
Menachanite, &c.

3. Oxides of Titanium, Silicium, and Calcium
Sphene

Genus 21. CHROMIUM.

Spec. 1. Chromium with Oxygen, Oxide of Iron, and Oxide of Aluminum
Chromite

Genus 22.

Genus 22. COLUMBIUM.

Spec. 1. Columbium Oxide, with the Oxides of Iron and Manganese
Columbite

Spec. 2. Columbium Oxide, with Oxides of Iron, Manganese and Yttrium
Yttriferous Columbite

Genus 23. CERIUM.

Spec. 1. Cerium with Oxygen and Oxide of Silicium.
Cerite

CLASS II.—NON-METALLIC COMBUSTIBLES.

Order I. *Oleaginous.*

Genus 1. CARBON.

Spec. 1. Carbon with Hydrogen and Oxygen
Naptha, &c.

Spec. 2. Carbon with Hydrogen, Oxygen, and the Oxides of Aluminum, Silicium, &c.
Cannel Coal, &c.

Order II. *Not Oleaginous.*

Genus 1. CARBON.

Spec. 1. Carbon, almost pure
Diamond

2. Carbon with Iron
Plumbago

Spec. 3. Carbon with Oxygen, Silex, and Iron
Anthracite

Genus 2. SULPHUR.

Spec. 1, Sulphur with Hydrogen
Native Sulphur

Spec. 2. Sulphur with Iron
Martial Pyrites

CHARAC-

CHARACTERISTIC OR TABULAR VIEW

OF THE

CLASSES, ORDERS, GENERA, AND SPECIES

OF THE

MINERAL SYSTEM.

CHARACTERISTIC OR TABULAR VIEW

OF THE

CLASSES, ORDERS, GENERA AND SPECIES

OF THE

MINERAL SYSTEM.

1.

WHEN we wish to determine the *Species* to which any Mineral belongs, by means of the following Tabular View, we first ascertain either its primitive Form or Cleavage, and afterwards the Hardness and Specific Gravity. We next compare these characters with those in the *Classes, Orders, Genera* and *Species*; and if a Species in any of the Genera possesses the same characters, our mineral is to be considered as belonging to that species.

If the form or cleavage cannot be ascertained, our determination of the species will not be so satisfactory or certain. Thus, suppose we meet with a variety of Iron-pyrites, in which neither form nor cleavage can be detected, but of which the hardness and specific gravity are known; and that the hardness is 6, and the specific gravity 4.9. If we compare these characters with those of the Classes, Orders, Genera and Species,

cies, we shall find that the only Genus to which they apply is *Iron-Pyrites.* But these characters will not enable us to determine the Species with absolute certainty, because the essential character of every species depends on the primitive form. They will, however, shew that the mineral is Iron-pyrites, even that it is not Rhomboidal iron-pyrites; but they will not enable us to decide whether it is Hexahedral or Prismatic iron-pyrites. In other cases, the species can be determined without knowing the primitive form; but still, the determination is not so certain as when that form is known. Thus, suppose we meet with a species of Magnetic Iron-ore, which we find, by inspection, cannot be either the rhomboidal or prismatic species, but which agrees in hardness and specific gravity with the octahedral species, we can say that it very probably is a variety of Octahedral Magnetic Iron-ore. But there may be a fourth species of this genus not in the System, having the same hardness and specific gravity as the octahedral, but with a different primitive form; and we cannot be certain that our mineral does not belong to that species. When the primitive form is known, all doubt vanishes. In compound minerals it is very often impossible to determine the external form. In such cases, a knowledge of the Cleavage is of infinite importance. But when neither form, nor hardness, nor specific gravity can be determined, the Tabular View can no longer be used; for the principal characters on which it depends are wanting. Amianthus, which is a variety of straight-edged augite, (hornblende), occurs in crystals so very minute that they cannot be determined either by the eye or the microscope, and of course the cleavage is not visible. These crystals are flexible, and their hardness not capable of being determined. Their surface is so considerable in comparison of their mass, that they float on water, although they have a considerable specific gravity. It is remarked, that in other varieties of straight-edged augite, the crystals become thicker, then lose their flexibility, but are still too small for allowing the hardness

ness to be ascertained: Others, again, are thicker, but still, owing to their minuteness, the dimensions of the form cannot be measured; These sink in water, scratch gypsum, but break on calcareous-spar. At last, in other varieties, the form is discernible by the cleavage, and the hardness is equal to 5 and 6, and the specific gravity equal to 3.0. These, on examination, prove to be straight-edged augite. What these are, so are all the preceding varieties, and also amianthus. It is by pursuing this mode of examination, that we are able to refer such substances as amianthus to their true place in the System. Other minerals, again, which occur in an earthy state, can only be referred to their true place in the System, by tracing them in connection with compact minerals, which stand in connection with others having a crystallised structure. Thus Porcelain-earth can be traced to Compact felspar, and this to Foliated felspar; or it can be traced immediately to Foliated felspar, and in this way its true place is ascertained. Other Earths, and loosely aggregated minerals, as many Clays, cannot be referred to any species; these, therefore, are determined in an empirical way; and we may use the blowpipe, acids, and other means, for obtaining a knowledge of their properties. These bodies are more properly objects of geological curiosity, and of economical value, than interesting to the Mineralogist.

2.

The nomenclature of the species used in the Tabular View, is nearly that of Mohs, and is founded on the primitive forms of the minerals, on the nature of their cleavage, or on the position of the bevelment.

According to Mohs, all the regular forms in the mineral kingdom are reducible to some one of four great systems or groupes, named Rhomboidal, Pyramidal, Prismatical, and Hexahedral or tessular, including octahedron, cube octahedron, rhomboidal dodecahedron, &c. Thus, in the genus Corundum,

dum, there are three species in which the primitive forms are the octahedron, rhomboid, and prism; and hence these are named, octahedral corundum, rhomboidal corundum, and prismatic corundum. In the genus Zeolite, there are seven species; one of these is named Prismatoidal zeolite, because the cleavage is prismatoidal; another is named Axifrangible, because one of its most striking characters is its axifrangible cleavage. In the genus Augite, one species is named Oblique-edged augite, because the edge formed by the meeting of the bevelling planes, on the extremities of the crystal, is placed obliquely to the axis of the prism; another species is named Straight-edged augite, because the edge formed by the bevelling planes on the extremity, is straight or perpendicular to the axis of the prism.

3.

In the generic characters, the number of axes of the Crystals is given. But it will be inquired, what is here understood by Axis. When the section of a simple figure, as a rhomboid or cube, affords, by means of a plane which does not pass through its centre, a regular, or equi-angular or equi-lateral figure, or one in which such a figure can be inscribed, the straight line, which stands perpendicular on the middle point of the figure, and passes through the centre of the figure, is an *axis*. If we take a hexahedron, and place it in such a situation that two only of its planes are horizontal, and the others vertical, every section of it, with a horizontal plane, will afford a square; and the vertical line, which stands perpendicular on the middle point of the square, and passes through the centre of the figure itself, will be an axis. Bring the same hexahedron in such a situation, that one of its solid angles is above, and another vertically under it. The section with a horizontal plane will be an equilateral triangle or equi-angular hexagon, and the straight line perpendicular on the middle point of this plane, and through the centre of the figure, an axis.

Lastly,

Lastly, If we place the hexahedron in such a situation, that four of its edges are horizontal, and the others are equally inclined towards the horizontal plane; all the sections but two will be longish rectangles, and the straight line, perpendicular on the middle point, and through the centre of the figure, is an axis. —The kind of axis is determined by the figure of the section, and one and the same figure may contain not only many, but also axes of different kinds. That axis in which the form of the section is triangular, or in which a triangle can be inscribed by connecting some of its angles by straight lines, is named a *rhomboidal axis*, because it occurs in the rhomboid; when the form of the section is a square, the axis is named *pyramidal*, because it occurs in the pyramid with square bases; and when the form of the section is rhomboidal, the axis is named *prismatic*, because it occurs in the oblique double four-sided prism, which is a member of the prismatic series. In the Tabular View, the Diamond is said to have *many axes*, because its primitive figure, the octahedron, has rhomboidal axes that pass through the centre of the planes, pyramidal axes that pass through the angles, and six subordinate axes that pass through the middle point of the edges. Zircon is said to have one axis, because its primitive figure belongs to the pyramidal system, in which there is only one principal axis. Topaz has three axes, because it belongs to the prismatic series, in which there are three principal axes.

4.

The degrees of Hardness are expressed in the Tabular View by figures.

The following are the different degrees.

1. Expresses the hardness of Talc.
2. . . . . . Gypsum
3. . . . . . Calcareous Spar
4. . . . . . Fluor-Spar
5. . . . . . Apatite

6.

6. expresses the hardness of Felspar
7. . . . . . Quartz
8. . . . . . Topaz
9. . . . . . Corundum
10. . . . . . Diamond

Thus, if the hardness of a mineral is marked 7, it shews that it is equal to that of quartz. If the hardness is marked 7.5, it intimates that it is intermediate between that of quartz, and of the next number 8 or topaz. By using still smaller numbers, more minute degrees of hardness might be expressed.

CHARACTERS OF THE CLASSES.

Class I.—EARTHY MINERALS.

Tasteless.
Specific gravity above 1.8 *.

Class II.—SALINE MINERALS.

If solid, there is a sensible taste. No bituminous smell.
Specific gravity under 3.8.

Class III.—METALLIFEROUS MINERALS.

Tasteless.
Specific gravity above 1.8 †.

Class IV.

* All the specific gravities in this Tabular View, were taken by Professor Mohs, and may be depended on for their perfect accuracy. It will be seen that they occasionally differ from those in the body of the work.

† From the characteristic of the first and third Classes being the same, it is obvious that they should be arranged under one head, a method which is adopted by Professor Mohs.

Class IV.—INFLAMMABLE MINERALS.

If fluid, there is a bituminous smell. If solid, there is no taste.

Specific gravity under 1.8.

CHARACTERS OF THE ORDERS.

First Class.—EARTHY MINERALS.

Order I.—Gem.

No metallic lustre. Streak white.

Cleavage. If there are distinct cleavages, the hardness is equal to 8 and more; if only single imperfect cleavages, the hardness is equal to 7.5 and more; or the specific gravity is equal to 3.3 and more.

Hardness ranges from 5.5 to 10. At and below 6, the specific gravity is equal to 2.5 and less, and amorphous.

The specific gravity ranges from 2.0 to 4.7.

Order II.—Spar.

No metallic lustre. No adamantine lustre. Streak white.

Hardness ranges from 3.5 to 7.0: if above 6, there are single distinct cleavages.

Specific gravity ranges from 2.0 to 3.7: if 2.4 and less, it is not amorphous *.

Order III.

* The cleavages not given, and therefore the characters of this order incomplete.

Order III.—Mica.

If no metallic lustre, the specific gravity is above 2.2. Streak neither yellow nor dark red. If the specific gravity is under 2.2, the lustre is perfectly metallic and shining.

Cleavage. It is distinctly axifrangible *, and prismatoidal †.

The hardness ranges from 1 to 2.5.

Specific gravity ranges from 1.9 to 5.6.

Order IV.—Malachite.

No metallic lustre. Streak blue, green, brown. If white, the specific gravity is 2.2 and less. Colour not inclining to yellow.

Cleavage. It is neither distinctly axifrangible nor prismatoidal.

Hardness ranges from 2 to 5. If the streak is brown, the hardness is less than 3.5.

Specific gravity ranges from 2 to 4.6; if it is less than 3.2, the hardness is below 3.

Order V.—Kerate.

No metallic lustre. Streak colourless. Sectile.

Cleavage. It is neither distinctly axifrangible nor prismatoidal,

Hardness ranges from 1 to 2.

Specific gravity ranges from 4 to 6.

Order VI.—Baryte.

No metallic lustre. Colour rarely changed in the streak; if orange-yellow, the specific gravity is 6 and more.

Hardness ranges from 2.5 to 5.

Specific gravity ranges from 3.3 to 7.2. If the specific gravity be less than 3.6, and the hardness 5, the cleavage is di-prismatic.

Order VII.

* In *axifrangible* minerals, the cleavage is at right angles to the prism.

† In *prismatoidal* minerals, there is but a single cleavage, and which is parallel with the side of the prism.

Order VII.—Haloide.

No metallic lustre. Streak not changed in the colour.

Cleavage. If in the direction of a four-sided prism, the hardness is equal to 4 and less; if axifrangible and prismatoidal, the hardness and specific gravity are below 3.

Hardness ranges from 1.5 to 5. If the hardness is less than 2.5, the specific gravity will be 2.4 and less. Divisible.

Specific gravity ranges from 2.2 to 3.2. If less than 2.4, the hardness will be 2.4 and less.

Second Class.—SALINE MINERALS.

Order I.—Fossil Salts.

Solid. Sensible taste.

Third Class.—METALLIFEROUS MINERALS.

Order I.—Native Metals.

Metallic lustre. White; yellow; red; grey: if steel-grey, is malleable.

Hardness ranges from 0 to 4.

Specific gravity ranges from 5.7 to 19.5.

Order II.—Ore.

If the lustre is metallic, the colour is pure black; if the lustre is not metallic, it is adamantine, or imperfect metallic. Streak black, brown, red, or white. If white, the hardness is equal to 5 and more, and the lustre is adamantine; or the specific gravity is equal to 4.6 and more: if red or brown, the hardness is equal to 3.5 and more.

Hardness ranges from 2.5 to 7. If 3 and less, the specific gravity is under 5; if 6.5 and more, and streak white, the specific gravity is 6 and more.

Specific gravity ranges from 3.4 to 7.4 *.

Order III.—Pyrites.

Lustre metallic. Not lead-grey. If pale steel-grey or white, the hardness is equal to 5 and more; if dark steel-grey or black, the hardness is under 5, and the form tessular.

Hardness ranges from 3 to 6.5.

Specific gravity ranges from 4.1 to 7.7 †.

Order IV.—Glance.

Lustre metallic. Lead and steel grey; black; streak unchanged. If malleable, colour blackish lead-grey.

Hardness ranges from 1. to 3. If 3, is dark lead-grey.

Specific gravity ranges from 4 to 7.6. If less than 5, is pure lead-grey.

Order V.—Blende.

If the lustre is metallic, the colour is black, with a green streak. If not metallic, the lustre is adamantine. Streak brown, red, and white. If streak brown and white, it is tessular, with a hardness of 3.5 and more, and a specific gravity of 4.2 and less; if streak red, the hardness is 2.5 and less, and the specific gravity 4.5 and more.

Hardness ranges from 1. to 4.

Specific gravity ranges from 3.9 to 8.2.

Order VI.—Sulphur.

No metallic lustre. Streak red, yellow, or white. If the streak is white, the colour inclines to yellow or brown.

Cleavage.

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* The characters of this Order incomplete.

† The characters of this Order incomplete.

Cleavage. If distinctly prismatoidal, the streak is yellow.
Hardness ranges from 1.0 to 2.5.
Specific gravity ranges from 1.9 to 3.6.

Fourth Class.—INFLAMMABLE MINERALS.

Order I.—Resin.

Fluid; solid; streak white: brown; black.
Hardness ranges from 0 to 2.5.
Specific gravity ranges from 0.7 to 1.6. If the specific gravity is 1.2 or more, the streak is white.

Order II.—Coal.

Solid. Streak brown; black.
Hardness ranges from 0.1 to 2.5.
Specific gravity from 1.2 to 1.5.

CHARACTERS of GENERA and SPECIES.

First Class.—EARTHY MINERALS.

Order 1.—GEM.

Genus i.—Diamond.

Many axes. Cleavage tessular. Hardness = 10. Sp. gr. = 3.4, 3.6.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus ii.—ZIRCON.

One axis. Cleavage pyramidal. Hardness = 7.5. Sp. gr. = 4.5, —4.7.

1. Pyramidal. *Zircon.*

Pyramid = 123° 19′; 84° 20′. Cleavage pyramidal, or in the direction of the lateral planes of the prism.

Genus iii.—CORUNDUM.

One and many axes. Cleavage rhomboidal; prismatic; octahedral. If prismatic, the specific gravity is 3.7 and more, and the hardness 8.5 and more. Hardness = 8.0,—9.0. Specific gravity = 3.5,—4.3.

1. Octahedral. *Spinel, &c.*

Tessular. Cleavage octahedral. Hardness = 8. Sp. gr. = 3.5,—3.8.

2. Rhomboidal. *Sapphire, &c.*

Rhomboid = 86° 38′. Cleavage in the direction of the rhomboid, or parallel with the terminal planes of the regular six-sided prism. Hardness = 9. Sp. gr. = 3.8,—4.3.

3. Prismatic. *Chrysoberyl.*

Prism = 104° 41′. Cleavage prismatoidal, in the direction of the smaller diagonal of the oblique four-sided prism. Hardness = 8.5. Sp. gr. = 3.7,—3.8.

Genus iv.—ANDALUSITE.

Three axes. Cleavage prismatic, slightly oblique. No single perfect cleavages. Hardness = 7.5. Sp. gr. = 3.0,—3.2.

1. Prismatic.

Prism unknown. Cleavage indeterminate diagonal.

Genus v.—TOPAZ.

Three axes. Cleavage axifrangible. Hardness = 8. Sp. gr. = 3.4,—3.6.

1. Prismatic.

Prism = 124° 22′.

Genus vi.

Genus vi.—Emerald.

One and three axes. Cleavage prismatoidal, rhomboidal. If rhomboidal, cleavage is imperfect axifrangible, and Sp. gr.=2.8 and less. Hardness ranges from 7.5 nearly to 8.0. Sp. gr. from 2.6 to 3.2.

1. Prismatic. *Euclase.*

Prism=133° 24′. Cleavage prismatoidal, in the direction of the smaller diagonal. Hardness = 7.5. Sp. gr.=3.0,—3.2.

2. Rhomboidal. *Emerald.*

Di-rhomboid=138° 35′; 90°. Cleavage most distinct, parallel with the terminal planes of the regular six-sided prism, less distinct in the direction of the lateral planes of the prism. Hardness = 7.5,—8.0. Sp. gr. = 2.6,—2.8.

Genus vii.—Tourmaline.

One axis. Cleavage rhomboidal. Hardness=7.0,—7.5. Sp. gr. = 3.0,—3.2.

1. Rhomboidal.

Rhomboid=133° 36′. The cleavage is most distinct in the direction of the planes of the rhomboid; less so in the direction of the lateral planes of the six-sided prism.

Genus viii.—Chrysolite.

Three axes. Cleavage parallel with the sides of a rectangular prism; and of these cleavages one is more perfect than the others. Vitreous lustre. Green. Hardness=6.5,—7.0. Sp. gr. = 3.3,—3.5.

1. Prismatic.

Prism=131° 48′ Cleavage perfect, in direction of the smaller diagonal.

Genus. ix.—Axinite.

Three axes. Cleavage prismatic, very oblique. No perfect single cleavages. Not green. Hardness=6.5,—7.0 Sp. gr.= 3.0,—3.3.

1. Prismatic

1. Prismatic.

Prism $= 116° 54'$. Cleavage straight prismatic $= 101° 30'$.

Genus x.—Garnet.

One and many axes. Cleavage pyramidal; prismatoidal; dodecahedral. If prismatoidal, the hardness is $= 7$ and more, and no pure vitreous lustre. Hardness ranges from 6.5 to 7.5 Sp. gr. from 3.3 to 4.3. If black, the sp. gr. is $= 3.8$ and less.

1. Pyramidal. *Vesuvian.*

Pyramid $= 129° 30'$; $74° 12'$. Cleavage in the direction of the lateral planes of the prism; in the direction of the diagonals of the prism; and also in direction of the terminal planes of the prism. Hardness $= 6.5$. Sp. gr. $= 3.3,—3.4$.

2. Dodecahedral. *Garnet.*

Tessular. Cleavage dodecahedral. Hardness $= 7.0,—7.5$. Sp. gr. $= 3.5,—4.3$.

3. Prismatic. *Grenatite.*

Prism $= 129° 30'$. Cleavage prismatoidal, in the direction of the smaller diagonal of the prism. Hardness $= 7.0,—7.5$. Sp. gr. $= 3.3,—3.8$.

Genus xi.—Gadolinite.

Three axes. Cleavage unknown. Black. Streak, greenish-grey. Hardness $= 6.5,—7.0$. Sp. gr. $= 4.0,—4.2$.

1. Prismatic.

Prism $= 100°$ nearly.

Genus xii.—Iolite.

One axis. Cleavage rhomboidal. Hardness $= 7$. Sp. gr. $= 2.56$.

1. Prismato-rhomboidal.

Rhomboid unknown. Cleavage in the direction of the lateral and terminal planes of the regular six-sided prism.

Genus xiii.

Genus xiii.—QUARTZ.

One axis. Cleavage rhomboidal, not axifrangible. Hardness=5.5,—7.0. Sp. gr. = 2,—2.7.

1. Rhomboidal. *Common Quartz, &c.*

Rhomboid = 76° 2′. Cleavage in the direction of the alternate planes of the double six-sided pyramid. Hardness = 7.0. Sp. gr. = 2.5, 2.7.

2. Indivisible. *Opal, &c.*

Form unknown. No cleavage. Hardness = 5.5,—7.0. Sp. gr. = 2.0,—2.4.

Genus xiv.—BORACITE.

Many axes. Cleavage tessular. Hardness = 7.0. Sp. gr. = 2.8. 3.0.

1. Octahedral.

Tessular. Cleavage octahedral.

Order II.—SPAR.

Genus i.—PREHNITE.

Three axes. Cleavage axifrangible. Hardness = 6.0,—7.0. Sp. gr. = 2.8,—3.0. Not blue.

1. Prismatic.

Prism=103°. Cleavage axifrangible.

Genus ii.—DATOLITE.

Three axes. Cleavage prismatic, but detected with difficulty. Internally, lustre resinous. Not blue. Hardness = 5.0,—5.5. Sp. gr. = 2.9,—3.0.

1. Prismatic.

Prism = 109° 28′. Cleavage the same.

Genus iii.

Genus iii.—Zeolite.

Every kind of axis. Hardness ranges from 3.5 to 6.0. Sp. gr. from 2.0 to 2.5 *.

1. Dodecahedral. *Leucite.*

Tessular. Cleavage hexahedral and dodecahedral. Hardness = 5.5,—6.0. Sp. gr. = 2.4,—2.5.

2. Hexahedral. *Analcime.*

Tessular. Cleavage hexahedral. Hardness = 5.5. Sp. gr. = 2.0,—2.2.

3. Rhomboidal. *Chabasite.*

Rhomboid = 93° 48′. Cleavage rhomboidal. Hardness = 4.0,—4.5. Sp. gr. = 2.0,—2.1.

4. Pyramidal. *Cross-stone.*

Pyramid = 121° 58′; 86° 36′. Cleavage is either pyramidal, or is in the direction of the diagonals. Hardness = 4.5. Sp. gr. = 2.3,—2.4.

5. Di-prismatic. *Laumonite.*

Vertical prism = 98° 12′; horizontal prism in the direction of the smaller diagonal 121° 34′. Cleavage double. Hardness = 5. Sp. gr. = 2.3,—2.4.

6. Prismatic. *Mesotype.*

Prism = 91° 25′. Cleavage the same. Hardness = 5.0,—5.5. Sp. gr. = 2.0,—2.3.

7. Prismatoidal. *Stilbite.*

Prism = 99° 22′. Cleavage in the direction of the smaller diagonal very distinct. Hardness = 3.5,—4.0. Sp. gr. = 2.0,—2.2.

8. Axifrangible. *Apophyllite.*

Pyramid = . Cleavage very distinctly axifrangible. Hardness = 4.5,—5.0. Sp. gr. = 2.3,—2.5.

Genus iv.

* The characters of this Genus are incomplete.

Genus iv.—AZURE-SPAR *.

Three axes. Cleavage prismatic and prismatoidal. Blue. Hardness=5.0,—6.5. Sp. gr.=2.7,—3.1.

1. Prismatic. *Azurite and Haüyne.*

Prism unknown. Cleavage prismatic. Lively colour. Hardness=5,—5.5.

2. Prismatoidal. *Blue-spar.*

Prism unknown. Cleavage prismatoidal. Pale colours. Hardness=5.5, 6.0.

Genus v.—FELSPAR.

One and three axes. Cleavage in the direction of rectangular four and regular six-sided prisms. Imperfectly axi-frangible. Hardness=5.0,—6.0. Sp. gr.=2.5,—2.8.

1. Prismatic. *Common Felspar, &c.*

Prism=120°. The most distinct cleavage is that parallel with the terminal planes of the prism; other two less distinct, parallel with the lateral planes. Hardness=6.0. Sp. gr.=2.5,—2.8.

2. Pyramidal. *Scapolite, &c.*

Pyramid=136° 38′; 62° 56′. Cleavage is in the direction of the lateral planes and the diagonals of a rectangular four-sided prism. Hardness=5.0,—5.5. Sp. gr. = 2.5,—2.8.

3. Prismato Pyramidal. *Meionite.*

Pyramid=136° 22′, 63° 22′. Cleavage in the direction of the diagonals of the prism. Hardness = 5.5. Sp. gr. = 2.5,—2.7.

4. Rhomboidal. *Nepheline.*

Di-rhomboid = 152° 44′; 56° 15′. Cleavage is fourfold. Three of the cleavages are parallel with the lateral planes, and one with the terminal planes, of the six-sided prism. Hardness=6.0. Sp. gr.=2.5,—2.6.

Genus vi.

* *Lapis Lazuli* and *Calaite* belong to this Genus, but their specific characters have not been accurately ascertained.

Genus vi.—SPODUMEN.

Three axes. Cleavage prismatic. Three cleavages parallel with the axis, nearly of equal perfection. Hardness = 6. Sp. gr. = 3.0,—3.1.

1. Prismatic.

Prism nearly = 100°. Cleavage threefold; two of the cleavages parallel with the lateral planes, and a third with the shorter diagonal of the basis of the prism.

Genus vii.—KYANITE.

Three axes. Cleavage prismatic. On the most perfect cleavages, the hardness is = 5; on the angles, it is = 7. Specific gravity = 3.5,—3.7.

1. Prismatic.

Prism = 102° 50′. Cleavage prismatoidal.

Genus viii.—AUGITE.

Three axes. Cleavage prismatic. No metallic pearly lustre. If common lustre on single cleavages, the hardness is = 6 and more, and specific gravity below 3.5. If the lustre is resinous, the specific gravity = 3.2 and more. Not blue. Hardness ranges from 4.5 to 7.0. If the hardness is 6.0 and more, the specific gravity = 3.2 and more. Specific gravity ranges from 2.7 to 3.6.

1. Oblique-edged. *Augite.*

Prism = 92° 18′. Cleavage indeterminate diagonal. Hardness = 5.0,—6.0. Sp. gr. = 3.2,—3.5.

2. Straight-edged Augite. *Hornblende.*

Prism = 124° 34′. Cleavage indeterminate diagonal. Hardness = 5.0,—5.5. Sp. gr. = 2.7,—3.2.

3. Prismatoidal. *Epidote.*

Prism = 114° 37′. Cleavage sometimes prismatoidal. Hardness = 6.7. Sp. gr. = 3.2,—3.5.

4, Prismatic

4, Prismatic. *Tabular Spar.*

Prism = 105° nearly. Cleavage indeterminate diagonal. Hardness = 4.5,—5.0. Sp. gr. = 2.8,—2.9.

Genus ix.—Schiller-Spar.

Three axes. Cleavage prismatic. Pearly lustre on single cleavages. If common pearly lustre, the specific gravity = 3.2 and less, the hardness = 5.5 and less, and colour green. Hardness ranges from 4 to 6.; Sp. gr. from 3.0 to 3.4.

1. Green Diallage.

Prism unknown. Cleavage prismatoidal. Common pearly lustre. Hardness = 4.5,—5.5. Sp. gr. = 3.0,—3.2.

2. Schiller-Spar.

Prism nearly 100°. Cleavage prismatoidal. Metallic-like pearly lustre. Hardness = 4.0,—5.0. Sp. gr. = 3.0,—3.3.

3. Hyperstene.

Prism nearly 100°. Cleavage prismatoidal. Metallic-like pearly lustre. Hardness = 6.0. Sp. gr. = 3.3,—3.4.

4. Anthophyllite.

Prism nearly 106°. Cleavage in the direction of a rectangular prism. The lustre nearly metallic-like pearly. Hardness = 5.0,—5.5. Sp. gr. = 3.0,—3.3.

Order III.—MICA.

Genus i.—Copper-Mica.

Three axes. Cleavage prismatic. Streak green. Hardness = 2.0. Sp. gr. = 2.5,—2.6.

1. Prismatic.

Prism unknown. Cleavage prismatic,

Genus ii.—Uranite or Uran-Mica.

One axis. Cleavage pyramidal; streak green. Hardness = 2.0,—2.5. Sp. gr. = 3.1,—3.3.

1. Pyramidal,

1. Pyramidal.

Pyramid = 95° 13′; 144° 56′. The only distinct cleavage is that parallel with the base of the prism.

Genus iii.—Red Cobalt or Cobalt-Mica.

Three axes. Cleavage prismatic. Streak red; green. Hardness = 2.5. Sp. gr. = 4, 4.3.

1. Prismatic. *Cobalt-Bloom.*

Prism unknown. Cleavage prismatoidal.

Genus iv.—White Antimony or Antimony-Mica.

Three axes. Cleavage prismatic. Hardness = 1.5,—2,0. Sp. gr. = 5.0,—5.6.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus v.—Blue Iron.

Three axes. Cleavage prismatic. Streak white? Hardness = 2.0. Sp. gr. = 2.8,—3.0.

1. Prismatic.

Prism unknown. Cleavage prismatoidal.

Genus vi.—Graphite.

One axis. Cleavage rhomboidal. Streak black. Hardness = 1.0,—2.0. Sp. gr. = 1.9,—2.1.

1. Rhomboidal.

Rhomboid unknown. Cleavage axifrangible.

Genus vii.—Mica.

One axis. Cleavage rhomboidal. Streak green; white. Hardness = 1.0,—2.5. Sp. gr. = 2.7,—3.0.

1. Rhomboidal. *Mica, Chlorite, &c.*

Rhomboid unknown. Cleavage parallel with the terminal planes of the regular six-sided prism.

Genus viii.

2

Genus viii.—PEARL-MICA *.

One axis. Cleavage rhomboidal. Streak white. Hardness $= 3.5$. Sp. gr. $= 3.0, — 3.1$.

1. Rhomboidal.

Rhomboid unknown. Cleavage is parallel with the terminal planes of the regular six-sided prism.

Order IV.—MALACHITE.

Genus i.—COPPER-GREEN.

Reniform; botryoidal. Streak white. Hardness $= 2.0, — 3.0$. Sp. gr. $= 2.0, — 2.2$.

1. Common Copper-Green.

No cleavage.

Genus ii.—MALACHITE.

Three axes. Cleavage prismatic. Streak blue; green; very pure. Hardness $= 3.5, — 4.0$. Sp. gr. $= 3.5, — 3.7$.

1. Prismatic. *Blue Copper.*

Prism = . Cleavage uncertain. Streak blue.

2. Acicular. *Common Malachite.*

Prism = . Cleavage uncertain. Streak green.

Genus iii.—OLIVENITE.

Many axes. Cleavage prismatic; tessular: streak blue; green; brown. If streak green or blue, the specific gravity is $= 4$ and more, or $= 3$ and less.

Hardness ranges from 2.5 to 5.

Specific gravity from 2.8 to 4,6.

1. Prismatic. *Phosphat of Copper.*

Prism $= 110°$. Cleavage the same. Streak emerald-green. Hardness $= 5$. Sp. gr. $= 4.0, — 4.3$.

2. Di-prismatic

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* The characters of Pearl-mica given above by Professor Mohs, contain all the information I possess of this mineral. This species is not included in the body of the work.

2. Di-prismatic. *Lenticular Copper.*

Prism unknown. Cleavage in the direction of the lateral and terminal bevelling planes of an oblique four-sided prism. Streak pale verdigris-green, and sky-blue. Hardness = 2.5. Sp. gr. = 2.8,—2.9.

3. Acicular. *Olivenite.*

Prism unknown. Cleavage unknown. Streak olive-green; brown. Hardness = 3.0. Sp. gr. = 4.2,—4.6

4. Hexahedral. *Cube-ore.*

Tessular. Cleavage hexahedral. Streak olive-green; brown. Hardness = 2.5. Sp. gr. = 2.9,—3.0.

Genus iv.—Emerald-Copper.

One axis. Cleavage rhomboidal. Streak
Hardness = 5.0. Sp. gr. = 3.3,—3.4.

1. Rhomboidal.

Rhomboid = 123° 58′. Cleavage rhomboidal.

Order V.—KERATE.

Genus i.—Corneous Silver.

Three axes. Cleavage invisible. Hardness = 1.0,—2.0. Sp. gr. = 4.6.

1. Hexahedral.

Tessular. Cleavage not visible. Malleable.

Genus ii.—Corneous Mercury.

One axis. Cleavage very indistinct. Hardness = 1.0,—2.0. Sp. gr.=

1. Pyramidal.

Pyramid unknown. Cleavage indistinct axifrangible. Sectile.

Order VI.

Order VI.—BARYTE.

Genus i.—LEAD-SPAR.

One and three axes. Cleavage rhomboidal, pyramidal, prismatic. Hardness ranges from 2.5, to 4.0. If above 3.5, the specific gravity is equal to 6.5 and more. Specific gravity ranges from 6.0 to 7.2.

1. Tri-prismatic. *Sulphat of Lead.*

The vertical prism =120°; horizontal prism, in the direction of the longer diagonal,=70° 31′; and in the smaller=101° 32′. Cleavage is the same. Hardness = 3. Sp. gr. = 6.3.

2. Pyramidal. *Yellow Lead-spar.*

Pyramid =99° 40′; 131° 45′. Cleavage in the direction of the faces of the pyramid, or in the direction of the terminal planes of the rectangular four-sided prism. Hardness = 3. Sp. gr.=6.5, 6.8.

3. Prismatic. *Red Lead-spar.*

Prism unknown. Cleavage in the direction of a rectangular prism. Hardness = 2.5. Sp. gr. = 6.0, 6.1.

4. Rhomboidal. *Green and Brown Lead-spar.*

Di-rhomboid = 141° 47′; 81° 46′. Cleavage in the direction of the planes of the rhomboid, and in the direction of the lateral planes of the six-sided prism. Hardness = 3.5, 4.0. Sp. gr. = 6.9, 7.2.

5. Di-prismatic. *White Lead-spar.*

Vertical prism = 117° 4′. Horizontal prism in the direction of the smaller diagonal = 109° 30′. Cleavage the same. Hardness = 3.0, 3.5. Sp. gr. = 6.2, 6.6.

Genus ii.—BARYTE.

One and three axes. Cleavage rhomboidal and prismatic. If cleavage rhomboidal, the specific gravity is 4.2 and more. Hardness = 3.0, 3.5. Sp. gr. = 3.6, 4.6.

1. Rhomboidal.

1. Rhomboidal. *Witherite.*

Rhomboid=91° 54′. The most distinct cleavage is in the direction of the planes of the rhomboid, and a less distinct cleavage parallel with the alternate planes of the six-sided pyramid. Hardness = 3.0, 3.3. Sp. gr. = 4.2, 4.4.

2. Prismatic. *Heavy-spar.*

Prism = 101° 53′. The most distinct cleavage is that parallel with the terminal planes of the oblique four-sided prism; less perfect are those parallel with the lateral planes of the prism. Hardness = 3, 3.5. Sp. gr. = 4.1, 4.6.

3. Di-prismatic. *Strontianite.*

Vertical prism=117° 19′. Horizontal prism in the direction of the smaller diagonal = . Cleavage in the direction of the planes of both prisms. Hardness = 3.5. Sp. gr. = 3.6, 3.8.

4. Axifrangible. *Celestine.*

Prism = 104° 48′. The most distinct cleavage is that at right angles to the axis of the prism; another less distinct cleavage is parallel with the lateral planes of the prism. Hardness = 3.0, 3.3. Sp. gr. = 3.6, 4.0.

Genus iii.—TUNGSTEN.

One axis. Cleavage pyramidal. Hardness = 4.0, 4.5. Sp. gr. = 6.0, 6.1.

1. Pyramidal.

Pyramid = 107° 26′; 113° 36′. The most distinct cleavage is that parallel with the planes of the primitive pyramid; another less distinct in which the planes are parallel with the sides of an acute pyramid, (100° 8′; 130° 20′); and a third the least distinct, parallel with the common base of the pyramid *.

Genus iv.

* At page 435, vol. ii. it is stated, through mistake, that this last cleavage is the most perfect.

Genus iv.—Calamine.

One and three axes. Cleavage di-prismatic; rhomboidal. If rhomboidal, the sp. gr. = 4.2 and more. Hardness = 5.0. Sp. gr. = 3.3,—4.5.

1. Prismatic. *Electric Calamine.*

Vertical prism = 99° 56′. Horizontal prism, in the direction of the longest diagonal, = 120°. Cleavage is the same. Hardness = 5.0. Sp. gr. = 3.3,—3.6.

2. Rhomboidal. *Common Calamine.*

Rhomboid about 110°. The cleavage is in the direction of the planes of the rhomboid. Hardness = 5.0. Sp. gr. = 4.2,—4.4.

Genus v.—Red Manganese.

One axis. Cleavage rhomboidal. Hardness = 3.5,—4.5. Sp. gr. = 3.3,—3.9.

1. Rhomboidal.

Rhomboid = . Cleavage rhomboidal. Hardness = 3.5. Sp. gr. = 3.3,—3.6.

Genus vi.—Sparry Iron.

One axis. Cleavage rhomboidal. Hardness = 3.5,—4.6. Sp. gr. = 3.6,—3.9.

1. Sparry Iron.

Rhomboid = 107°. The most perfect cleavage is in the direction of the planes of the primitive rhomboid; the least perfect in the direction of the planes of a flat rhomboid. Hardness = 3,5,—4.5. Sp. gr. = 3.6,—3.9.

Order VII.—HALOIDE.

Genus i. Limestone.

One and three axes. Cleavage prismatic; rhomboidal. Hardness ranges from 3.0 to 4.5. Sp. gr. = 2.5,—3.2 *.

1. Rhomb

* The characters of this genus are incomplete.

1. Rhomb-Spar.

Rhomboid = 106° 15′. Cleavage rhomboidal. Hardness = 3.5,—4.0. Sp. gr. = 2.8,— 3.2.

2. Dolomite.

Rhomboid = 107° 22′. Cleavage rhomboidal. Hardness = 4.0,—4.5, Sp. gr. = 3.0,—3.2.

3. Limestone.

Rhomboid = 105° 5′. The most perfect cleavage is in the direction of the primitive rhomboid: less perfect cleavage in the direction of a flatter rhomboid; a third, still more imperfect, which is parallel with the planes of the six-sided prism; and a fourth, the most imperfect, which is parallel with the terminal planes of the six-sided prism. Hardness = 3.0. Sp. gr. = 2.5,—2.8.

4. Prismatic. *Arragonite.*

Vertical prism = 115° 56′: horizontal prism in the direction of the shorter diagonal 109° 28′. The cleavage is the same, but most distinct in the direction of the smaller diagonal of the vertical prism. Hardness = 3.5,—4.0. Sp. gr, 2.6,—3.0.

Genus ii. Apatite.

One axis. Cleavage rhomboidal. Hardness = 5.0. Sp. gr. = 3.1,=3.2.

1. Rhomboidal.

Di-rhomboid = 131° 49′; 109° 28′. The most perfect cleavage is parallel with the terminal planes of a regular six-sided prism; and another, less distinct, parallel with the sides of the six-sided prism. Hardness = 5.0.

Genus iii. Fluor.

Many axes. Cleavage octahedral. Hardness = 4.0. Sp. gr. = 3.0,—3.1.

1. Octahedral.

Tessular. Cleavage octahedral. Hardness = 4.0.

Genus iv.

Genus iv.—Alum-Stone.

One axis. Cleavage rhomboidal. Hardness = 5.0. Sp. gr. = 2.4,—2.6.

1. Rhomboidal.

Rhomboid unknown. The most distinct cleavage parallel with the sides of a rhomboid; another, less distinct, parallel with the terminal planes of a six-sided prism.

Genus v.—Cryolite.

One axis. Cleavage pyramidal. One perpendicular cleavage, and other two less perfect. Hardness = 2.5,—3.0. Sp. gr. = 2.9,—3.0.

1. Pyramidal.

Pyramid unknown. The most perfect cleavage is parallel with the terminal planes of a rectangular four-sided prism; another, less distinct, parallel with the diagonals of a rectangular four-sided prism; and a third, still less perfect, parallel with the planes of the pyramid.

Genus vi.—Gypsum.

Three axes. Cleavage prismatic. Hardness = 1.5,—3,5. Sp. gr. = 2.2,—3.0 *.

1. Prismatic. *Anhydrite.*

Prism = 100° 8′. Three cleavages perpendicular to each other. Hardness = 3.0,—3.5. Sp. gr. = 2.7,—3.0.

2. Axifrangible. *Gypsum.*

Prism = 113° 8′. Cleavage perpendicular to the axis or axifrangible. Hardness = 1.5,—2.0. Sp. gr. = 2.2,—2.4,

* The characters of this Genus incomplete.

CLASS II.—*SALINE MINERALS.*

Order I.—FOSSIL SALTS.

Genus i.—Rock Salt.

Many axes. Cleavage tessular. Taste saline. Hardness = 2.0,—2.5. Sp. gr. = 2.1,—2.2,

1. Hexahedral.

Tessular. Cleavage hexahedral.

Genus ii.—Sal Ammoniac.

Many axes. Cleavage tessular. Taste pungent and urinous. Hardness 1.5,—2.0. Sp. gr. = 1.5,—1.6.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus iii.—Vitriol.

One and three axes. Cleavage rhomboidal, pyramidal, and prismatic. Taste astringent. Hardness = 2.0,—2.5. Sp. gr, = 1.9,—2.2,

1. Rhomboidal. *Green Vitriol.*

Rhomboid = 81° 23′. The cleavage is rhomboidal. Hardness = 2.0. Sp. gr. = 1.9,—2.0.

2. Prismatic. *Blue Vitriol.*

Prism = 124° 2′. Cleavage same. Hardness = 2.5. Sp. gr. = 2.1,—2.2.

3. Pyramidal. *White Vitriol.*

Pyramid = 120° 90′. Cleavage unknown. Hardness = . Sp. gr. = 2.0.

Genus iv.—Epsom Salt.

Three axes. Cleavage prismatic. Taste saline and bitter. Hardness = . Sp. gr. =

1. Prismatic.

1. Prismatic.

Prism = 90°. Cleavage very perfect in the direction of one of the diagonals.

Genus v.—Alum.

Many axes. Cleavage tessular. Taste sweetish, astringent and acidulous, Hardness = 2.0,—2.5. Sp. gr. = 1.7,—1.8.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus vi.—Glauber Salt.

Three axes. Cleavage prismatic Taste cooling, saline, and bitter. Hardness = Sp. gr. = 2.2,—2.3.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus vii.—Nitre.

Three axes. Cleavage prismatic. Taste saline and cooling. Hardness = 2.0. Sp. gr. = 1.9,—2.0.

1. Prismatic.

Prism = . Cleavage in the direction of the shorter diagonal of the prism.

Genus viii.—Natron.

Three axes. Cleavage prismatic. Taste pungent and alkaline. Hardness = . Sp. gr. = 1.4.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus ix.—Borax.

Three axes. Cleavage prismatic. Taste alkaline and sweet. Hardness = Sp. gr. = 1.5,—1.7.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Class III.

CLASS III.—METALLIFEROUS MINERALS.

Order I.—NATIVE METALS.

Genus i.—PLATINA.

Form unknown. Cleavage either invisible or very imperfect Colour steel-grey, or steel-grey inclining to silver-white. Sp. gr. =11.8 to 19.5.

1. Native Platina.

In grains and rolled pieces. Sp. gr. = 17.7.

2. Palladium.

Colour steel-grey, inclining to silver-white. Sp. gr. = 11.8, —12.148.

3. Iridium.

Colour pale steel-grey. Sp. gr. = 19.5.

Genus ii.—GOLD.

Many axes. Cleavage not discernible. Colour gold-yellow; brass-yellow; greyish-yellow; brass-yellow, inclining to silver-white. Sp. gr. = 12.0.

1. Hexahedral.

Tessular.

Genus iii.—SILVER.

Many axes. Cleavage not discernible. Ductile; malleable; silver-white. Sp. gr. =10.0,—10.4.

1. Hexahedral.

Tessular.

Genus iv.—MERCURY.

Many axes. Fluid. Cleavage not discernible. Not malleable. White. Hardness = 0,—3.0. Sp. gr. = 10.5,—13.6.

1. Fluid.

1. Fluid.

Fluid. Tin-white. Hardness = 0. Sp. gr. = 13.4,—13.6.

2. Dodecahedral. *Native Amalgam.*

Tessular. Silver-white. Hardness = 1.3. Sp. gr. = 10.5.

Genus v.—Copper.

Many axes. Cleavage not discernible. Copper-red. Sp. gr. = 8.4,—8.7.

1. Octahedral.

Tessular.

Genus vi.—Iron.

Many axes. Cleavage not descernible. Steel-grey, inclining to silver-white. Sp. gr. = 7.4,—7.6.

1. Octahedral.

Tessular.

Genus vii.—Arsenic.

Form unknown. Cleavage unknown. Tin-white, inclining to lead-grey. Hardness = 3.5. Sp. gr. = 5.7,—5.8.

1. Native.

Probably tessular.

Genus viii.—Bismuth.

Many axes. Cleavage tessular. Malleable. White, inclining to red. Hardness = 2.0,—2.5. Sp. g. = 8.9.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus ix.—Antimony.

Many axes. Cleavage tessular. Not ductile. Pure white. Hardness = 3.0,—3.5. Sp. g. = 6.5,10.0 *.

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* The characters of this Genus are incomplete.

1. Dodecahedral. *Native Antimony.*

Tessular. Cleavage octahedral and dodecahedral. Hardness 3.0,—3.5. Sp. gr. 6.5,—6.8.

2. Octahedral. *Antimonial and Arsenical Silver.*

Tessular. Cleavage octahedral. Hardness = 3.5. Sp. gr. = 8.9 *,—10.0.

Genus x.—TELLURIUM.

Form unknown. Cleavage unknown. Tin-white. Hardness = 2.0,—2.5. Sp. gr. 6.1,—6.2.

1. Native.

Probably tessular.

Order II.—ORE.

Genus i.—TITANIUM ORE.

One and three axes. Cleavage prismatic, and pyramidal. Streak white; brown; black. If the streak is brown, the hardness is = 6.0 and more. If the specific gravity is 4.4 and more, the streak is black, and the mineral is slightly magnetic. Hardness = 5.0,—6.5. Sp. gr. = 3.4,—4.8.

1. Prismatic. *Sphene.*

The vertical prism = 136° 50′. The horizontal prism in the direction of one of the diagonals = 120°. Streak white. Hardness = 5.0,—5.5. Sp. gr. = 3.4,—3.6.

2. Prismato-Pyramidal. *Rutile. Iserine. Menachine.*

Pyramid = 117° 2′; and 84° 48′. The most distinct cleavage is in the direction of the lateral planes of the rectangular four-sided prism; and another, less distinct, is parallel with the diagonals of the prism. The streak is brown; black. Hardness = 5.5,—6.5. Sp. gr. = 4.2.—4.8.

3. Pyramidal.

* The specific gravity of Mohs is lower than what is given in the text,

3. Pyramidal. *Octahedrite.*

Pyramid = 97° 38′; 137° 10′. The most perfect cleavage is in the direction of the faces of the pyramid; another, less perfect, is parallel to the common base of the pyramids. Streak white. Hardness = 5.5,—6.0. Sp. gr. = 3.8,—3.9.

Genus ii.—Red Copper-Ore.

Many axes. Cleavage tessular. Streak red. Hardness = 3.5. Sp. gr. = 5.6,—6.0.

1. Octahedral.

Tessular. Cleavage octahedral.

Genus iii.—Tin-Ore.

One axis. Cleavage pyramidal. Streak not black. Hardness = 6.0,—7.0. Sp. gr. = 6.3,—7.0.

2. Pyramidal.

Pyramid = 133° 36′; 67° 42′. The most perfect cleavage is in the direction of the lateral planes of a rectangular four-sided prism: and another, less perfect, in the direction of the diagonals of the same prism.

Genus iv.—Wolfram.

Three axes. Cleavage prismatic. Streak dark reddish-brown. Hardness = 5.0,—5.5. Sp. gr. = 7.1,—7.4.

1. Prismatic.

Prism = 120°. There is always one distinct cleavage, which is parallel with the longer diagonal of the prism; and another, less distinct, in the direction of the shorter diagonal *.

Genus v.—Tantalum-Ore.

Three axes. Cleavage unknown. Streak dark brownish-black.

* In the text, the most perfect cleavage is, through mistake, said to be parallel with the shorter diagonal.

black. Lustre nearly semi-metallic adamantine. Hardness = 6.0 under the file. Sp. gr. = 6.0,—6.3.

1. Prismatic.

Prism unknown.

Genus vi.—Uranium-Ore.

Form unknown. Cleavage unknown. Streak black and glistening. Hardness = 5.5. Sp. gr. = 6.4,—6.6.

1. Indivisible.

Reniform. Massive.

Genus vii.—Cerium-Ore.

Three axes. Cleavage either prismatic or invisible. No metallic lustre. Streak white; grey. Hardness = 5.5. Sp. gr. = 3.5,—5.0.

1. Prismatic.

Prism = 117°. Sp. gr. = 5.3,—4,0.

2. Indivisible.

Massive. Hardness = 5.5. Sp. gr. = 4.6,—4 5.

Genus viii.—Chrome-Ore.

Three axes. Cleavage prismatic. Imperfect metallic lustre. Streak dark brown. Hardness = 5.5. Sp. gr. = 4.4,—4.5.

1. Prismatic.

Prism unknown. Cleavage imperfect.

Genus ix.—Iron-Ore.

One and many axes. Cleavage rhomboidal; prismatic; tessular. Streak black; red; yellowish; brown. If the streak is black, it affects the magnet powerfully; if the streak is brown, the hardness is = 5.5 and less. Hardness = 5.0,—6.5. Sp. gr. = 3.8,—5.2.

1. Octahedral.

1. Octahedral. *Magnetic Iron-Ore.*

Tessular. Cleavage octahedral. Streak black. Hardness = *5.5,—6.5*. Sp. gr. = 4.8,—5.2.

2. Rhomboidal. *Iron-glance, and Iron-ore.*

Rhomboid = 87° 9′. The most perfect cleavage is parallel with the planes of the primitive rhomboid; and another, less perfect, which is parallel with the lateral planes of the six-sided prism or table. The streak is red, or reddish-brown. Hardness = *5.5,—6.5*. Sp. gr. = 4.9,—5.2.

3. Prismatic. *Brown Iron-ore.*

Prism unknown. Cleavage prismatic. Streak yellowish-brown. Hardness = 5.0,—5.5. Sp. gr. = 3.8,—4.2.

Genus x.—Manganese-Ore.

Three axes. Cleavage prismatic. Streak black. No action on the magnet. Hardness = 2.5,—5.0? Sp. gr. 4.4,—4.8.

1. Prismatic. *Grey Manganese Ore, &c.*

Prism nearly = 100°. Cleavage the same, but most perfect in the direction of the longer diagonal.

Order III.—PYRITES.

Genus i—Nickel Pyrites. *Copper-Nickel.*

Three axes. Cleavage unknown. Copper-red. Hardness = 5.0,—5.5. Sp. gr. 7.5,—7.7.

1. Prismatic.

Prism unknown.

Genus ii.—Arsenical Pyrites.

Three axes. Cleavage prismatic. White, and pale steel-grey. If white, the specific gravity is = 6.2, and less; if steel-grey the specific gravity is = 6.9 and more. Hardness = 5.0, —6.0. Sp. gr. = 5.7,—7.4.

1. Prismatic,

1. Prismatic.

Prism unknown. Cleavage unknown. Steel-grey. Hardness = 5.0,—5.5. Sp. gr. 6.9,—7.4.

2. Di-prismatic. *Common Arsenical Pyrites.*

The vertical prism = 111° 18′. The horizontal prism = . Cleavage in the direction of the vertical prism. Hardness = 5.5,—6.0. Sp. gr. = 5.7,—6.2.

Genus iii.—Cobalt Pyrites.

Many axes. Cleavage tessular. White; also inclining to red and steel-grey. Hardness = 5.5. Sp. gr. = 6.0,—6.6.

1. Hexahedral. *Silver-white Cobalt.*

Tessular. Cleavage hexahedral. Sp. gr. = 6.1,—6.3.

2. Octahedral. *Tin white and grey Cobalt.*

Tessular. Cleavage octahedral, but in general very indistinct. Sp. gr. = 6.0,—6.6.

Genus iv.—Iron-Pyrites.

One and many axes. Cleavage rhomboidal; prismatic; tessular; bronze-yellow, occasionally inclining to copper-red. Hardness = 3.5,—6.5. Sp. gr. = 4.4,—5.0.

1. Hexahedral. *Common Iron-Pyrites.*

Tessular. Cleavage hexahedral. Hardness = 6.0,—6.5. Sp. gr. = 4.7,—5.0.

2. Prismatic. *Radiated Pyrites, &c.*

Prism = 106° 36′. Cleavage the same? Hardness = 6.0,—6.5. Sp. gr. = 4.7,—5.0.

3. Rhomboidal. *Magnetic Pyrites.*

Rhomboid unknown. The most perfect cleavage is in the direction of the terminal planes of a six-sided prism; and another, less perfect, in the direction of the lateral planes of a six-sided prism. Hardness = 3.5,—4.5. Sp. gr. = 4.4.,—4.6.

Genus v.

Genus v.—Copper-Pyrites.

Many axes. Cleavage tessular. Brass-yellow; steel-grey; iron-black. Hardness = 3.0,—4.0. Sp. gr. = 4.1, 4.9.

1. Octahedral. *Common Copper-Pyrites.*

Tessular. Cleavage probably octahedral. Brass-yellow. Hardness = 3.0,—4.0. Sp. gr. = 4.1,—4.2.

2. Tetrahedral. *Grey-Copper.*

Tessular. Cleavage probably octahedral. Steel-grey and iron-black. Hardness = 3.4. Sp. gr. = 4.4,—4.9.

Genus vi.—Tin-Pyrites.

Steel-grey, inclining to brass-yellow. Sp. gr. = 4.3,—5.0.

1. Compact.

Massive.

Order IV.—GLANCE.

Genus i.—Copper-Glance.

One axis. Cleavage rhomboidal. Blackish lead-grey. Sectile, and nearly malleable, The intensity of the lustre increased in the streak. Hardness = 2.5,—3.0. Sp. gr. 5.5,—5.8.

1. Rhomboidal.

Rhomboid unknown. The cleavage is in the direction of the lateral planes of a six-sided prism *.

Genus ii.—Silver-Glance.

One and many axes. Cleavage rhomboidol, or not discernible. Blackish lead-grey, and iron-black. If blackish lead-grey, or the intensity of the lustre increased in the streak, it is malleable, and the sp. gr. = 6.9 and more.

Hardness = 2.0,—2.5. Sp. gr. = 5.7,—7,2.

1. Hexahedral.

* This determination differs a little from that given in the description of the species.

1. Hexahedral. *Vitreous Silver-Ore.*

Tessular. Cleavage not discernible. Sp. gr. = 6.9,—7.2.

2. Rhomboidal. *Brittle Silver-Glance.*

Rhomboid unknown. Sp. gr. = 5.7,—6.1.

Genus iii.—Galena or Lead-Glance.

Many axes, Cleavage tessular. Pure lead-grey. Hardness = 2.5. Sp. gr. = 7,—7.6.

1. Hexahedral. *Common Galena.*

Tessular. Cleavage hexahedral.

Genus iv.—Black Tellurium.

Three axes. Cleavage perfect, according to one direction. Blackish lead-grey. Not malleable. Hardness = 1,—1.5. Sp. gr. = 7.0,—7.2.

1. Prismatic.

Prism unknown. Cleavage prismatoidal or axifrangible.

Genus v.—Molybdena.

One axis. Cleavage rhomboidal. Pure lead-grey. Flexible. Hardness = 1.—1.5. Sp. gr. = 4.4,—4.6.

1. Rhomboidal.

Rhomboid unknown. Single cleavage, parallel with the terminal planes of a six-sided prism, or the lateral planes of a six-sided table.

Genus vi.—Gold-Glance.

Three axes. Cleavage prismatic; not axifrangible. Pure steel-grey. Hardness = 1.5,—2.0. Sp. gr. = 5.7,—5.8.

1. Prismatic Gold-Glance. *Graphic and Yellow Tellurium.*

Prism unknown. Cleavage prismatic.

Genus vii.—Bismuth-Glance.

Three axes. Cleavage prismatic. Lead-grey. Hardness = 2,0,—2.5. Sp. gr. = 6.1,—6.4.

1. Acicular.

3

1. Acicular.

Prism unknown. Cleavage imperfect. Dark lead grey. Hardness = 2.0,—2.5. Sp. gr. = 6.1,—6.2.

2. Prismatic.

Prism unknown. The cleavage is parallel to the sides and to the short diagonal of an oblique four-sided prism. Lead-grey. Hardness = 2.0,—2.5. Sp. gr. = 61,—6.4.

Genus viii.—ANTIMONY-GLANCE.

Three axes. Cleavage prismatic. Lead-grey falling into blackish and steel-grey. If it passes into steel-grey, its cleavage is axifrangible; inflexible; sectile. If it passes into lead-grey, is brittle. Hardness = 2.3. Sp. gr. = 4.0,—5.8.

1. Prismatoidal. *Grey Antimony.*

Prism = . Cleavage perfect prismatic. Hardness = 2.0. Sp. gr. = 4.0,—4.6.

2. Axifrangible. *Bournonite.*

Prism unknown, Cleavage axifrangible. Its colour is blackish lead-grey, falling into steel-grey, Hardness = 2.0,—2.5. Sp. gr. 5.5,—5.8.

3. Prismatic.

Prism unknown. Cleavage in direction of the smaller diagonal. Blackish lead-grey. Hardness = 2.5,—3.0. Sp. gr. = 5.7,—5.8.

Order V.—BLENDE.

Genus i.—MANGANESE BLENDE. *Sulphuret of Manganese.*

Three axes. Cleavage prismatic. Streak greenish. Hardness = 3.5,—4.0. Sp. gr. = 3.9,—4.0.

1. Prismatic.

Prism unknown. Cleavage prismatic, but very imperfect.

Genus ii.

Genus ii.—Zinc-Blende. *Blende.*

Many axes. Cleavage tessular. Streak brown and white. Hardness 3.5.—4.0. Sp. gr. = 4.0,—4.2.

1. Dodecahedral.

Tessular. Cleavage dodecahedral.

Genus iii.—Antimony-Blende. *Red Antimony.*

Three axes. Cleavage prismatic. Streak red. Hardness = 1.0,—1.5. Sp. gr. = 4.5,—4.6.

1. Prismatic.

Prism unknown. Cleavage prismatic.

Genus iv.—Ruby-Blende.

One axis. Cleavage rhomboidal. Streak reddish. Hardness = 2.0,—2.5. Sp. gr. 5.6,—8.2.

1. Rhomboidal. *Red Silver.*

Rhomboid = 109° 28′. Cleavage rhomboidal. Hardness = 2.5. Sp. gr. 5.6,—5.7.

2. Prismato-rhomboidal. *Cinnabar.*

Rhomboid = . Cleavage in the direction of the sides of the six-sided prism. Hardness = 2.0,—2.5. Sp. gr. = 6.7,—8.2.

Genus v.—Sulphur.

Three axes. Cleavage prismatic. Streak yellow and white. Hardness = 1.5,—2.1. Sp. gr. = 2.3 ?—3.6.

Order VI.—SULPHUR.

Genus i.—Sulphur.

Three axes. Cleavage prismatic. Streak yellow; white. Hardness = 1.0,—2.5. Sp. gr. = 1.9,—3.6.

1. Red Orpiment or Hemi-prismatic Sulphur.

Prism 107° 42′. Cleavage in the direction of the diagonals of the prism, but imperfect. Hardness = 1.0,—2.0. Sp. gr. = 3.3,—3.4.

2. Yellow

2. Yellow Orpiment or Prismatoidal Sulphur.

Prism unknown. Cleavage prismatoidal. Hardness = 1.5, —2.0. Sp. gr. = 3.4,—3.6.

3. Prismatic Sulphur.

Prism 107° 19′; 84° 24′: Basis = 102° 41′. Cleavage prismatic and axifrangible. Hardness = 1.5,—2.5. Sp. gr. = 1.9, —2.1.

Class IV.—INFLAMMABLE MINERALS.

Order I.—RESIN.

Genus i.—Honeystone.

One axis. Cleavage pyramidal, Hardness = 2.2,—2.5. Sp. gr. = 1.4,—1.6.

1. Pyramidal.

Pyramid = 118° 4′; 93° 22′. Cleavage pyramidal.

Genus ii.—Mineral Resin.

Without form. Hardness = 0,—2.2. Sp. gr. = 0.8,—1.2.

1. Yellow Mineral Resin or Amber.

Solid. Yellow and white. Streak white. Hardness = 2.0, —2.2. Sp. gr. = 1.0.—1.1.

2. Black Mineral Resin. *Naphtha, Petroleum, Mineral Pitch, &c.*

Solid and fluid. Black; brown; red; green. Streak black; brown; yellow; green. Hardness 0.—2.0. Sp. gr. = 0.8,—1.2.

Order II.—COAL.

Genus i.—Coal.

Amorphous. Black; brown. Hardness = 1.0,—2.5. Sp. gr. = 1.2,—1.5.

1. Brown Coal.

Brown. Low resinous lustre. Bituminous smell. Hardness = 0.—1.0. Sp. gr. = 1.0,—1.3.

2. Black Coal.

Black. Higher resinous lustre. Hardness = 2.0,—2.5. Sp. gr. = 1.2,—1.4.

3. Glance-Coal.

Black. Partly imperfect metallic lustre. No bituminous smell. Hardness = 2.0,—2.5. Sp. gr. = 1.3.

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MINERAL SYSTEM.

CLASS I.

EARTHY MINERALS.

Order I.—GEM.

Genus I.—DIAMOND.

This Genus contains but one species, viz. Octahedral or Common Diamond.

1. Octahedral or Common Diamond.

Demant, *Werner*.

Octaedrischer Demant, *Mohs*.

Adamas, *Plinius,* Hist. Nat. l. xxxvii. c. 4.—Alumen lapidosum pellucidissimum hyalinum, *Lin.*—Gemma vera colore aqueo, *Cartheus.*—Diamant, *Romé de Lisle,* t. ii. p. 189.—Quartzum nobile, *Born.* t. i. p. 56.—Diamond, *Kirw.* vol. i. p. 393.—Diamant, *Estner,* b. ii. s. 54. *Id. Emm.* b. i. s. 187. —Le Diamant, *Broch.* t. i. p. 153. *Id. Haüy,* t. iii. p. 287.—Diamant, *Reuss,* b. iii. s. 198. *Id. Lud.* b. i. s. 57. *Id. Suck.* 1r th. s. 80,–85. *Id. Bertele,* s. 333, 335. *Id. Mohs,* b. i. s. 3,–16. *Id. Haberle,* s. 161. *Id. Lucas,* p. 91. *Id. Brong.* t. ii.

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External Characters.

The most common colours of the Diamond are white and grey. The varieties of white are, snow-white, greyish-white, and yellowish-white; of grey, ash-grey, smoke-grey, bluish-grey, pearl-grey, yellowish and greenish grey.

Besides these two colours, it occurs blue, red, brown, yellow, and green.

Of blue, the only variety is indigo-blue, which appears to pass into red.

Of red, the varieties are rose-red and cherry-red; from the latter it passes into clove-brown and yellowish-brown; from this into ochre-yellow, orange-yellow, wine-yellow, lemon and sulphur-yellow; further, into siskin-green, asparagus-green, pistachio-green, leek-green, and, lastly, into mountain-green: which latter passes into greenish-grey, and greenish-white.

The clove-brown passes into blackish-brown, pitch-black, and greyish-black.

Of all the colours, blue and black are the rarest.

The colours are generally pale and light, seldom deep, and very seldom dark. It exhibits a most beautiful play of colours, in the direct rays of the sun, or in candle-light, particularly when cut.

It occurs in rolled pieces, in indeterminate angular and spherical grains; also crystallised in the following figures:

1. Regular octahedron, in which each plane or face is inclined on the adjacent, under 109° 28′ 16″. The faces are either straight or convex, and of these varieties

varieties the convex or curvilinear are the most frequent *. This is the fundamental figure, or that from which all the others may be derived. Is represented in Fig. 1. Pl. I. When the planes of the octahedron become alternately smaller and larger, it passes into

2. A simple three-sided pyramid, which is truncated on all the angles. Sometimes the apex is very deeply truncated, and then there remains only
3. A segment of the octahedron. Sometimes two of these segments are joined by their basis, and form a
4. Twin-crystal.

Other varieties of form arise from the octahedron, by alterations of its edges.

5. Octahedron, in which all the edges are truncated. The truncating planes are cylindrical convex †.
6. The octahedron, flatly bevelled on all the edges. The bevelling planes are also convex.
7. The octahedron, bevelled on all the edges, and the bevelling planes once broken.

When the truncating planes of the variety 5. become so large that they meet, and the original planes of the octahedron disappear, there is formed a

8. Rhomboidal dodecahedron, with cylindrical convex faces, which is sometimes very short, sometimes much elongated ‡.

* Diamant primitif, Haüy.—Romé de Lisle, t. ii. p. 191. Pl. 3. fig. 1.

† Diamant plan-convex, Haüy.—Romé de Lisle, t. ii. p. 195. var. 1. Pl. 3. fig. 7.

‡ Diamant spheroidal conjoint, Haüy.—Romé de Lisle, p. 199. var. 4. Pl. 3. fig. 7.

When the bevelling planes of variety 6. become so large that the original planes disappear, there is formed

9. An octahedron, with convex faces, in which each is divided into three triangular ones. The dividing edges run from the middle point of each face to the angles. The crystal has thus 24 equal convex triangular faces *.

When the broken bevelling planes of the variety 7. become so large that they meet, and the original faces of the octahedron disappear, there is formed an

10. Octahedron, with convex faces, and in which each is divided into six faces or planes. In this figure, the dividing edges run from the center of each face; three to the angles, and three to the middle of the edges †. The crystal consists of 48 equal curved faces, and has a rounded appearance, Fig. 2. Pl. I.

The rhomboidal dodecahedron, var. 8. affords the following varieties of form:

11. Rhomboidal dodecahedron, with diagonally broken planes, and all the planes broken or divided in the direction of the smaller diagonal ‡.

When the prism of the dodecahedron becomes lower, and the acuminations on both ends meet, there originates

12. A

* Romé de Lisle, p. 196. var. 2. Pl. 3. fig. 17.

† Diamant spheroidal sextuplé, Haüy.—Romé de Lisle, p. 197. var. 3. Pl. 3. fig. 18.

‡ Romé de Lisle, p. 200. var. 5. Pl. 4. fig. 66.

12. A flat double three-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and the edge of the common basis sometimes truncated.

Lastly, if we conceive two rhomboidal dodecahedrons pushed into each other in the direction of their length to such an extent, that the lateral planes almost entirely disappear, and that scarcely more than the acuminations remain, and further, that one prism, in regard to the other, is turned round $\frac{1}{6}$th of its circumference, so that the acuminating planes of the one dodecahedron rest upon those of the other,—another twin-crystal is formed, which may be thus described:

13. Very flat double three-sided pyramid, with cylindrical convex faces, the lateral faces of the one set on the lateral faces of the other, and each angle of the common basis flatly acuminated with four planes, which are set obliquely on the planes of the two pyramids. These acuminating planes are the remains of the lateral planes of the dodecahedrons.

If the planes of the dodecahedrons are divided, there is formed a

14. Very flat double six-sided pyramid.

15. Cube, truncated on the edges.

The crystals are generally very small, seldom small, and very rarely middle-sized. Those of a greater magnitude are uncommonly rare.

The crystals are all around crystallised.

The surface of the grains is either rough, granulated, or uneven; that of the octahedrons generally smooth; in the dodecahedron, and the other forms which originate from the truncation and bevelment of the edges of the octahedron,

tahedron, the surface is rough or streaked; and that of the twin-crystal var. 13. is granulated.

Externally, the smooth surface of the crystals is splendent; of the streaked, shining; and of the rough and granulated, glimmering *.

Internally, it is always splendent, often specular splendent, and the lustre is perfectly adamantine.

The cleavage is octahedral, or parallel with the sides of an octahedron.

It is generally straight foliated, sometimes floriform foliated.

The fragments are octahedral or tetrahedral.

It rarely occurs in distinct concretions; and these are small, and fine granular.

It is seldom completely transparent; more generally it rather inclines to semitransparent; but the black variety is nearly opaque.

It refracts single.

It scratches all other known minerals.

It is rather easily frangible.

It affords a grey streak.

Specific gravity, 3.518, *Cronstedt.*—3.521, *Muschenbroeck.*—3.521, *Wallerius.*—3.500, *Brisson.*—3.600, *Werner.*—3.5185 to 3.55, *Haüy.*—3.51 to 3.53, *Brongniart.*—3.488, *Lowry.*—3.4, 3.6, *Mohs.*

Constituent Parts.

Boetius de Boot, in his History of Gems, published in 1609, conjectured that the diamond was an inflammable substance. In 1673, Boyle discovered, that when exposed to

* It is remarked, that the greater number of diamonds with curved faces, have a dull surface.

to a high temperature, part of it was dissipated in acrid vapours. In 1694 and 1695, experiments were made in the presence of the Grand Duke of Tuscany, which confirmed those of Mr Boyle, and shewed that the diamond, although the hardest of minerals, agrees with combustible bodies, in being combustible. In 1704, Sir Isaac Newton, in his great work on Optics, hinted, that from its very great refracting power, it might be an unctuous substance coagulated *.

Since that period, the diamond has been very often examined by chemists, and they find, that when heated to the temperature of 14° of Wedgwood's pyrometer, or not so high as the melting point of silver, it gradually dissipates and burns, and combines with nearly the same quantity of oxygen, and forms the same proportion of carbonic acid, as charcoal. Hence it consists principally of carbon.

Physical Characters.

When rubbed, whether rough or polished, it shews positive electricity; whereas quartz, and the other precious stones, if rough, afford negative electricity, but when polished, positive electricity. In general, it does not retain this electricity above half an hour. It becomes phosphorescent when exposed to the rays of the sun. Many diamonds, however, do not become phosphorescent, although agreeing in colour, form, and transparency, with those which readily become luminous. The continuance of the phosphorescence varies from five or six seconds to a full hour, and this even when the stone has not been

* Newton does not appear to have been acquainted with the experiments made in Tuscany: and, besides, a considerable part of his work on Optics was written in 1675.

been exposed more than a few seconds to the rays of the sun. It is phosphorescent under water as well as in the air. The phosphoreal light is shining and firey, not shining white like that exhibited by calcareous-spar. Diamond exposed to the blue rays of the prism, remains phosphorescent for fifteen minutes; but when exposed to the red rays, is not phosphorescent. The spark from a charged jar produced the same effect as exposure to the sun's rays. Exposure to the light of a wax-candle also produced phosphorescence; but the light even of the full moon occasioned no phosphorescence. The remarkable facts in regard to the phosphorescence of the diamond, are then as follows: 1. The striking phosphorescent property of some, and the total want of it in other diamonds. 2. The efficacy of the blue rays, and the inefficacy of the red rays. 3. The perfect agreement in external aspect of phosphoric and non-phosphoric diamonds. It is remarked by Grossier, that sometimes a diamond which does not become phosphorescent by the simple action of the solar rays, may be made so, by previously immersing it for some time in melted borax.—*Grossier*, Journ. de Physique, vol. xx. p. 270.

Since the time of Sir Isaac Newton, the diamond has been supposed to exceed every other body in its power of refracting and reflecting light, the index of refraction, according to that philosopher, being about 2.439. Dr Brewster, however, has found, that both red lead-ore and orpiment exceed the diamond in their action upon light. Owing to the great quantity of light which it reflects at both surfaces, the diamond is never completely transparent; and in consequence of its high refractive power, it reflects all the light that is incident upon its posterior surface at an angle of incidence exceeding 24° 13′, from which cause it derives that high lustre to which it owes its value as an ornament. The diamond has always been considered as a crystal

crystal which gives single refraction; and in whatever way the diamond is cut, it exhibits no direct marks of two images. Dr Brewster, however, has found, that it possesses the property of depolarising light; and it necessarily follows, from his theory of depolarisation, that like many other bodies, it actually forms two images, which are polarised in an opposite manner, like those of all doubly refracting crystals; but in consequence of its possessing only one refracting power, these images can never be separated and rendered visible. The diamond polarises light by reflection at an angle of 68° 10′ according to experiment, and at angles of 68° 2′ according to theory; and its dispersive power is 0.038, nearly the same as oil of olives, and very much below flint glass.

Geognostic Situation.

It occurs in imbedded grains and crystals, in a sandstone named in Brazil *cascalho*, which rests on chlorite and clay-slate. The sandstone often contains grains of gold, and has occasionally a ferruginous basis. In some districts in India, in mining for this gem, they first pass through a bed of hornstone (claystone?), containing balls of hornstone and jasper; next through a ferruginous sandstone, which leads to the *diamond bed*, or rock, containing grains and crystals of diamond, and which appears to be a secondary or flœtz-trap rock. In other places, immediately below the soil, are beds of red or bluish-black clay, underneath which is the *diamond bed*, consisting of clay with rolled masses of different kinds; and, lastly, many undoubted alluvial tracts in Brazil and India are celebrated for the diamonds they afford. In Brazil, the gravel consists principally of quartz, mixed with oxide of iron, and containing, besides the diamonds, blue, yellow, and white topazes, and grains of gold.

Geographic

Geographic Situation.

Asia.—The diamond was first found in this quarter of the globe, and is still collected there, although not in such quantity as formerly. It occurs in the central and southern parts of India: the peninsula of Malacca, and the island of Borneo.

America.—Diamonds were first found in America in the district of Cerro do Frio in Brazil, towards the beginning of the last century.

Lord Anson, who performed his voyage round the world in the years 1740–1–2–3 and 4, gives the following account of its first discovery: "I have already mentioned, that besides gold, this country does likewise produce diamonds. The discovery of these valuable stones is much more recent than that of gold, it being as yet scarce twenty years since the first were brought to Europe. They are found in the same manner as the gold, in the gullies of torrents, and beds of rivers; but only in particular places, and not so universally spread through the country. They were often found in washing the gold, before they were known to be diamonds, and were consequently thrown away with the sand and gravel separated from it. And it is very well remembered, that numbers of very large stones, which would have made the fortunes of the possessors, have passed unregarded through the hands of those, who now with impatience support the mortifying reflection. However, about twenty years since, a person acquainted with the appearance of rough diamonds, conceived that these pebbles, as they were then esteemed, were of the same kind: But it is said, that there was a considerable interval between the first starting this opinion, and the confirmation of it by proper trials and examination,

tion, it proving difficult to persuade the inhabitants, that what they had been long accustomed to despise, could be of the importance represented by this discovery; and I have been informed, that in this interval, the governor of one of these places procured a good number of these stones, which he pretended to make use of at cards, to mark with instead of counters. But it was at last confirmed by skilful jewellers in Europe, consulted on this occasion, that the stones thus found in Brazil were truly diamonds, many of which were not inferior, either in lustre or any other quality, to those of the East Indies *."

But Cerro do Frio is not the only district in Brazil where this gem is found; it is also collected in the provinces of Goyaz, Matto Grosso, and Saint Paul.

Diamond Mines.

Brazil.—In Brazil, the usual method of searching for diamonds, is to collect the disintegrated sandstone met with at the bottoms of rivers and of ravines, and, by washing, to separate the clayey matter from the grains of quartz and diamond. The residue is carefully examined for the diamonds it may contain, which are distinguished by their adamantine lustre, and regular forms †.

Hindostan.—In the district of *Cuddapah*, the mode of working the diamond mine is as follows. After all the superincumbent beds, and the large stones in the diamond bed, are removed out of the mine, the small gravel and other constituents of the bed are carried

* Anson's Voyages, 4to, p. 51.

† Mineralogische nachrichten aus Brazilien mitgetheilt von dem H. Ingenieur-Oberstlieutenant von Eschwege.—Von Moll's Neue Jahrbucher der Berg und Hüttenkunde, 3ter Band, 3te Lief, s. 321, &c.—Mawe's Treatise on Diamonds.

ried to a small distance, and put into a cistern, about eight feet square, and three deep. In this situation, water is poured upon it, which separates the lighter loamy particles. The gravel and small stones which sink to the bottom, are then thrown into a heap beside the cistern, from which they are conveyed to a smooth plane of about twenty feet square, made of hardened clay. Upon this the whole is thinly spread. The gravel in this position being slightly moistened, six or seven people go over it several times in succession. The first time, they pick out only the large stones; the second and subsequent times, the smaller gravel is carefully turned over with the flat of the hand, whilst they as carefully watch for the spark from the diamond, which invariably strikes the eye.

At *Banaganpilly*, the Diamond Mines, as they are called, are scarcely any thing but deep holes, open at top; sometimes, indeed, the work is carried on for some extent under the rock, which is then supported by stone pillars. None are deeper than twenty feet. The gallery under the rock is so low, that the people are obliged to work in it sitting, a mode of working which an Indian prefers to every other. The solid rock of the hills, (which by the bye is not destitute of diamonds), is an aggregate consisting chiefly of a coarse grey hornstone, with rounded pebbles of the same species, or of jasper. At some depth this rock becomes a ferruginous sandstone, the grains of which are finely cemented together. Through this solid rock they are obliged to make their way before they arrive at the bed in which the diamonds are usually found. They commence at different places, as their fancy leads them, with a spot about twenty feet square, which by iron instruments and steel wedges, they break into slabs and fragments of from one hundred to five hundred pounds weight. In this way they sink to the diamond

diamond bed, which is fifteen or twenty feet under the surface; this bed extends round the whole hill, and is as regular in its thickness and extent as the other unproductive beds in the same place: it consists of a conglomerate, composed of rounded siliceous pebbles, quartz, calcedony, and jasper. The cement appears to be of the nature of clay or wacke, and is small in quantity: thus it appears that the diamond bed is of the same nature with the rocks both above and below it, but it is distinguished from them by its superior hardness. This bed is seldom more than a foot in thickness; and is intimately connected with the beds both above and below it, and frequently differs from them in nothing but the greater quantity of pebbles which it contains.

It appears from this description, that the diamond bed here is a solid rock, whereas at Cuddapah and other places it is in a state of gravel.

The mass containing the supposed diamonds is carefully cleared from the portions of the roof, and floor of the mine, that may be adhering to it: it is then carried to another spot of ground, where it is broken into pieces, and gradually reduced by means of iron instruments to the size of very small gravel. The process followed for separating the diamonds from the rubbish is almost the same as that observed in other places.

At *Ovalumpilly* the diamond bed is found under a bed of red clay, about three feet thick *.

Uses.

* The above descriptions are from *Heyne's Tracts on India*, a work which contains an account of the Diamond Mines in the Peninsula of India.—Mawe's Treatise on Diamonds may be consulted for information in regard to the diamond mines in Brazil.

Uses.

The diamond, on account of the splendour of its lustre, its peculiar play of colour, its hardness, and lastly, its rarity, is considered as the most precious substance in the mineral kingdom, and is particularly valued by jewellers. The diamonds purchased by jewellers are generally in grains or crystals, and sometimes coarsely polished.

It is also used by lapidaries for cutting and engraving upon harder gems; by watchmakers in their finer kinds of work; and by glaziers for cutting glass. The diamonds chosen for cutting glass are all crystallized. The faces are curved, and hence the meeting of any two of them presents a curvilinear edge. If the diamond be so placed that the line of the intended cut is a tangent to this edge near its extremity, and if the two surfaces of the diamond, laterally adjacent, be equally inclined to the surface of the glass, then the conditions necessary for effecting the cut are complied with. A simple fissure is effected, which need not be more than $\frac{1}{200}$th of an inch in depth. When a force is applied to one end of this fissure, a crack extends itself almost certainly in the direction of the fissure. Dr Wollaston, to whom we are indebted for the preceding observations, found that other bodies, as sapphire and spinel, when ground into the same curved surfaces as the diamond, would also cut glass; but the edges very speedily lost the requisite shape *.

1. *Art*

* Wollaston, Philosophical Transactions of the Royal Society of London for 1816.

1. *Art of Cutting and Polishing Diamonds.*

The ancients were unacquainted with the art of cutting the diamond, and hence they used it in its natural granular or crystallised state *. Even in the middle ages, this art still remained unknown; for the four large diamonds that ornament the clasp of the imperial mantle of Charlemagne, and which is still preserved in Paris, are uncut octahedral crystals.

The art of cutting and polishing diamonds was probably known to the artists of Hindostan and China at a very early period. European artists, until the fifteenth century, were of opinion that it was impossible to cut the diamond. Robert de Berghen relates, that Louis Berghen, a native of Bruges, in the year 1456, endeavoured to polish two diamonds, by rubbing them against each other: he found that by this means a facet was produced on the surface of the diamonds; and in consequence of this hint, constructed a polishing wheel, on which, by means of diamond powder, he was enabled to cut and polish this substance, in the same way as other gems are wrought by emery. James of Trezzo appears to have been one of the first artists who cut figures on the diamond itself. Clement of Biragues, in the year 1564, cut figures on the diamond; and even so early as the year 1500, Charadossa cut the figure of one of the Fathers of the Church on a diamond for Pope Julius II. The artists

* Some antiquaries pretend, that the ancients cut figures on the diamond itself. Govi, for example, cites an antique head of this kind, in the possession of the Duke of Bedford. Lessing, a very acute and skilful antiquary, is of opinion, that these pretended antique cut diamonds are amethysts or sapphires.

tists Natter and Costanzi were also famous for cutting figures on the diamond.

This art has been gradually improved, particularly by the Dutch and British jewellers. For a long time all the finest diamonds were sent to Holland to be cut and polished, owing to the real or fancied superiority of the Dutch artists. Now the diamond cutters in London are considered as equal to any in the world; and we no longer hear of this gem being sent abroad to be cut by foreign artists, on account of any want of skill in our workmen.

The cutting and polishing of the diamond is effected in the following manner: If the rough diamond has rents or flaws which must be removed, or if the figure is such that it must be altered before it is regularly cut, we either split or saw off the part or parts. The splitting is effected by the blow of a hammer on a small chissel, placed in the direction of the folia or cleavage of the diamond. The sawing is effected by means of an iron wire attached to a bow; the wire is covered with diamond powder, and drawn backwards and forwards, until the portion is cut off. This, however, is a very tedious process, as the wire is generally cut through after having been drawn across the diamond five or six times, and thus requires very frequent renewal. When the diamond is in this way freed from its flaws, and reduced to the proper shape, it is next imbedded in a strong cement of brick-dust and white pitch, fixed at the end of a spindle-shaped stick about a foot long, with that portion only projecting, the removal of which is to form the facet. The facet is formed by the friction of another diamond fixed in a stick in a similar manner to the former, with one of the angles projecting. In order to collect the powder and splinters that are detached during the process, the cutting is performed over a strong box, four or five inches

inches square, furnished with a false bottom, perforated with excessively minute holes, in order to sift as it were the dust from the splinters; and also with two upright iron pegs fixed on the sides for the workmen to support and steady his fingers against, while, with a sharp repeated stroke, somewhat between scratching and cutting, he is wearing away the diamond on that part where the facet is to be made. This being done, the cement is softened by warming it, and the position of the diamond is changed, in order to bring a fresh part under the action of the cutting diamond. When, in this manner, all the facets have been cut upon the surface of the diamond, the cutting is completed. The next object is to polish the facets, and, at the same time, to remove any little inequalities that may have taken place in the cutting. The polishing mill is very simple. It consists of a circular horizontal plate of cast iron, 14 or 15 inches in diameter, (called a *skive*), suspended on a spindle, and put in motion by means of a wheel 5 or 6 feet in diameter, and turned by an assistant. From the centre to the circumference of the iron plate, are shallow grooves, formed by rubbing it in that direction with a fine-grained sandstone; these grooves serve to retain the mixture of oil and diamond-powder with which the plate is charged. In order to keep the diamond perfectly steady while the polishing of each facet is going on, the following contrivance is had recourse to. A copper cup, about three quarters of an inch in depth and width, and furnished with a stem about four inches long of thick copper wire, is filled with plumbers' solder, which also projects in a conical form beyond the rim of the cup; in the apex of this cone, the solder being softened by heat, the diamond is imbedded with one of the facets projecting. The stem of the cup is now put into very powerful pin-

 cers,

cers, which screw up with a nut and a wrench, and thus hold it perfectly tight. The handles of the pincers are of wood, are broad, and terminated by two feet about an inch high. In this position the diamond is placed on the plate, the pincers resting on their legs on the wooden bench or table that supports the plate, and pressing at the same time against an upright iron peg; the broad part of the pincers between the legs and the diamond is then loaded with weights, both to steady the machine and to increase the pressure of the diamond against the skive. A little oil and diamond-powder is now dropped on the plate; it is set in motion at the rate of about 200 revolutions in a minute, and the grinding and polishing processes now begin. The diamond is examined from time to time, and is adjusted so as to give the facet its true form. The heat occasioned by the friction is at all times considerable, and sometimes increases to such a degree as to soften the solder, and displace the diamond. This accident sometimes occasions a flaw in the diamond, and always damages the skive, by tearing up its surface. There is room in the skive for three or four diamonds, and a skilful operator can undertake the polishing of all of them at the same time. The completion of a single facet often occupies some hours.

2. Different forms into which the Diamond is cut.

Diamonds are cut and manufactured by jewellers into *brilliant*, *rose*, and *table* diamonds. To fashion a rough diamond into a brilliant, the first step is to modify the faces of the original octahedron, so that the plane formed by the junction of the two pyramids shall be an exact square, and the axis of the crystal precisely twice the length of one of the sides of the square. The octahedron being thus rectified, a section is to be made parallel to the common base,

or

or girdle, so as to cut off $\frac{5}{18}$ths of the whole height from the upper pyramid, and $\frac{1}{18}$th from the lower. The superior and larger plane thus produced is called the *table*, and the inferior and smaller one is named the *collet;* in this state it is called a *complete square table diamond*. To convert it into a brilliant, two triangular facets are placed on each side of the table, thus changing it from a square into an octagon; a lozenge-shaped facet is also placed at each of the four corners of the table, and another lozenge extending lengthwise along the whole of each side of the original square of the table, which, with two triangular facets, set on the base of each lozenge, complete the whole number of facets on the table side of the diamond, viz. eight lozenges, and twenty-four triangles. On the collet side are formed four irregular pentagons, alternating with as many irregular lozenges, radiating from the collet as a centre, and bordered by sixteen triangular facets adjoining to the girdle. The brilliant being thus completed, is set with the table side upwards, and the collet side implanted in the cavity made to receive the diamond. Such is the method recommended by Mr Jeffries for cutting the brilliant diamond, and which ought to be attended to, if we are desirous that the diamond should display its highest degree of lustre and play of colour; but Mr Mawe remarks, " that so great a stress is laid by modern fashion on the superficial extent of a brilliant, that the rules just given are not much attended to; and, in forming the facets, artists trust principally to an accurate and well practised eye *."

The *regular rose diamond* is that form given to those stones, the spread of which is too great in proportion to their depth, to admit of being brilliant cut, without a great

* The brilliant form was invented in England.

loss of substance. It is formed by inscribing a regular octagon in the centre of the table side of the stone, and bordering it by eight right-angled triangles, the bases of which correspond with the sides of the octagon; beyond these is a chain of eight trapeziums, and another of sixteen triangles. The collet side also consists of a minute central octagon, from every angle of which proceeds a ray to the edge of the girdle, forming the whole surface into eight trapeziums, each of which is again subdivided by a salient angle (the apex of which touches the girdle,) into one irregular pentagon, and two triangles *.

The *table diamond* is the least beautiful mode of cutting, and is used only for those stones, or rather fragments, which, with a considerable breadth, have only a very trifling depth.

3. *Valuing Diamonds.*

In valuing diamonds, we have to attend to their *weight*, their *form* when cut, *colour*, *transparency*, *purity*, or *freedom from flaws, veins and stains*, the *regularity of the cleavage*, *proportion of the parts*; and, lastly, *the setting on of the facets*.

a. *Weight and Form.*—In the cutting either of a brilliant or a rose diamond, of regular proportions, so much is cut away, that the weight of the polished gem is not more than half that of the rough crystal out of which it was formed; whence the value of a cut diamond is esteemed equal to that of a similar rough diamond of twice its weight, exclusive of the price of workmanship. The weight and consequently the value, of diamonds, is estimated in *carats*, one of which is equal to four grains, and the difference

* The finest rose cut diamonds were formerly manufactured in Holland. More than 300 years ago, this mode of cutting was known and practised at Antwerp.

difference between the price of the one diamond and another, *cæteris paribus*, is as the square of the respective weights. Thus the value of three diamonds, of one, two, and three carats weight, is as one, four and nine. The average price of rough diamonds that are worth working, is about L. 2 for the first carat; and consequently in wrought diamonds, exclusive of the cost of workmanship, the cost of the first carat is L. 8. In other words, in order to ascertain the value of a wrought diamond, ascertain its weight in carats, and fractions of a carat, multiply this by two, then multiply this product into itself, and finally multiply this latter sum by L. 2. Hence a wrought diamond of

1	carat is worth	- -	£ 8
2	carats..........	- -	32
3	....	- -	72
4	....	- -	128
5	....	- -	200
6	....	- -	288
7	....	- -	392
8	....	- -	512
9	....	- -	612
10	....	- -	800
20	....	- -	3,200
30	....	- -	7,200
40	....	- -	12,000
50	....	- -	20,000
60	....	- -	28,800
70	....	- -	39,200
80	....	- -	51,200
90	....	- -	64,800
100	....	- -	80,000

This rule, however, actually holds good only in the smaller diamonds of 20 carats and under; the larger ones, in consequence of the scarcity of purchasers, being disposed of at prices greatly inferior to their estimated worth. The value of some of the most perfect diamonds exceeds that given in the table; but for a stone that is flawed, cloudy, or of a bad colour, sometimes three quarters of the whole value may be deducted.

b. *Colour.*—The most frequent colours of the diamond, as already mentioned, are the white and grey, and of these the most highly prized by the jeweller is the snow white. The brown varieties are of inferior value, and the yellow diamond, which is not uncommon, is only esteemed of equal value with the snow white variety when the colour is deep and pure. The other varieties of colour occur but rarely, and are viewed as objects of curiosity to the collector rather than as generally interesting to the jeweller. Thus a rose diamond is more valuable than a snow white diamond of equal weight, owing to the great beauty of its colour, and its rarity; the green diamond is much esteemed on account of its colour, but the blue diamond is only prized for its rarity, as the colour is seldom pure. The black diamond, which is uncommonly rare, but destitute of beauty, is very highly prized by collectors *.

c. *Transparency.*—A good diamond must be nearly completely transparent. If semitransparent, it is of little value.

* Mr Milburn has the following observations on the colour of rough diamonds, which are deserving the attention of the diamond merchant. "The colour should be perfectly crystalline, resembling a drop of clear spring water, in the middle of which you will perceive a strong light, playing with a

value. Transparency and purity comprehend what is called the *water* of the diamond by jewellers. If the gem is transparent and quite pure, it is said to be of the first water; if less transparent and pure, of the second, or of the third water.

d. *Freedom from flaws, veins and stains.*—Diamonds in a state of nature are sometimes rent in different directions; these rents are either confined to the surface or central parts of the stone, or traverse its whole mass. When the rents

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a great deal of spirit. If the coat be smooth and bright, with a little tincture of green in it, it is not the worse, and seldom proves bad; but if there is a mixture of yellow with green, then beware of it,—it is a soft greasy stone, and will prove bad.

If the stone has a rough coat, so that you can hardly see through it, and the coat be white and look as if it were rough by art, and clear of flaws or veins, and no blemish cast in the body of the stone, (which may be discovered by holding it against the light), the stone will prove good.

It often happens, that a stone will appear of a reddish hue on the outward coat, not unlike the colour of rusty iron; yet by looking through it against the light, you may observe the heart of the stone to be white, (and if there be any black spots or flaws, or veins in it, they may be discovered by a true eye, although the coat of the stone be the same,) and such stones are generally good and clear.

If a diamond appears of a greenish bright coat, resembling a piece of green glass, inclining to black, it generally proves hard, and seldom bad; such stones have been known to have been of the first water, and seldom worse than the second; but if any tincture of yellow seem to be mixed with it, you may depend upon its being a very bad stone.

All stones of a milky coat, whether the coat be bright or dull, if never so little inclining to a bluish cast, are naturally soft, and in danger of being flawed in the cutting; and though they should have the good fortune to escape, yet they will prove dead and milky, and turn to no account.

All diamonds of a cinnamon colour are dubious; but if of a bright coat, mixed with a little green, then they are certainly bad, and are accounted amongst the worst of colours.

You will meet with a great many diamonds of a rough cinnamon coloured coat, opaque; this sort is generally very hard, and when cut, contains a great deal of life and spirit; but the colour is very uncretain: it is sometimes white, sometimes brown, and sometimes of a fine yellow."

rents traverse the whole mass of the stone, or traverse its interior, the value of the diamond is diminished one half. If the rents are superficial, the value of the stone is not very greatly diminished. It requires a very experienced eye to distinguish these different kinds of rents.

Rough diamonds are frequently *beamy*, that is, look fair to the eye, yet are so full of veins to the centre that no art or labour can polish them. Mr Milburn, in his valuable work on *Oriental Commerce*, vol. ii. p. 80. gives the following account of *beamy* diamonds. "The veins run through several parts of the stone, and sometimes through all; and when they appear on the outside, they shew themselves like protuberant excrescences, from whence run innumerable small veins, obliquely crossing one another, and shooting into the body of the stone. The stone itself will have a bright and shining coat, and the veins will look like very small veins of polished steel rising upon the surface of the stone. This sort of stone will bear no polishing, and is scarcely worth a rupee per mangalin. Sometimes the knot of the veins will be in the centre, the fibres will shoot outward, and the small ends terminate in the coat of the diamond. This is more difficult to discover, and must be examined by a nice eye; yet you may be able here and there to observe a small protuberance, like the point of a needle, lifting up a part of the coat of the stone; and though by a great deal of labour it should be polished, it will be a great charge, and scarcely pay for the cutting, and is therefore to be esteemed as little better than the former. But if you are not very careful, they will throw one of these stones into a parcel, and oftentimes the largest."

A good diamond should never contain small spots of a white or grey colour of a nebulous form; it should be free of small reddish and brownish grains, that sometimes occur on their surface, or in their interior.

e. *Regularity*

e. *Regularity of the cleavage.*—A good diamond should split readily in the direction of the cleavage; it sometimes happens, however, that the folia are curved, as is the case in twin-crystals. When this is the case, the stone does not readily cut and polish, and is therefore of inferior value.

f. *Proportion of parts.*—In the cut and polished gem, the thickness must always bear a certain proportion to the breadth. It must not be too thin nor too thick; when too thin it loses much of its fire, and appears not unlike glass.

g. *The setting on of the facets.*—If these are not properly disposed, the diamond loses much of its fire, and its value is thereby diminished.

4. *Diamond Trade.*

The only diamond districts at present known, are those of India, Borneo, and Brazil. In the earlier ages, all the diamonds of commerce were obtained from India, but now the diamond mines of that country have become comparatively inconsiderable; several of them have been abandoned, and scarcely any of the rest contribute to the supply of the European market. Borneo furnishes annually a small quantity. The diamonds of the East are imported into Europe, in their rough state, in small parcels, called *bulses*, neatly secured in linen, and sealed by the merchant, and are generally sold in Europe by the invoice, that is, are bought before they are opened, it being always found they contain the value for which they were sold in India, and the purchaser gives the importer such an advance on the invoice as the state of the market warrants. The bulse contains stones of various shapes and sizes. They may be imported duty free, saving the duty granted to the East India Company on diamonds imported from any place within the limits of their charter.

Brazil.

Brazil affords more diamonds than India and Borneo, and it is said that nearly all the diamonds in the European market are obtained from that country. The diamond mines of Brazil belong either to the crown or to the Prince Regent. The trade in this gem, except through the medium of the government agents, is considered as contraband. Notwithstanding the severe penalties against this contraband trade, many diamonds are disposed of by private adventurers. The government diamonds, however, form the chief part of the trade. These are the produce of the different royal mines in the interior of Brazil; whence they are sent to the seat of government at Rio de Janeiro. The Prince Regent there selects from the whole such specimens as he chooses to add to his own magnificent collection, and the remainder are consigned to the Portuguese ambassador for the time resident in England, by whom they are deposited in the Bank for sale.

This branch of trade was, at one period, almost monopolized by the Dutch. The consul for Holland possessed an exclusive contract in Brazil for all the diamonds that were brought to the market in that country, whilst in India their agents were very active in securing all that were offered for sale. The trade is now divided between the English and Portuguese. The demand for diamonds of a moderate size is, at present, very great; and it would appear that the price of this gem has been gradually rising for several years. The sale of the larger diamonds has been very dull for many years past.

5. *Account of some large Diamonds.*

We shall conclude our history of the diamond, with a short account of some of the largest diamonds hitherto discovered.

a. Authors mention a diamond weighing 1680 carats, in the possession of the royal family of Portugal, which was

was found in Brazil, and is still uncut. This gem, if valued according to the rule already mentioned, should be worth L. 5,644,870 Sterling. It is now, however, generally believed to be a fine white-coloured topaz.

b. One of the largest undoubted diamonds, is that mentioned by Tavernier, formerly in the possession of the Great Mogul, and which that traveller found to weigh $279\frac{9}{10}$ carats. It is the size of a hen's egg, of the same shape, and is cut in the rose form. Before cutting it weighed 900 carats. It was found in the mine of Colore, to the east of Golconda, about the year 1550.

c. A very large diamond is said to be in the possession of the Rajah of Mattan, in Borneo, in which island it was found about eighty years ago. It is egg-shaped, with an indented hollow near the smaller end. It is said to be of the finest water. It weighs 367 carats. Now, as 156 carats are equal to 1 ounce Troy, it is obvious that this diamond weighs 2 ounces 169.87 gr. Troy. Many years ago, the Governor of Borneo attempted to purchase this diamond. He sent a Mr Stewart to the Rajah, who offered 150,000 dollars, two large war-brigs, with their guns and ammunition, together with a certain number of great guns, and a quantity of powder and shot. The Rajah, however, refused to deprive his family of so valuable a hereditary possession, to which the Malays attach the miraculous power of curing all kinds of diseases, by means of the water in which it is dipped, and with which they imagine that the fortune of the family is connected.

d. The magnificent diamond on the top of the sceptre of the Emperor of Russia, deserves next to be noticed. It is perfectly pure; weighs 195 carats; and is the size of a pigeon's egg. It was one of the eyes of a Brahminical idol, and was stolen by a French grenadier, who disposed of of it at a very low price; and, lastly, after passing through three other hands, it was offered for sale to the Empress Catharine of Russia, who purchased it for about L. 90,000 ready money, and an annuity of about L. 4000 more.

e. The diamond of the late Grand Duke of Tuscany, now in Vienna, is of a pale lemon-yellow colour, but beautifully formed, and weighs 139½ carats.

f. The Pitt or Regent diamond. It is cut in the brilliant form, and is said to be the most beautiful diamond hitherto found. It weighs 136¾ carats, and was purchased for L. 130,000, although it is now valued at double that sum. It was brought from India by an English gentleman of the name of Pitt, and was sold by him to the Regent Duke of Orleans, by whom it was placed among the crown jewels of France. It is now set in the handle of the sword of state of the King of France.

g. The finest collections of crystallized diamonds in Europe are those in London, and of these the most complete are in the British Museum, and in the cabinets of Sir Abraham Hume and Mr Lowry. Mr Joseph Marryat *junior*, and two other collectors, possess diamonds of great value. On the Continent, the collection of Werner is the most perfect.

Genus II.

Genus II.—ZIRCON.

This genus contains but one species, viz. Pyramidal Zircon.

Pyramidal Zircon.

Pyramidaler Zircon, *Mohs.*

This species is divided into two subspecies, Common Zircon, and Hyacinth.

First Subspecies.

Common Zircon *.

Zirkon, *Werner.*

Topazius clarus hyalinus jargon, *Wall.* t. i. p. 252.—Jargon de Ceylan, *Romé de Lisle,* t. ii. p. 229. *Id. Born.* t. i. p. 77.—Zirkon, *Wid.* s. 233. *Id. Kirwan,* vol. i. p. 257. *Id. Estner,* b. ii. s. 35. *Id. Emm.* b. i. s. 3.—Giargone, *Nap.* p. 105.—Zircon, *Lam.* t. ii. p. 204. *Id. Broch.* t. i. p. 159. *Id. Haüy,* t. ii. p. 465.—Gemeiner Zirkon, *Reuss,* b. i. s. 56.—Zircon, *Lud.* b. i. s. 58. *Id. Suck.* 1r th. s. 166. *Id. Bert.* s. 304. *Id. Mohs,* b. i. s. 16. *Id. Lucas,* p. 89.—Gemeiner Zircon, *Hab.* s. 1.—Zircon Jargon, *Brong.* t. i. p. 269.—Zircon, *Kid,* vol. i. p. 125. *Id. Brard.* p. 106. *Id. Steffens,* b. i. s. 7.—Zircon, joints naturels peu sensibles; formes relatives à la varieté prismée, *Haüy,* Tabl. p. 28.—Zircon, *Hoff.* b. i. s. 396. Muschlecher Zircon, *Haus.* Handb. b. ii. s. 618.—Jargoon, *Aikin,* p. 184.

External Characters.

The principal colour is grey: it also occurs white, green, and

* The word Zircon, is by some authors considered to be of Indian origin: others derive it from the French word *jargon,* which was applied to all those gems, which, on being cut and polished, had somewhat of the appearance of diamond.

and brown; and rarely yellow, blue, and red. White and brown are the extremes of its colour-suite, and the intermediate colours are grey, yellow, green, blue, and red. It never occurs hyacinth-red or orange-yellow.

The colours are generally pale, seldom dark, and often muddy.

It occurs in angular, or roundish original grains; and crystallized in the following figures:

1. Rectangular four-sided prism, rather flatly acuminated on the extremities with four planes, which are set on the lateral planes under equal angles *, fig. 3. This is the fundamental figure †.
2. The fundamental figure truncated on the lateral edges.
3. The fundamental figure bevelled on the angles between the acumination and the prism, and the bevelling planes set on the edges between the acumination and the prism ‡, fig. 4. When these bevelling planes become larger, so that they meet and intersect each other, there is formed
4. A four-sided prism, acutely acuminated on the extremities by eight planes, of which two and two meet under very obtuse angles, and are set on the lateral planes of the prism. This acumination is frequently rather flatly acuminated by four planes,

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* Zircon prismé, Haüy.

† The primitive form of Zircon, according to Haüy, is composed of two four-sided pyramids, applied base to base, whose sides are isosceles triangles. The inclination of the sides of the same pyramid to each other, is 124° 12′: the inclination of the sides of the one pyramid to those of another, 82° 50′; the angle of the summit is 73° 44′. Mohs states the two first at 123° 19′ and 84° 20′. Mr Phillips gives the same measurement.

‡ Zircon plagiedre, Haüy.

planes, which are set on the obtuse edges of the first acumination.

5. N° 3. in which the edges between the acumination and the prism are truncated *, fig. 5.
6. When the prism of N° 1. disappears, there is formed a double four-sided pyramid.

The crystals are generally small and very small, seldom middle-sized, and occur loose or imbedded.

The surface of the crystals is sometimes rough, sometimes smooth, and that of the grains is uneven.

The surface of the grains is glistening, that of the crystals shining.

Internally it is splendent, passing into shining, and the lustre is intermediate between adamantine and resinous, but rather more inclined to the first.

The cleavage is fourfold, and the folia in the direction of the planes of a four-sided pyramid of 123° 19′ and 84° 20′. The cleavage is sometimes visible only in the direction of the extremities of a prism; but is not so perfect as in hyacinth.

The fracture is perfect and flat conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates from transparent to opaque.

It refracts double in a high degree.

It is harder than quartz, but softer than topaz.

It is rather easily frangible.

Specific gravity, 4.557, to 4.721, *Lowry*.

Chemical

* Zircon soustractif, Haüy.

Chemical Character.

It is infusible, without addition, before the blowpipe.

Constituent Parts.

	Zircon of Ceylon.	Zircon of Norway.
Zirconia, -	69.00	63
Silica, -	26.50	33
Oxide of Iron, -	0.50	1
	96.00	99
	Klaproth, Beit. b. i. s. 222.	Id. *Klaproth*, b. iii. s. 271.

The Geognostic and Geographic Situations are the same with those of the second subspecies.

Observations.

1. This species is characterised by its colour-suite, the principal members of which are grey, green, and brown, generally of a muddy aspect; its suite of crystals, adamantine lustre, flat conchoidal fracture, considerable hardness, and weight.

2. It is distinguished from *Hyacinth* by colour, crystallization, kind of lustre, and perfect conchoidal fracture: from *Diamond*, by its crystallization, greater weight, inferior hardness, conchoidal fracture, and its grey muddy colours: from *Spinel*, by form, lustre, fracture, inferior hardness, and greater weight: from *Topaz*, by its crystallization, smooth lateral planes, kind of lustre, fracture, inferior hardness, and greater weight: from *Vesuvian*, by lustre, perfect acumination, strong double refracting power, greater hardness and weight: from *Chrysolite*, by crystallization, lustre, greater hardness, and weight; and from

from all other cut and polished *gems*, by its exhibiting a stronger double refracting power.

Second Subspecies.

Hyacinth *.

Hiacinth, *Werner.*

Topazius flavo-rubens, Hyacinthus, *Wall.* t. i. p. 252.—Hiacinth, *Wid.* s. 254. *Id. Kirw.* vol. i. p. 257. *Id. Estner,* b. ii. s. 141. *Id. Emm.* b. i. s. 205.—Giacinto, *Nap.* p. 109.—L'Hyacinthe, *Broch.* t. i. p. 163.—Hiacinth, *Reuss,* b. i. s. 62. *Id. Lud.* b. i. s. 59. *Id. Suck.* 1r th. s. 172. *Id. Bert.* s. 308. *Id. Mohs,* b. i. s. 23. *Id. Hab.* s. 2.—Zircon Hyacinthe, *Brong.* t. i. p. 270.—Hyacinth, *Kid,* vol. i. p. 126. *Id. Steffens,* b. i. s. 7.—Hyacinth-joints naturels plus apparens; formes relatives à la varieté dodecaedre, *Hauy,* Tabl. p. 29.—Hiacinth, *Hoff.* b. i. s. 407.—Blättricher Zircon, *Haus.* b. ii. s. 619.—Hyacinth, *Aikin,* p. 184.

External Characters.

The most frequent colours are red and brown, more rarely yellow, grey, and green; and the rarest is white. The principal colour is hyacinth-red, which passes on the one side into orange-yellow; on the other into reddish-brown, brownish-red, and flesh-red.

It occurs sometimes in angular grains; more frequently crystallized, in the following figures:

 1. Rectangular

* The Hyacinth of the ancients appears to have been either amethyst or sapphire. The name hyacinth, is derived from that of the plant denominated *hyacinthus* by the ancients, which is supposed to be the Hyacinthus orientalis *Lin.*

1. Rectangular four-sided prism, acuminated on both extremities by four planes, which are set on the lateral edges, Fig. 6. Pl. I.
2. The preceding crystal, slightly truncated on the lateral edges, Fig. 7. Pl. I.
3. N° 2. in which the edges between the lateral and acuminating planes are also truncated, Fig. 8. Pl. I.

The crystals are small and very small, seldom middle-sized. They are all around crystallized.

The surface of the crystals is smooth and splendent.

Internally it is specular-splendent, and the lustre is intermediate between resinous and vitreous.

The cleavage is the same as in common zircon, but more perfect.

The fracture is perfect, and small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates from transparent to semitransparent.

It refracts double.

It has the same degree of hardness as common zircon.

It is rather easily frangible.

Specific gravity, 4.545, 4.620, *Klaproth.* 4.525, 4.780, *Mohs.*

Chemical Characters.

Before the blowpipe it loses its colour, but not its transparency, and is infusible without addition.

Constituent

Constituent Parts.

	Hyacinth of Ceylon.	Hyacinth of Expailly.	
Zirconia,	70.00	64.00	66.00
Silica,	25.00	32.00	31.00
Oxide of Iron,	0.50	2.00	2.00
Loss,	4.50	1.50	1.00
	100.00	100	100
	Klaproth, Beit. b. i. s. 231.	*Vauquelin*, Jour. d. Mines, N. 26. p. 106.	

Observations.

1. It is characterised by its colour-suite, the central colour of which is hyacinth-red, its crystallizations, resinous lustre, distinct cleavage, and great specific gravity.

2. It is distinguished from *Common Zircon* by its colours, crystallization, smooth planes, external and internal lustre, distinct cleavage, and small conchoidal fracture: from *Precious Garnet*, by its crystallization, resinous lustre, distinct cleavage, greater weight and infusibility.

3. Common zircon has been frequently confounded with Sapphire, Hyacinth, and several other minerals, as appears from the following enumeration. 1. The oriental hyacinth of Romé de Lisle (t. ii. p. 282.) is orange-coloured sapphire. 2. The occidental hyacinth is yellow-coloured topaz (Dutens, *Des pierres prec.* p. 62.) 3. Cruciform hyacinth is cross-stone. 4. Brown volcanic hyacinth is vesuvian. 5. White hyacinth of Somma is meionite. 6. Hyacinth of Compostella is iron-shot quartz. 7. Hyacinth of Dissentis (Saussure, *Voyages dans les Alpes*, n. 1902.) is a variety of garnet.

Geognostic Situation of the Zircon Species, including Common Zircon and Hyacinth.

It occurs in grains and crystals, imbedded in gneiss and sienite; also imbedded in basalt and lava, and dispersed through alluvial soil, along with sapphire, spinel, ceylanite, pyrope, tourmaline, augite, olivine, iron-sand, iron-pyrites, and gold.

Geographic Situation of the Zircon Species, including Common Zircon and Hyacinth.

Europe.—It occurs in this quarter of the globe, not only loose in the sand of rivers, but also in its original repository. Thus it is associated with sapphire and iron-sand, in what is called *volcanic sand*, in the rivulet of Rioupezzouliou, near Expailly in Auvergne; and imbedded in basalt in the same country; also near to Pisa, and in the supposed volcanic sand of the Vicentine. In the vicinity of Trziblitz and Podsedlitz in Bohemia, it occurs in a clayey alluvial deposite, near rocks of the newest trap formation, along with pyrope, sapphire, and iron; also, in very small grains, in auriferous sand, in Silesia; and in the trap rocks around Lisbon, and in those of Spain.

It was first found in its original repository at Friedrickschwärn, in the district of Christiania in Norway, where it occurs in considerable abundance in sienite. Faujas St Fond found it imbedded in basalt near Expailly: Cordier in a similar rock in the mountain of Anise, also in Auvergne; and Weiss detected it imbedded in a volcanic scoria in the same country. In the year 1812, I found it imbedded in a rolled mass of sienite in the shire of Galloway.

Asia.

Asia.—In the island of Ceylon, where this mineral was first found, it occurs imbedded in gneiss along with sapphire, oriental ruby, and cinnamon-stone *; but is found most abundantly in the sand of rivers, along with spinel, sapphire, tourmaline, and iron-sand. It occurs in alluvial soil, in the district of Ellore in Hindostan; and it is mentioned by Reuss as a production of Asiatic Russia.

America.—A Spanish mineralogist, M. Henri Amana, presented Haüy with some small crystals of zircon, which had been collected in the province of Antioquia, in the kingdom of Santa Fe de Bogota: it is mentioned as a mineral of Brazil; it occurs in granite, two miles from Baltimore in Maryland; in gneiss near Trenton in New Jersey; in granite in Schooley's Mountain in New York; in quartz at Sharon in Connecticut †; and Sir Charles Giesecké discovered it at Portusok in the island of Kittiksut in South Greenland, imbedded in sienite, and associated with cerite.

Africa.—It is said to occur in Teneriffe.

Uses.

As common zircon is considered by jewellers one of the gems, it is frequently cut and polished, and used for ornamental purposes. The greyish-white and yellowish-white varieties are the most highly valued, on account of their resemblance to the diamond. The darker coloured varieties can be deprived of their colour by exposure to heat: hence artists generally employ this method, when they in-

* This interesting discovery was made by Dr Davy, who is now actively employed in the investigation of the natural history of Ceylon.

† Cleaveland's Mineralogy, p. 206, 207.

tend to employ zircon in place of diamond. Like the diamond, it is cut into the table, rose and brilliant forms, and is used for jewelling watches, ear-pendents, necklaces, and, on account of the intermixture of grey in the colour, it is particularly valued in some countries as an ornament in mourning-dress. When cut, it exhibits in a faint degree the play of colours of the diamond; and hence it is not unfrequently sold as an inferior kind of diamond. The hyacinth is also esteemed by jewellers, and, when pure, and of considerable size, is employed in various kinds of ornamental work. But it seldom occurs large, and in trade, other minerals, as cinnamon-stone, hyacinth-coloured garnets, and rock-crystals, are frequently substituted for it.

GENUS III.—CORUNDUM*.

THIS Genus contains three species, viz. Octahedral Corundum, Rhomboidal Corundum, and Prismatic Corundum.

1. Octahedral Corundum.

Octaedrischer Corund, *Mohs.*

This species is subdivided into three subspecies, viz. Automalite, Ceylanite, and Spinel.

First

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* *Corundum* is the Indian name for the coarser varieties of rhomboidal corundum: it was applied to the rhomboidal corundum by Count Bournon, and to the present genus by Mohs.

First Subspecies.

Automalite *.

Authomolite, *Werner.*

Automalit, *Eckeberg*, in N. Allgem. Journal der Chemie, 5. B. s. 422,—455.—Automalit, Corindon zincifere, Jour. de Phys. an 14, p. 270.—Automalit & Fahlunit, *Karst.* Tabel. p. 102. —Gahnite, *Von Moll.*—Spinelle zincifere, *Haüy*, Tabl. p. 67. —Automalith, *Steffens*, b. i. s. 32. *Id. Hoff.* b. i. s. 526.— Gahnit, *Haus.* Handb. b. ii. s. 364. *Id. Aikin*, p. 185.

External Characters.

Its colour is muddy duck-green, which inclines very much to mountain-green.

It has been hitherto found only crystallized, and in the following figures:

1. Perfect octahedron.
2. Octahedron, with alternate larger and smaller planes.
3. Tetrahedron, truncated on the angles.
4. Segment of the tetrahedron.
5. Two segments, N° 4. joined together, so that re-entering angles are formed on the three corners of the figure.

The crystals are small and middle-sized; all around crystallized, and the planes are smooth.

Externally it is glistening; and the lustre is pearly, inclining to semi-metallic. Internally it is shining on the principal fracture, but glistening on the cross fracture, and the lustre is resinous.

It has a fourfold cleavage, and the folia are parallel with the faces of an octahedron.

Fracture

* *Automalite* is derived from the Greek word ἀυτόμολος, and was given to this gem because it approaches to the metalliferous minerals by reason of its chemical composition, and thus deserts or denies its close affinity with the earthy minerals.

The fracture is flat conchoidal.

The fragments are splintery, or angular, and not very sharp-edged.

It is opaque, or faintly translucent on the edge.

It is so hard as to scratch quartz, but is scratched by spinel.

It is brittle.

It is rather easily frangible.

Specific gravity, 4.261, *Hisinger*. 4.297, *Hoffmann*. 4.696, *Haüy* *.

Chemical Character.

It is infusible before the blowpipe.

Constituent Parts.

Alumina,	60	42
Silica,	4	4
Oxide of Zinc,	24	28
Iron,	9	5
Sulphur,	0	17
Loss,	3	Undecomposed, 4
	100	100
	Eckeberg, J. de Phys. an 14, p. 270.	*Vauquelin*, Annales du Mus. t. vi. p. 33.

Geognostic and Geographic Situations.

It occurs imbedded in talc-slate, along with galena, and has been hitherto found only at Fahlun in Sweden.

Observations.

In its crystallizations it resembles both Ceylanite and Spinel: it is distinguished from the former by its more distinct green colour, foliated fracture, inferior hardness, superior

* The automalite sometimes contains disseminated galena, which may be the cause of the high specific gravity in the specimens examined by Haüy.

perior specific gravity, and chemical composition: from the latter by colour, inferior lustre, perfect cleavage, low degree of transparency, inferior hardness, greater specific gravity, and chemical composition.

Second Subspecies.

Ceylanite *.

Ceylanit, *Werner.*

Schorl ou Grenat brun, *Romé de Lisle,* t. iii. p. 180. Note 21.—Ceylanit, *La Metherie,* Journ. de Phys. 1793, p. 23.—Pleonaste, *Haüy,* t. iii. p. 17. *Id. Broch.* t. ii. p. 525.—Ceylanite, *Reuss,* b. ii. th. ii. s. 38. *Id. Lud.* b. ii. s. 148. *Id. Suck.* 1r th. s. 148.—Pleonast, *Bert.* s. 284. *Id. Mohs,* b. i. s. 100. *Id. Lucas,* p. 52. 263.—Spinelle pleonast, *Brong.* t. i. p. 438. *Id. Steffens,* b. i. s. 27.—Spinelle noir-purpurin, bleu, vert, *Haüy,* Tabl. p. 31.—Zeilanit, *Hoff.* b. i. s. 530.—Pleonast, *Haus.* Handb. b. ii. s. 363.—Pleonast, *Aikin,* p. 185.

External Characters.

Its colour is muddy duck-green, and greyish-black, which approaches to iron-black.

It occurs in blunt angular pieces, and grains; and crystallized in the following figures;

1. Octahedron, either perfect, or truncated on the edges. Figs. 9, and 10. Pl. 1.
2. Octahedron, having each of its angles acuminated by four planes, which are set on the lateral planes. Fig. 11. Pl. 1.
3. Garnet or rhomboidal dodecahedron. Fig. 12. Pl. 1.

The crystals are small, and very small, seldom middle-sized; and sometimes imbedded, sometimes superimposed.

Externally

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* The name *Ceylanite* is derived from Ceylon, one of the first known habitats of this mineral.

Externally the angular pieces and grains are rough and glimmering, or glistening, but the crystals are smooth and splendent.

Internally it is splendent, and the lustre is vitreous, inclining to semimetallic.

The fracture is perfect, and very flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent on the edges.

It scratches quartz and topaz, but not so readily as spinel, and is therefore softer than that gem.

It is rather easily frangible.

Specific gravity, 3.7647; or 3.7931, *Haüy.*

Chemical Character.

It is infusible before the blowpipe.

Constituent Parts.

Alumina, - -	68
Magnesia, - -	12
Silica, - - -	2
Oxide of Iron, - -	16
Loss, - - -	2
	100

Collet Descotil, Ann. de Chem. xxxiii.

Geognostic and Geographic Situations.

This mineral was first found in the Island of Ceylon, where it occurs in the sand of rivers, along with tourmaline, zircon, sapphire, and iron-sand. It also occurs in the ejected unaltered rocks at Monte Somma. These rocks are sometimes calcareous, sometimes composed of leucite, felspar, mica, quartz, and olivine, and contain in their

their cavities octahedral crystals of ceylanite. It occurs also in the trap rocks near Andernach on the Rhine, and in the supposed volcanic rocks of Valmaargue, Montferrier, and at Lestz near Montpellier.

It thus appears to be an inmate of secondary trap rocks; probably also of volcanic rocks; and if the loose rocks of Somma are primitive, of primitive rocks.

Observations.

This mineral is distinguished from *Spinel*, by its semimetallic lustre, inferior hardness, greater weight, and inferior transparency. When it occurs in grains, it is apt to be confounded with *Tourmaline*, but its semimetallic lustre, greater weight, and its not becoming electric by heating, distinguish it from that mineral.

Third Subspecies.

Spinel *.

Spinell, *Werner.*

Rubinus balassus, Rubinus spinellus, *Wall.* t. i. p. 247.—Rubis spinelle octaedre, *Romé de Lisle,* t. ii. p. 224.—Spinel, & Balass Rubies, *Kirw.* vol. i. p. 253.—Spinel, *Estner,* b. ii. s. 73. *Id. Emm.* b. i. s. 56, & b. iii. s. 252.—Rubino Spinello, *Nap.* p. 118.—Rubis, *Lam.* t. ii. p. 224.—Spinel, *Haüy,* t. ii. p. 496. *Id. Broch.* t. i. p. 202. *Id. Bournon,* Phil. Trans. 1792, part ii. p. 305. *Id. Reuss,* b. ii. th. 2. s. 31. *Id. Lud.* b. i. s. 67. *Id. Suck.* 1r th. s. 449. *Id. Bert.* s. 281. *Id. Mohs,* b. i. s. 101. *Id. Hab.* s. 36. *Id. Lucas,* p. 42.—Spinelle rubis, *Brong.* t. i. p. 436.—Spinell, *Brard,* t. i. p. 113.—Spinel Ruby, *Kid,* vol. i. p. 143.—Spinell, *Steffens,* b. i. s. 23. *Id. Haüy,* Tabl. p. 31. *Id. Haus,* b. ii. s. 360. *Id. Hoff.* b. i. s. 535. *Id. Aikin,* p. 185.

External

* This name is first mentioned by the earlier writers of the middle ages, but its derivation is unknown.

External Characters.

The principal colour is red; from which there is a transition on the one side into blue, and almost into green; on the other side into yellow and brown, and even into white. Thus it passes on the one side from carmine-red into cochineal-red, crimson-red, and cherry-red, into plum-blue, violet-blue, and indigo-blue; the indigo-blue sometimes inclines to green: on the other side it passes from crimson-red into blood-red, and hyacinth-red, into a colour intermediate between orange and ochre yellow, into yellowish-brown, and reddish-brown. From the cochineal-red it passes through rose-red into reddish-white. The colours are seldom pure, being generally somewhat muddy. The blue and white varieties are rare, and the green variety is very rare.

It occurs, sometimes in grains, more frequently crystallized. The grains are usually rolled crystals.

The following are its crystallizations:

1. Perfect octahedron, which is the fundamental figure. Fig. 13 *.
2. Octahedron, with alternate larger and smaller planes.
3. Tetrahedron, slightly truncated on the angles. Fig. 14 †.
4. Perfect tetrahedron. Fig. 15.
5. Tetrahedron, deeply truncated on the apex ‡.
6. Segment of figure 3.
7. Two segments of the tetrahedron, truncated on the angles, as in figure 3. joined together in a conformable

* Spinelle primitif, Haüy.—Romé de Lisle, t. ii. p. 224. Pl. 3. fig. 1.

† Romé de Lisle, p. 227. var. 5. Pl. 3. fig. 2.

‡ Romé de Lisle, var. 6. Pl. 3. figs. 10, 11. and 12.

formable manner by their bases, forming a *twin-crystal* with three re-entering angles.

8. Two segments of the tetrahedron, truncated on the angles, (as in figure 3.), joined together by their bases in an unconformable manner, so that the extremities of the segments project. *Twin-crystal.*
9. Two crystals, N° 5. attached by their bases. *Twin-crystal.* Fig. 16 *.
10. A crystal of N° 6. attached by its base to the lateral plane of a crystal N° 5. *Twin-crystal.*
11. A crystal of N° 10. attached to one of N° 13. *Triple-crystal.*
12. Octahedron, in which two opposite planes are much larger than the others.
13. Thick equiangular six-sided table, in which the terminal planes are set alternately oblique on the lateral planes. Sometimes the table is elongated, when it assumes more the appearance of a
14. Very oblique four-sided table, which is truncated on both the acute angles.
15. Octahedron, truncated on the edges. Fig. 17 †.
16. Rhomboidal dodecahedron. Fig. 18.
17. Octahedron, in which the axis is oblique, the edge of the common bases is truncated, and the apices sometimes rounded off.
18. Rectangular four-sided prism, acuminated by four planes, which are set on the lateral planes. Fig. 19.
19. Lengthened or cuneiform octahedron. Fig. 20 ‡.

All

* Spinelle transposé, Haüy.—Romé de Lisle, var. 7. Pl. 3 fig. 16.

† Spinelle emarginé, Haüy.—Romé de Lisle, t. ii. p. 226. var. 2. Pl. 3. fig. 7.

‡ Spinelle primitif cuneiformé, Haüy.—Romé de Lisle, t. ii. p. 226. var. 1 Pl. 3. fig. 2. & 33.

All the planes of the crystals that originate from the fundamental figure are smooth; whereas those which are derived from truncations on the edges are streaked.

The crystals are generally small and very small; seldom middle-sized *.

Externally and internally the spinel is splendent, and the lustre vitreous. Many crystals are invested with an opaline crust, and then have a pearly reflection.

The cleavage is fourfold, but imperfect, and the folia are parallel with the sides of an octahedron.

The fracture is flat conchoidal.

The fragments are indeterminate angular and sharp-edged, or they are splintery.

It alternates from translucent to transparent, and refracts single.

It scratches topaz, but is scratched by sapphire.

It is brittle.

Specific gravity, 3.500, 3.789, *Werner*. 3.645, *Haüy*. 3.570, 3.590, *Klaproth*. 3.705, *Lowry*. 3.5, 3.8, *Mohs*.

Chemical Characters.

Infusible before the blowpipe without addition; but is fusible with borax.

Constituent Parts.

Alumina, - - -	82.47
Magnesia, - - -	8.78
Chromic acid, - -	6.18
Loss, - - -	2.57
	100

Vauquelin, J. M. N° 38. p. 89.

Geognostic

* Brard mentions a fine spinel, weighing 215 grains, which was intended for Josephine, the wife of Buonaparté.

Geognostic and Geographic Situations.

Europe.—It is found in the gneiss district of Acker in Sudermannland, in a white foliated granular primitive limestone, in which bronze-yellow coloured scales of mica are disseminated; and the crystals are sometimes intermixed with the limestone at their line of junction. It occurs in drusy cavities, along with vesuvian and ceylanite, in the ejected foliated granular limestone of Vesuvius.

Asia.—It occurs in the kingdom of Pegu, and at Cananor in the Mysore country. In the island of Ceylon, so prolific in gems, it is found not only in the sand of rivers, but also imbedded in gneiss *.

Uses.

It is used as a precious stone, being cut for various ornamental purposes; but it has neither the hardness nor fire of the red sapphire or oriental ruby. When it weighs four carats, (about sixteen grains), it is considered of equal value with a diamond of half the weight. Figures are sometimes cut upon it. It does not appear that the ancients ever cut figures on this mineral; for there is no mention made of antique engraved gems of this kind, by any

* In the magnificent collection of the late Honourable Mr Greville, now in the British Museum, there are two interesting specimens, which, although they do not enable us to ascertain the repository or kind of rock in which the spinel occurs, make us acquainted with some of its accompanying minerals. In one of the specimens, crystals of spinel are imbedded in calcareous-spar, and accompanied with crystals of mica, magnetic-pyrites, and a substance which Count de Bournon believes to be asparagus-stone; and in the other specimen, the spinel is imbedded in adularia, and is accompanied with magnetic pyrites.

any of their writers; and in the vast collections of engraved gems, preserved in different parts of Europe, there are none of spinel.

Observations.

1. *Distinctive Characters.—a.* Between Spinel and octahedral *Zircon:* In zircon, the principal crystallization is an obtuse four-sided pyramid, not a regular octahedron, as in spinel; and the specific gravity of zircon is higher, it being 4.4, whereas spinel is only 3.8.—*b.* Between Spinel and *Oriental Ruby* or *Red Sapphire:* Red sapphire is not only harder, but heavier than spinel.

2. The carmine-red variety is the *Spinel-ruby* of the jeweller: the cochineal-red variety is the *Balais-ruby* of jewellers, so named from Balacchan, the Indian name of Pegu, where this variety is found: the violet-blue spinel is the *Almandine of Pliny;* is so named from Alabanda, a town in Lesser Asia, near which it was found; and the orange-yellow variety is the *Rubicelle-ruby* of jewellers..

3. It is a remarkable circumstance, as noticed by Hausmann, that the precious stones of the North, such as the spinel-ruby of Acker, the physalite or topaz of Sweden, and the zircon of Norway, have less transparency and muddier colours than the same gems found in warmer climates.

2. Rhomboidal Corundum.

Rhomboedrischer Corund, *Mohs.*

This species contains four subspecies, viz. Salamstone, Sapphire, Emery, and Corundum.

First

First Subspecies.

Salamstone *.

Salamstein, *Werner.*

Salamstein, *Hoff.* b. i. s. 541.—Corindon hyalin, *Haüy,* Tabl. p. 38.

External Characters.

Its colours are, brownish-red, carmine-red, crimson-red, and cochineal-red; also violet-blue and Berlin-blue.

It occurs in grains, which are rolled pieces, and crystallized in

1. Six-sided prisms, in which the lateral faces are ribbed.
2. Rhomboids, with truncated summits.

Internally it is shining and vitreous.

The cleavage is, in the direction of a rhomboid of 86° 38′, but is very difficultly discoverable.

The fracture is conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is translucent, and exhibits a particular kind of opalescence in two directly opposite places.

It is so hard as to scratch all other minerals but diamond.

Specific gravity not determined.

Geographic Situation.

It occurs principally in the Peninsula of India.

* *Salamstone* is the Indian name for this gem.

Second Subspecies.

Sapphire *.

Sapphir, *Werner.*

Saphirus, *Wall.* t. i. p. 248.—Rubinus orientalis, *Id.* p. 247.—Topazius orientalis, *Id.* p. 251.—Rubis d'orient, *Romé de Lisle,* t. ii. p. 212.—Oriental ruby, sapphire, and topaz, *Kirw.* t. i. p. 250.—Sapphir, *Estner,* b. ii. s. 86. *Id. Emm.* b. i. s. 67. & b. i. s. 251.—Zaffiro, et Rubin-zaffiro, *Nap.* p. 113. & 121. —Saphir, *Broch.* t. i. p. 207.—Telesie, *Haüy,* t. ii. p. 480.—Perfect corundum, *Greville* and *Bournon,* Lond. Phil. Trans. 1798 & 1802.—Sapphir, *Reuss,* b. ii. th. 2. s. 24.—Rubin, *Reuss,* b. ii. th. 2. s. 20. *Id. Lud.* b. i. s. 67. *Id. Suck.* 1r th. s. 446. *Id. Bert.* s. 280. *Id. Mohs,* b. i. s. 128. *Id. Hab.* s. 36. —Telesie, *Lucas,* p. 40.—Corindon telesie, *Brong.* t. i. p. 427. —Corindon hyalin, *Brard,* p. 110.—Saphire, *Kid,* vol. i. p. 137.—Corindon hyalin, *Haüy,* Tabl. p. 30.—Sapphir, *Steffens,* b. i. s. 14. *Id. Hoff.* b. i. s. 547.—Edler corund, *Haus.* Handb. b. ii. s. 367.—Telesia, *Aikin,* p. 186.

External Characters.

Blue and red are its principal colours; it occurs also grey, white, green, and yellow. From indigo-blue it passes through smalt-blue, Berlin-blue, azure-blue, lavander-blue, into a kind of flesh-red, rose-red, crimson-red, peach-blossom-red, and cochineal-red. It occurs also pearl-grey, bluish-grey, milk-white, reddish-white, yellowish-white; which latter inclines strongly to lemon-yellow. It is sometimes of a deep green colour.

The

* The name *Sapphire* is of Grecian origin, and according to Stephanus Byzant, is derived from the island Sapphirine in the Red Sea. But the sapphire of the ancients appears to have been a different mineral from the present,—probably azure-stone.

The colours of sapphire are generally pure and light, seldom muddy and deep. Sometimes two, but more rarely three colours occur in the same specimen: these are white and blue, blue and red, white, blue, and red *.

It occurs in blunt-edged pieces, and in roundish grains, both of which are pebbles, and crystallized. Its crystallizations are as follows:

The primitive figure is a slightly acute rhomboid, or double three-sided pyramid, in which the alternate angles are 86° 4′, and 93° 56′ †. The following, which are the usual forms, can be traced to this rhomboid:

1. Very acute, equiangular, simple, six-sided pyramid. Fig. 21. Pl. 2.
2. Preceding figure truncated on the summit. Fig. 22. Pl. 2.
3. Perfect six-sided prism, Fig. 23. Pl. 2.; sometimes truncated on the alternate angles, Fig. 24. Pl. 2.
4. Acute, double, six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other. Fig. 25. Pl. 2.
5. The preceding figure acuminated on the extremities by six planes, which are set on the lateral planes.
6. The preceding figure truncated on the extremities.
7. N° 4. truncated on the extremities. Fig. 26. Pl. 2.

D 2 8. N° 3.

* Romé de Lisle mentions a sapphire among the crown jewels of France, which is of a beautiful yellow in the middle, and pure blue on the extremities. Faujas St Fond observed some sapphires which appeared green when viewed in the direction of their thickness, but blue in the direction of their length; and in the British Museum, there is a specimen which is blue and red at the extremities, and yellow in the middle.

† This is the determination of Phillips in the Geological Transactions, vol. iv. p. 224.

8. N° 3. acutely acuminated with six planes, which are set on the lateral planes.
9. The preceding crystal truncated on the summit. Fig. 27. Pl. 2.
10. N° 1. acutely acuminated by six planes, which are set on the lateral planes.
11. The preceding figure truncated on the summit.

The crystals are small, middle-sized, and all around crystallized. The planes of the crystals are generally transversely streaked, and, when fresh, are usually splendent.

Internally, its lustre is splendent and vitreous, sometimes inclining to adamantine.

The cleavage is in the direction of the planes of a rhomboid of 86° 4′, or is parallel with the terminal planes of the prism. The cleavage is scarcely discernible in the blue varieties, the sapphire of the jeweller, but is pretty distinct in the red varieties, the oriental ruby of the jeweller.

The fracture is conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates, from transparent to translucent; and the translucent varieties frequently exhibit a six-rayed opalescence.

It refracts double.

It is, after diamond, the hardest substance in nature; the blue varieties are harder than the red.

It is brittle, and easily frangible.

Specific gravity 4.320, 4.000, *Werner.*—4.283, 3.999, *Haüy.*—4.000, *Hatchet* and *Greville.*—4.161, 3.907, *Bournon.* Yellow Sapphire, 3.916; Blue Sapphire, 3.985; Red Sapphire, 3.975, *Lowry.*

Constituent

Constituent Parts.

	Blue sapphire.		Blue sapphire.		Red sapphire, or Oriental Ruby.
Alumina, - -	98.5	- - -	92.0	- -	90.0
Lime, - -	0.5	Silica, -	5.25	- -	7.0
Oxide of Iron, -	1.0	- - -	1.0	- -	1.2
		Loss, -	1.75	- -	1.8
	100		100		100
	Klap. Beit. b. i. s. 88.		*Chenevix*, Phil. Trans. 1802.		*Chenevix*, Phil. Trans. 1802.

Chemical Character.

It is infusible before the blowpipe.

Physical Characters.

Becomes electrical by rubbing, and retains its electricity for several hours; but does not become electrical by heating.

Geognostic Situation.

It occurs in alluvial soil, in the vicinity of rocks belonging to the secondary or flœtz-trap formation, and imbedded in gneiss.

Geographic Situation.

Europe.—It occurs in alluvial soil, along with pyrope, zircon, and iron-sand, at Podsedlitz and Trziblitz in Bohemia; near Hohenstein in Saxony. In France, on the banks of the stream Riou Pezzouliou, near Expailly; also at Brendola in the Vicentine, and in Portugal.

Asia.—It is found particularly beautiful in the Capelan Mountains, twelve days journey from Sirian, a city of Pegu; it is said, also in Persia, and imbedded in gneiss in the Island of Ceylon.

Use.

Uses.

This mineral is, next to diamond, the most valuable of the precious stones. The white and pale-blue varieties, by exposure to heat, become snow-white, and when cut, exhibit so high a degree of lustre, that they are used in place of diamond. The most highly prized varieties are the crimson and carmine red; these are the *Oriental Ruby* of the jeweller, and next to the diamond, are the most valuable minerals hitherto discovered. The blue varieties, the *Sapphire* of the jeweller, are next in value to the red. The yellow varieties, the *Oriental Topaz* of the jeweller, are of less value than the blue or true Sapphire.

The *Asterias* or *Star-stone* is a very beautiful variety, in which the colour is generally of a reddish violet, and the form a rhomboid, with truncated apices, which exhibit an opalescent lustre. If cut *en cabochon*, or in the form of an ellipse, the summit of the ellipse being situated exactly over the point corresponding with the summit of the rhomboid, there will be produced the appearance of a star with six rays, from which, when held in the sunshine, a bright yellowish light shoots forth, forming a beautiful contrast to the rich violet-blue of the other part of the gem.

Sapphire is now usually set with a foil of its own colour; but it was formerly the practice, instead of a foil, to place under the gem the blue part of a peacock's feather.

A sapphire of ten carats weight, is considered to be worth fifty guineas.

An oriental ruby of thirty-one carats weight, of perfect colour, and without flaws, is considered as even more valuable

luable than a diamond of the same weight. It is usually set with a foil; but if peculiarly rich in colour, it is sometimes set without a bottom or *à jour*, that the stone may be seen through.

In the construction of time-keepers, no stones have been found sufficiently hard for jewelling the holes, except the ruby and the diamond.

It does not appear that the ancients ever engraved figures upon this mineral. All the engraved sapphires preserved in collections, are of modern date; and of these, one of the most beautiful is a red sapphire, or oriental ruby, on which is cut the figure of Henry the Fourth of France. This gem was engraved by the celebrated artist Coldere, and was in the collection of the late Duke of Orleans.

Observations.

1. Sapphire was first established as a distinct species, and separated from spinel, with which it had been confounded, by Romé de Lisle and Werner.

2. Red sapphire and spinel ruby are sometimes confounded together. The following characters will assist in discriminating them:

Red sapphire shows in some specimens milky reflections; it has generally a sensible tint of violet, when we place it near the eye, and look through it.

Spinel-ruby does not show the milky reflections, and when placed very near the eye, and looked through, shows only a pale rose-red colour.

3. The following are the names given to the different varieties of this mineral:

a. Blue

a. Blue sapphire. *True* or *oriental sapphire.*
b. Crimson red sapphire. *Oriental ruby.*
c. Yellow sapphire. *Oriental topaz.*
d. Violet-blue sapphire. *Oriental amethyst.*
e. Pearl-grey or bluish-grey sapphire. *Vermeille* or *Calcedonic ruby.*
f. Green sapphire. *Oriental emerald* or *Oriental peridot.*
g. White sapphire. *Lux sapphire.*

4. Certain varieties of sapphire exhibit particular kinds of opalescence, and these have received the following denominations.

(1.) *Girasol sapphire.* This variety exhibits a pale-reddish and bluish reflection upon a transparent ground.

(2.) *Opalescent sapphire.* This variety shews a very bright pearly-opalescence.

(3.) *Asteria sapphire* or *Star-stone,* already described.

5. The Kings of Pegu, Ava and Siam, are reported to possess rich collections of oriental rubies. The finest ruby at present known belongs to the King of Pegu. Tavernier states, that in the throne of the Great Mogul there were 108 rubies, which, on an average, weighed from 100 to 200 carats each. Probably many of these were garnets. Among the crown jewels of France, there is a fine rhomboidal crystal of sapphire, of the weight of 166 carats.

6. The best sapphires and rubies come from Ava and Pegu; those of Ceylon are usually of a pale colour, and are often deteriorated by stains and streaks. The European varieties of this gem are not esteemed by jewellers.

7. We may here remark, that the epithet *Oriental,* frequently applied to the finer kinds of gems, was adopted in consequence of its having been observed, that the hardest precious stones came from the East.

Third

Third Subspecies.

Emery.

Schmiergel, *Werner.*

Smirgel, *Reuss,* b. ii. th. 2. s. 156. *Id. Broch.* t. ii. p. 292.—Smirgel, *Lud.* b. ii. s. 183. *Id. Suck.* 2. th. s. 298. *Id. Bert.* s. 427. *Id. Mohs,* b. i. s. 136.—Corindon granuleux, *Lucas,* p. 260. *Id. Brard,* p. 111.—Emeril, *Brong.* t. i. p. 431.—Corindon granulaire, *Haüy,* Tabl. p. 30.—Schmirgel, *Steffens,* b. i. s. 21. *Id. Hoff.* b. i. s. 561. *Id. Haus.* b. ii. s. 370.—Emery, *Aikin,* p. 187.

External Characters.

Its colour is intermediate between greyish-black and bluish-grey.

It occurs massive and disseminated; and the massive is sometimes intermixed with other minerals.

It sometimes occurs in fine granular distinct concretions.

Its lustre is glistening, passing into glimmering, and is adamantine.

The fracture is fine and small grained uneven; sometimes splintery.

The fragments are indeterminate angular, and rather blunt-edged.

Is slightly translucent on the edges.

It is hard in a high degree; scratches topaz.

Is rather difficultly frangible.

Specific gravity 4.0.

Constituent

Constituent Parts.

Alumina,		-	86.0
Silica,	-	-	3.0
Iron,	-	-	4.0
Loss,	-	-	7.0
			100

According to *Tennant*, Phil. Trans. for 1802.

Geognostic Situation.

We know only the geognostic situation of the Saxon emery, which occurs in beds of talc and steatite, along with blende and calcareous spar, in primitive clayslate. This substance is to be considered as bearing the same relation to sapphire that limestone does to calcareous spar; hence emery, in a general view, may be considered massive sapphire.

Geographic Situation.

Europe.—It is found at Ochsenkopf near Schwartzenberg, and Eibenstock in Saxony. Jersey and Guernsey are mentioned as localities of this species; but Dr MacCulloch, who examined these islands, could neither find it, nor learn that it ever had been discovered there *.

It occurs abundantly in the island of Naxos, in large loose masses, at the foot of primitive mountains, and also at Smyrna. It is mentioned as a production of Parma in Italy, and of Ronda, in the kingdom of Granada, in Spain.

Asia.

* MacCulloch, Geological Transactions, vol. i. p. 12.

Asia.—Near the town of Charlowa in the Altain Mountains.

America.—Mexico and Peru.

Use.

It is used for polishing hard minerals and metals, and hence is an important article in the arts. Before using, it is ground into powder of various degrees of fineness, according to the use that is intended to be made of it. The different kinds of powder are obtained, by repeatedly diffusing the ground emery in water, and allowing the water to settle a longer or shorter time, according as a fine or coarse powder is wished. It is used with water for polishing stones; but with oil for polishing metals.

Observations.

1. The name Emery is one of technical import, and was long applied to all those hard substances employed in the polishing of gems and other hard minerals: Such as fine granular garnet, named Red Emery; actynolite and quartz, mixed with iron-glance and other oxides of iron. These mixtures were at one time considered as simple minerals, and when the iron was the predominating ingredient, were placed along with the ores of iron, but under the name Emery. To obviate this irregularity, Werner restricted the name Emery to the present species, which has all the characters of a good emery, and is well marked as a distinct mineral.

2. Some very hard ores of iron, found in Sweden, which are used as emery, are probably intermixed with true emery.

Fourth

Fourth Subspecies.

Corundum.

Korund & Demant-Spath, *Werner.*

Korund, *Wid.* s. 237.—Adamantine-spar, *Kirw.* vol. i. p. 335.—Demant-spath, *Emm.* b. i. s. 9. & b. iii. s. 229.—Spato adamantino, *Nap.* p. 223.—Corindon, *Lam.* t. ii. p. 356.—Le spath adamantine, *Broch.* t. i. p. 356.—Corindon, *Haüy*, t. iii. p. 1.—Imperfect Corundum, *Greville* & *Bournon*, Phil. Trans. 1798 and 1802.—Korund & Demant-spath, *Reuss*, b. ii. th. 2. s. 16, & 12. *Id. Lud.* b. i. p. 103. *Id. Suck.* 1r th. s. 439. *Id. Bert.* s. 290. *Id. Mohs*, b. i. s. 112, & 120.—Corindon harmophane translucide, & Corindon harmophane opaque, *Lucas*, p. 259, & 260.—Corindon adamantine, & Corindon adamantine noiratre, *Brong.* t. i. p. 429, 430.—Corindon harmophane, *Brard*, p. 110.—Corindon harmophane opaque, *Haüy*, Tab Comparat. p. 30.—Korund, & Demant-spath, *Steffens*, b. i s. 17, & 19. *Id. Hoff.* b. i. s. 565, & 572.—Demant-spath, *Haus.* Handb. b. ii. s. 368.—Common Corundum, *Aikin*, p. 187.

External Characters.

Its colour is greenish-white, of various degrees of intensity, which passes into light greenish-grey, and even into mountain-green, asparagus-green, Berlin-blue, and azure-blue; it is sometimes also pearl-grey, which passes into flesh-red, cochineal-red, crimson-red, and hair-brown. The green, blue, and red colours are generally muddy, and inclining to grey.

When cut in a semicircular form, it often presents an opalescent star of six rays.

It

It occurs massive, disseminated, in rolled pieces, and crystallized. Its principal crystallizations are the following:

1. Equiangular six-sided prism.

2. Same prism, having its alternate angles truncated.

3. Same prism, having its terminal edges and alternate angles truncated.

4. When the truncations on the angles of N° 2. increase very much in magnitude, there is formed a three-planed acumination, in which the acuminating planes are set on the alternate lateral edges of the prism.

5. When the truncations on the edges increase very much, a six-planed acumination is formed; and when the prism becomes very short, or disappears, there is formed a simple six-sided pyramid; and if the prism is acuminated on both extremities, a double six-sided pyramid; and in both cases the summits of the pyramids are truncated.

The crystals are middle-sized.

Externally, they are dull and rough.

It shews a tendency to straight lamellar concretions.

The lustre of the cleavage and fracture is shining and glistening, and is either vitreous inclining to resinous, or pearly inclining to adamantine.

The cleavage is perfect, and in the direction of the planes of a rhomboid of 86° 4′, or is parallel with the terminal planes of the prism.

The fracture is small and imperfect conchoidal, and sometimes uneven.

The fragments are indeterminate angular, and sharp-edged.

It alternates from strongly translucent to translucent on the edges, and it refracts double.

It

It is so hard as to scratch quartz; but is softer than sapphire.

It is rather easily frangible.

Specific gravity, 3.710, *Klaproth.*—3.873, *Haüy.*—875, *Bournon.* 3.876, *Leonhard.*

Chemical Character.

It is infusible without addition before the blowpipe.

Constituent Parts.

	Corundum of the Carnatic.	Of Malabar.	Diamond spar, or Corundum of China.	Diamond spar, Etenengo.
Alumina,	91.0	86.5	84.0	92.0
Silica,	5.0	7.0	6.50	4.8
Iron,	1.5	4.0	7.50	2.4
Loss,	2.5	2.5	2	0.8
	100	100	100	*Vauquelin,* J. de Phys. t. 74. p. 465.
		Chenevix.	*Klaproth.*	

Geognostic and Geographic Situations.

Europe.—Red and blue corundum occur in dolomite in St Gothard; in mica-slate in Italy; in magnetic ironstone in Sweden; in nests of mica and felspar, which are contained in beds of greenstone porphyry subordinate to gneiss in Mount Rosa; and at Etenengo, near Mozzo, in the district of Sessia in Piedmont, in a granitic rock of felspar and silver-white mica.

Asia.—In the Carnatic, and on the coast of Malabar, it is imbedded in a rock composed of felspar, fibrolite, quartz, hornblende, and mica, and is sometimes accompanied with pistacite,

pistacite, talc, garnet, and zircon. It is also found very abundantly in the neighbourhood of Canton in China.

Use.

In its powdered state, it has long been used by the artists of India and China for cutting and polishing precious stones; but, although it will in some degree act upon the diamond, it is not sufficiently hard to bring out the fine lustre of that gem in a degree comparable to that which is effected by European artists with diamond powder. The Chinese also use it for polishing steel. European artists consider it superior to emery for the cutting of seals and precious stones; but for minute engraving it is much inferior to diamond-powder. Some authors say that the Chinese use it as an ingredient in their porcelain; but this opinion is called in question by late travellers.

Observations.

This mineral was known to Woodward, who mentions it under the name Corivindum. In the year 1768, Mr Berry, an eminent seal-engraver in Edinburgh, received a box of it from Madras. He showed it to Dr Black, who examined and pointed it out as a distinct and new mineral.

3. Prismatic

3. Prismatic Corundum or Chrysoberyl *.

Krysoberyll, *Werner.*

Cymophane, *Haüy.*

Prismatischer Corund, *Mohs.*

Chrysolithus colores reflectens varios; Chrysoberyllus, *Wall.* t. i. p. 216.—Krisoberill, *Wid.* s. 246. *Id. Kirw.* vol. i. p. 261. *Id. Estner,* b. ii. s. 63. *Id. Emm.* b. i. s. 19.—Crisoberillo, *Nap.* p. 134.—Chrysopal, *Lam.* t. ii. p. 244.—Le Chrysoberil, *Broch.* t. i. s. 167.—Cymophane, *Haüy,* t. ii. p. 491.—Chrysoberyll, *Reuss,* b. ii. s. 48. *Id. Lud.* b. i. s. 60. *Id. Mohs,* b. i. s. 42.—Cymophane, *Lucas,* p. 41. *Id. Brong.* t. i. p. 425. *Id. Brard,* p. 111. *Id. Haüy,* Tabl. p. 30.—Krysoberyll, *Steffens,* b. i. s. 12. *Id. Hoff.* b. i. s. 424.—Chrysoberyll, *Haus.* b. i. s. 358.—Cymophane, *Aikin,* p. 188.

External Characters.

Its chief colour is asparagus-green: which passes on the one side into apple-green, mountain-green, and greenish-white; on the other side, through light-olive and oil-green, into light yellowish-grey, which inclines strongly to brown, and even passes to reddish-brown.

It often exhibits a milk-white opalescence †, which appears in general to float in the interior of the mineral.

It

* The name *Chrysoberyl* is derived from the Greek, (from χρυσος, *gold, gold-yellow Beryl),* but in ancient times was applied to a yellow variety of Beryl. The mineral which at present bears this name, was only first known in modern times.

† It is said that the opalescence does not always occur.

It occurs in blunt angular rolled pieces, that sometimes approach to the cubic form.

It is seldom found crystallized.

The primitive form is a prism of 104° 41′. The most frequent secondary forms are the following:

1. Short and broad six-sided prism, or thick table. Fig. 28. Pl. 2.
2. Very short and broad six-sided prism or table, acuminated on both ends with six planes, set on the lateral planes, and the apices truncated. Fig. 29. Pl. 2.

The crystals are small.

The surface of the rolled pieces is intermediate between rough and smooth, and is glistening.

Externally the crystals are shining; internally splendent, and the lustre is intermediate between resinous and vitreous, but more inclining to the first.

The cleavage is observable only in the direction of the smaller diagonal of the prism.

The fracture is perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is semitransparent, sometimes inclining to transparent, and refracts double.

It scratches topaz, but does not affect sapphire.

It is brittle.

It is rather easily frangible.

Specific gravity, 3.720, *Werner*.—3.710, *Klaproth*.—3.7961, *Haüy*.—3.8, *Lucas*.

Constituent Parts.

Alumina,	-	71.5
Silica,	- -	18.0
Lime,	- -	6.0
Oxide of Iron,	-	1.5
Loss,	-	3.0
		100

According to *Klaproth*, b. i. s. 102.

Chemical Characters.

Before the blowpipe it is infusible without addition, *(Lelievre.)*

Geognostic and Geographic Situations.

It occurs in Brazil, in alluvial soil with topaz, or in sandstone with diamond; and at Haddam, on Connecticut River, in the United States, in granite, along with garnets, beryl, and tourmaline *.

It is found in the island of Ceylon, in the beds of rivers, along with sapphires, rubies and tourmalines.

Uses.

This fine gem was formerly much less prized than it is at present. When cut and polished, it is not inferior in brilliancy and beauty to other gems of the same colour, but of much greater value. The larger stones are cut into necklaces and ring-stones, and set either with or without diamonds; the smaller ones are made into circular ear-drops, and set round with deep-coloured gems. The opalescent

* Cleaveland's Mineralogy, p. 204.

opalescent varieties are cut *en cabochon* as ring-stones, and are very much esteemed.

The Brazilian variety is better fitted for the purpose of the jeweller than the North American.

Observations.

1. Rolled pieces or pebbles of chrysoberyl might be confounded with pebbles of *sapphire ;* but their green colour, milk or bluish white opalescence, frequent cubic form, rough and glistening surface, and inferior hardness, distinguish them sufficiently from that mineral. The crystallized varieties are distinguished from crystallized sapphire by colour and surface.

2. It was first established as a distinct species by Werner, in the Bergmännisches Journal, 3 Jahrg. 2. B. 54.

GENUS IV.—ANDALUSITE.

THIS genus contains one species, viz. Prismatic Andalusite.

1. Prismatic Andalusite.

Prismatischer Andalusit, *Mohs.*

This species contains two subspecies, viz. Common Andalusite and Saussurite.

First Subspecies.

Common Andalusite.

Andalusit, *Werner.*

Feldspath Apyre, *Haüy.*

Spath adamantin d'un rouge violet, *Bournon,* Journ. de Phys. 1799, p. 453.—Andalusit, *La Meth.* Id. An 6. p. 386. *Id. Reuss,* b. iv. s. 135.—Foretzer Feldspath, *Suck.* 1r Abh. s. 396. —Andalusit, *Mohs,* b. i. s. 423. *Id. Karsten,* Tabel. s. 46. *Id. Leonhard,* Tabel. s. 19. *Id. Brong.* t. i. p. 363.—Feldspath apyre, *Haüy,* Tabl. p. 60.—Micaphilit, *Brunner,* in Moll's Ann. 3. 2. 294.—Andalusit, *Steffens,* b. i. s. 455. *Id. Hoff.* b. ii. s. 291. *Id. Lenz,* b. i. s. 484. *Id. Oken,* b. i. s. 317. *Id. Haus.* b. ii. s. 506. *Id. Aikin,* p. 187.

External Characters.

Its colour is flesh-red, which sometimes inclines to pearl-grey.

It occurs massive, and crystallized in slightly oblique four-sided prisms, in which the terminal angles and lateral edges are sometimes truncated.

The crystals are seldom large, generally middle-sized or small, and almost always imbedded.

The principal fracture is shining, in a low degree; the cross fracture glistening, and the lustre is vitreous.

The cleavage is indeterminate diagonal.

The fracture is uneven.

The fragments are indeterminate angular.

It

It is feebly translucent.

It scratches quartz, but is softer than topaz *.

It is rather easily frangible.

Specific gravity, 3.050, *Romé de Lisle.*—3.074, *Guyton.*—3.165, *Haüy.*—3.060, 3.127, *Von Voith.*—3.2, *Mohs.*

Chemical Characters.

It becomes white before the blow-pipe, but does not melt. The andalusite of Herzogau was exposed by Bucholz for an hour and a half to a temperature equal to that of melting silver, when its colour was changed, its lustre almost destroyed, but it appeared to have increased in hardness and brittleness.

Constituent Parts.

Silica,	-	32	29.12
Alumina,	-	52	51.07
Potash,	-	8	
Oxide of Iron,		2	7.83
		94	88.02
		Vauquelin.	*Guyton.*

Geognostic Situation.

It occurs in gneiss, mica-slate, and clay-slate; also in veins that traverse granite or gneiss, either along with felspar, or with felspar, quartz, mica, and schorl.

Geographic

* Herr Von Voith says, that he found the schorl of Hörlberge, the steatite in gneiss near Werneberg, and the andalusite of Herzogau, so soft in their original repositories, that he could flatten them between the fingers, and cut them with a knife, but that they became very hard on exposure to the air.

Geographic Situation.

Europe.—It occurs in gneiss in Aberdeenshire; in granite in Banffshire; in mica-slate in the Island of Unst; Dartmoor in Devonshire; also in mica-slate on the north-east side of Douce Mountain, in the county of Wicklow; and at Killeny, in the county of Dublin, where it was first noticed by my friend Dr Blake *.

On the Continent it was first found in the province of Andalusia or Castile; afterwards by Count de Bournon at Imbert, near Montbrison in Forez, in a vein of felspar traversing granite. It also occurs in veins in gneiss near Herzogau, in the Upper Palatinate; Syser Alp in Tyrol; and in gneiss near Bodenmais in Bavaria. In the Fichtelgebirge, and at Braunsdorf, near Freyberg in Saxony, it occurs imbedded in mica-slate.

America.—At Readfield in Mainè, United States, in granite †.

Observations.

1. It is distinguished by its colour, external shape, fracture, hardness, and weight. It has been confounded with *Felspar;* but it is distinguished from that mineral by its greater hardness, and weight, and its infusibility. Its cleavage, and inferior specific gravity, distinguish it from *Corundum.*

2. The finest specimens of andalusite are found in the Sysser Alp.

Second

* Fitton's Mineralogy of Dublin, p. 47.

† Cleaveland's Mineralogy, p. 265.

Second Subspecies.

Saussurite.

Magerer nephrite, *Reuss*, b. ii. s. 192.—Jade, *Saussure*, Voyage —Jade tenace, *Haüy*, t. iv. p. 368.—Jade de Saussure, *Brong* t. i. p. 348.—Saussurite, *Karst.* Tabel. s. 34.—Feldspath tenace, *Haüy*, Tabl. p. 36.—Saussurite, *Theodore de Saussure*, Journal des Mines, n. cxi. p. 205. *Id. Steffens*, b. i. s. 451.—Variolit, *Hoff.* b. ii. s. 338.—Saussurit. *Lenz*, b. i. s. 507. *Id. Oken*, b. i. s. 332. *Id. Haus.* b. ii. s. 537. *Id. Aikin*, p. 234.

External Characters.

Its colours are white, grey, and green: it passes from greyish-white into greenish-white, greenish-grey, bluish-grey, and mountain-green; and sometimes it occurs smoke-grey and pearl-grey.

It occurs massive, disseminated, and in rolled pieces.

Internally it is dull, or feebly glimmering.

The cleavage is imperfect, and apparently twofold, and slightly oblique?

The fracture is splintery.

It breaks into very sharp-edged pieces.

It is faintly translucent on the edges.

It is very difficultly frangible.

It is hard; according to Saussure it scratches quartz.

It is meagre to the feel.

Specific gravity, 3.200, *Klaproth.* 3.310, 3.319, *Saussure.*

Chemical Characters.

Before the blowpipe it melts on the edges and angles, but is not entirely melted.

Constituent

Constituent Parts.

Silica, -	44.00	49.00
Alumina, -	30.00	24.00
Lime, -	4.00	10.50
Magnesia, - -		3.75
Natron, -	6.00	5.50
Potash, -	0.25	
Iron, -	12.50	6.50
Manganese, -	0.05	
	96.80	99.25
	Saussure, Journ. des Mines, n. cxi. p. 217.	*Klaproth*, Beit. b. iv. s. 278.

Geognostic and Geographic Situations.

It occurs at the foot of Mount Rosa. Rolled pieces are found at the mouth of the Reuss; and large blocks, containing diallage, abound in the Pays de Vaud. Rolled masses are scattered on the shores of the Lake of Geneva; and the well-known rock from Corsica, named *Verde di Corsica*, is a compound of diallage and saussurite. It is also found in Norway, Finland, Italy, France, and Savoy.

Observations.

The older Saussure, who has particularly described this mineral, was of opinion that it belonged to the magnesian class, and arranged it in the system under the name *Jade*. Saussure the Younger, after a careful examination and analysis, found that it could not be arranged with jade, but formed a distinct species, to which he gave the name *Saussurite*. Haüy described it under the name

name Feldspath tenace, and Werner arranges it with the feldspars; but its great hardness, and high specific gravity, induce me to retain it as a distinct mineral, and from its affinity with andalusite, to place it beside that species.

Genus V.—TOPAZ.

This genus contains but one species, viz. Prismatic Topaz.

Prismatic Topaz.

Prismatischer Topaz, *Mohs.*

The species contains three subspecies, viz. Common Topaz, Schorlite, and Physalite or Pyrophysalite.

First Subspecies.

Common Topaz *.

Topaz, *Werner.*

Chrysolithus, *Plin.* Hist. Nat. l. xxxvii. 9.—Topazius octaedricus prismaticus, *Wall.* t. i. p. 251.—Topaze du Brezil, *Romé de Lisle,* t. ii. p. 230.—Topaze de Saxe, *Id.* p. 260.—Topaz, *Wern.* Cronst. p. 97. *Id. Wid.* p. 267.—Occidental Topaz, *Kirw.* vol. i. p. 254.—Topaz, *Estner,* b. ii. s. 98. *Id. Emm.* b. i. s. 374.—Topazio, *Nap.* p. 136.—Topaze du Brezil, de Saxe, et de Siberie, *Lam.* t. ii. p. 254. *Id. Broch.* t. i. p. 212. *Id.*

* The name *Topaz* is derived from Topazos, a small island in the Red Sea, where, it is said, the Romans used to collect their topaz, which is the Chrysolite of the moderns.

Id. Haüy, t. ii. p. 504.—Topaz, *Reuss*, b. ii. th. ii. s. 40. *Id. Lud.* b. i. s. 68. *Id. Suck.* 1r th. s. 455. *Id. Bert.* s. 294. *Id. Mohs*, b. i. s. 27. *Id. Hab.* s. 54. *Id. Lucas*, s. 43. *Id. Brong.* t. i. p. 419. *Id. Brard*, p. 116. *Id. Kid*, vol. i. p. 145. *Id. Haüy*, Tabl. p. 17. *Id. Steffens*, b. i. s. 33. *Id. Hoff.* b. i. s. 377.—Edler Topaz, *Haus.* Handb. b. ii. s. 649.—Topaz, *Aikin*, p. 147.

External Characters.

Its principal colour is wine-yellow, which occurs of all degrees of intensity.

The *pale* wine-yellow passes into yellowish-white, greyish-white, greenish-white, mountain-green, and celandine-green.

The *dark* wine-yellow passes from orange-yellow through cherry-red into violet-blue *.

It seldom occurs massive, composed of coarse and small granular concretions, disseminated, and in rolled pieces; most frequently crystallized.

Its primitive form is an oblique prism of 124° 22'.

The following are the principal varieties of the prism.

1. Oblique four-sided prism, rather acutely acuminated by four planes, which are set on the lateral planes.
2. N° 1. in which the acuter lateral edges are bevelled; or it may be viewed as an eight-sided prism, in which two and two lateral planes meet under obtuse angles. Fig. 30. Pl. 2.
3. N° 1, & 2., with a double acumination; the planes of the second acumination set on those of the first.

4. N° 2.

* The violet-blue variety is very rare: in proof of this, it may be mentioned, that Mr Von der Nüll of Vienna, the proprietor of one of the most beautiful and instructive cabinets in Europe, and which has been excellently described by Mohs, paid 1500 ducats for a single specimen of violet-blue coloured topaz.—Vid. Von Moll's Ephemeriden.

4. N° 2. with a triple acumination; in which the planes of the one always rest on those of the others.
5. N° 2. in which the angles on the acute edges, and the summits of the acuminations, are truncated. Fig. 31. Pl. 2.
6. N° 4. in which the angles on the acute and obtuse edges are truncated. Fig. 32. Pl. 2.
7. N° 1, & 2., in which the summits of the acuminations are truncated.
8. The preceding figure, in which the angles formed by the obtuse lateral edges and the acuminating planes, are bevelled.
9. The bevelling edges of N° 8. truncated.
10. The preceding figure, in which the edges formed by the truncating planes of the bevelment with the surrounding planes, are truncated.
11. N° 2. in which the terminal planes are bevelled, and the bevelling planes set on the acute lateral edges.
12. The preceding figure, in which the angles formed by the proper edge of the bevelment are bevelled. Fig. 33. Pl. 2.

The crystals are middle sized, small and very small; very seldom large; and are generally superimposed.

The lateral planes of the crystals are longitudinally streaked; but the acuminating and bevelling planes are smooth; the terminal planes are rough *.

The

* The Brazilian and Siberian topazes are more deeply streaked than the Saxon: further, the Brazilian topaz is generally acuminated, but is without truncations; the Siberian, on the contrary, is usually bevelled.

The massive varieties occur in coarse and small granular distinct concretions.

Externally it is splendent; internally, splendent and vitreous.

The cleavage is perfect, and perpendicular to the axis of the prism.

The fracture is small and perfect conchoidal.

The fragments are indeterminate angular and sharp-edged, and sometimes tabular.

It alternates from transparent to semitransparent; and it refracts double.

It is harder than quartz or emerald; but softer than corundum.

It is easily frangible.

Specific gravity 3.464 to 3.556, *Werner*.—3.556 to 3.564, *Haüy*.—3.540 to 3.576, *Karsten*.—3.532 to 3.641, *Lowry*.—3.4, 3.6, *Mohs*.

Chemical Characters.

Saxon topaz in a gentle heat becomes white *, but a strong heat deprives it of lustre and transparency: the Brazilian, on the contrary, by exposure to a high temperature, burns rose-red †, and in a still higher violet-blue. Before the blowpipe it is infusible, but exposed to a stream of oxygen gas it soon melts into a porcellanous bead. It is fusible with borax, but alkali has little effect on it.

Physical

* When thus altered, the Saxon topaz is sometimes imposed on the ignorant for diamond.

† Topaz thus altered, is cut and sold by jewellers under the name of Brazilian ruby and Pale spinel.

Physical Characters.

The topaz of Brazil, Siberia, Mucla in Asia Minor, and Saxony, when heated, exhibits at one extremity positive, and at the other negative electricity. It also becomes electrical by friction, and retains this property for a considerable time, sometimes more than twenty-four hours.

Constituent Parts.

	Brazilian Topaz.	Saxon Topaz.	Saxon Topaz.
Alumina,	58.38	57.45	59
Silica,	34.01	34.24	35
Fluoric acid,	7.79	7.75	5
	100.18	99.44	99
	Berzelius, Afhandlingar, vol. iv. p. 236.	*Berzelius*, id.	*Klap.* b. 4. s. 160.

Geognostic Situation.

Topaz occurs in many different rocks and mineral repositories. It forms an essential constituent part of a particular mountain-rock, which is an aggregate of topaz, quartz, and schorl, and is named *topaz-rock*. The rock is composed of large and small globular and angular concretions, having a slaty structure; and between the concretions there are frequently drusy cavities lined with crystals of topaz, quartz, schorl, and lithomarge. At first sight it appears to be an aggregation of fragments, but a particular examination convinces us that all the remarkable phenomena it exhibits are effects of crystallization. Topaz occurs in drusy cavities in granite, along with beryl and rock-crystal; also in veins, which

which traverse primitive rocks, as granite, where it is associated with beryl, rock-crystal, and iron-ochre, or mica-slate and gneiss, where it is accompanied with tinstone, arsenical pyrites, sometimes copper-pyrites, apatite, fluor-spar, quartz, and steatite. It has been also discovered in nests, in transition clay-slate, along with red-coloured quartz, brown-spar, and selenite or gypseous spar; in chlorite-slate, associated with lithomarge and quartz; and it is found in rolled pieces and crystals in alluvial soil.

Geographic Situation.

Europe.—It occurs in large crystals, and rolled masses, in an alluvial soil, in the granite and gneiss districts of Mar and Cairngorm, in the upper parts of Aberdeenshire *; and in veins, along with tinstone, in clay-slate, at St Anne's, in Cornwall; also in St Michael's Mount, and at Trevaunance, in the same county. Upon the Continent of Europe, it appears most abundantly in topaz-rock at Schneckenstein; also in veins that traverse gneiss, along with tinstone, fluor-spar, and arsenical pyrites, at Ehrenfriedersdorff; and in rounded or angular pieces, and sometimes in crystals of a mountain-green colour, in alluvial soil, at Eibenstock in Saxony; it also occurs at Zinnwald and Geyer in the same country; at Schlakenwalde and Zinnwald in Bohemia, it occurs in veins that traverse gneiss, along with tinstone, fluor-spar, copper-pyrites, and lithomarge. It has been found at Hirschberg, and other places in Silesia, and at the Höllengraben, at Werfen in Salzburg, in nests in transition clay-slate.

Asia.—It occurs both in the Altain and Uralian mountains. In the Altain range, it occurs on the banks of the river

* Vid. Wernerian Transactions, vol. i. p. 445,—452.

river Tom; and in the mountain Adon-Tschelon, along with beryl, quartz, schorl, fluor-spar, and lithomarge. About twenty-five leagues north of Catharinenburg in the Uralian range, it is found in considerable quantity in a kind of granite, resembling that variety known under the name of Graphic Granite. There, it is said to occur in drusy cavities, along with rock-crystal and beryl. It has been discovered in loose crystals in Kamschatka; and it is said also along with rock-crystal, common quartz, &c. in the river Poyk in Caucasus. The beautiful rose-red variety was discovered at Mukla, in Asia Minor, by an intelligent traveller, our countryman Mr Hawkins. In Ceylon, Pegu, Hawkesbury river in New Holland, and Cape Barren Island in Bass's Straits, it occurs in alluvial soil.

America.—The topazes of Brazil, so much esteemed in trade, are dug in the district of Villa-Rica. The higher parts of the country are of sandstone, which is sometimes flexible, (this is the well known *flexible sandstone* of Brazil,) owing to intermixed chlorite; but in the lower, the prevailing rock is chlorite-slate. The topazes are found in nests in this slate, and are generally associated with lithomarge, loose granular quartz, and rock-crystal; and occasionally they are included in the rock-crystal *. Crystals of topaz twelve inches long, and from four to six inches thick, are met with in these cavities. They are also found in the alluvium of the country. In the National Museum in Paris, there is a large rock-crystal, containing red-coloured topazes from Brazil.

Uses.

* It is said by Mr Mawe, that the blue topaz of Brazil occurs in the same sandstone rock as that which affords the diamond.

Uses.

1. This gem is much prized by jewellers. The following kinds are known in commerce.

a. Saxon. The colours are yellow, and generally pale wine-yellow. When cut, they frequently have a lustre equal to the Brazilian, but are not so much esteemed.

b. Bohemian are found in the tin mines of that country; are small, deficient in transparency; the only colours are grey or muddy white; and hence they are not esteemed.

c. Aqua-marine. Under this name are included the mountain-green varieties of topaz found in the alluvial rocks of Eibenstock, in veins and drusy cavities in Siberia, and, we may add, in alluvial soil, in the upper parts of Aberdeenshire. They are not so highly valued as the Brazilian.

d. Yellow Brazilian Topaz. The most esteemed have a deep and pure yellow colour. The yellow topazes of Brazil are at present the most highly valued by jewellers.

e. Blue Brazilian Topaz,—named also *Brazilian sapphire.* This beautiful gem is rare, and sells at a high price. It has been found to vary in size from a few carats to three ounces and upwards.

f. White Topaz of Brazil. This variety, which is of a greyish or snow-white colour, is known in Brazil under the name *minas novas.* It generally occurs of small size, and is used in circular ear-rings, or is set round yellow topazes.

g. Taurian Topaz, Is of a pale-blue colour, and is also esteemed.

2. This gem was much prized by the ancients. In proof of this, it may be mentioned, that Cleopatra presented a fine

fine stone of this kind to Antony; and that Ovid adorns the chariot of the sun with it. Figures are sometimes engraved on it; and these, when well executed, are very highly valued. In the National Museum in Paris, there is a superb Indian Bacchus engraved on topaz. In the cabinet of the Emperor of Russia there are several fine engraved topazes; and the King of Spain had in his possession a Brazilian topaz, on which was admirably engraved the portraits of Philip II. and Don Carlos.

3. Other minerals are sometimes sold for topaz, as yellow-coloured Rock-crystal, in this country named *Cairngorm-stone*, from the place where it is found, or *Scots topaz* *. Even very fine varieties of Calcedony and Carnelian, when well cut and set, have been imposed on the ignorant as topaz.

4. Coarse kinds of topaz are pounded and used as a kind of emery in cutting hard minerals.—Lastly, it may be mentioned, that topaz was formerly kept in the apothecaries shops, and sold as a powerful antidote against madness.

Observations.

1. Topaz may in general be distinguished from all other minerals, by the rhomboidal base of its crystals, straight foliated cross cleavage, and longitudinal streaked lateral planes.

2. It cannot readily be confounded with yellow-coloured *Sapphire*, because sapphire is harder and heavier, and does not, like the greater number of topazes, become electric by heating:

* The large mass of yellow transparent stone which was preserved in the collection of the Stadtholder under the name Topaz, is but a fragment of rock-crystal.

heating: Nor can we mistake red topaz for *Spinel*, because spinel is harder, refracts only single, whereas topaz refracts double; and spinel does not become electric by heating, as is the case with topaz: And green-coloured topaz is readily distinguished from *Beryl*, by the following characters: It does not exhibit cleavages parallel with the lateral planes, as is the case with beryl; its prism has a rhomboidal base, which is not the case with the prism of beryl; and its specific gravity is 3.5, but that of beryl only 2.7.

3. When colour was considered as affording the most certain means of distinguishing the precious stones from each other, many different minerals were associated with the topaz, and varieties of topaz were described as distinct species; as appears from the following tables:

1.

Minerals which have been confounded with Topaz.

1. Yellowish-white sapphire,	Oriental topaz.
2. Zircon,	Hyaline topaz, and yellowish-red topaz *.
3. Chrysolite,	Yellowish-green topaz †.
4. Yellowish beryl,	Siberian topaz.
5. Yellowish rock-crystal,	Bohemian, Scotch, or Occidental topaz.
6. Clove-brown and brownish-black rock-crystal,	Smoke topaz.
7. Yellow fluor-spar,	False topaz.

2.

* Wall. edit. 1778, t. i. p. 252.

† Ibid.

2.

Names given to particular varieties of Topaz.

1. Mountain-green topaz,	Aqua-marine.
2. Blue topaz,	Sapphire.
3. Yellow topaz,	Chrysoprase, *Baillon*, Cat. p. 137.
4. Wine-yellow, inclining to red topaz,	Rubicelle.
5. Red topaz,	Brazilian or Balais ruby.
6. Yellowish-green topaz.	Saxon chrysolite.

4. In the collection of minerals in the Museum of Natural History at Paris, there is a Brazilian topaz which weighs 4 ounces and a quarter, and is the largest specimen in that great national repository. In the upper parts of Aberdeenshire, much heavier and larger specimens of real topaz have been found. In the first volume of the Wernerian Memoirs, we find mentioned a specimen weighing 1 pound 3 ounces 8 drams and 8½ grains, troy weight, from Aberdeenshire; and we understand that larger masses have been since discovered.

Second Subspecies.

Schorlite, or Schorlous Topaz.

Schörlartiger Berill, or Piknit, *Werner*.

Pycnite, *Hauy*.

Weisser Stangenschœrl, *Wern.* Cronst. p. 199.—Schorl blanc prismatique, *Romé de Lisle,* t. ii. p. 420.—Schörlartiger berill, *Wid.* p. 276.—Shorlite, *Kirwan,* vol. i. p. 286. *Id. Estner,* b. ii. p. 207.—Sorlo bianco, *Nap.* p. 152.—Leucolite, *Lam.* t. ii. p. 274.—Leucolite, et Pycnite, *Haüy,* t. iii. p. 236. —Le Beril schorliforme, *Broch.* t. i. p. 124.—Stangenstein, *Reuss,* b. ii. th. i. s. 110.—Schörlartiger berill, *Lud.* b. i. s. 70. *Id. Mohs,* b. i. s. 155.—Stangenstein, *Hab.* s. 52.—Pycnite, *Lucas,* p. 78. *Id. Brong.* t. i. p. 418. *Id. Brard,* p. 191.—Topaz septihexagonale, et Topaz cylindroide, *Haüy,* Tabl. p. 18.—Schorlit, *Steffens,* b. i. s. 37.—Schörlartiger Beril, *Hoff.* b. i. s. 620.—Gemeiner Topaz, *Haus.* b. ii. s. 648.—Pycnite, *Aikin,* p. 192.

External Characters.

Its principal colour is straw-yellow, which passes into yellowish-white, and is sometimes spotted red and grey.

It occurs almost always massive, composed of parallel, thin, and straight prismatic distinct concretions, which are longitudinally streaked, and crystallized in long six-sided prisms, which are sometimes truncated on the terminal edges and angles, and are generally imbedded.

The crystals are large and middle sized.

Externally and internally its lustre is shining, approaching to glistening, and is resinous.

The cleavage is the same as in common topaz, but not so distinct.

The

The fracture is small and imperfect conchoidal, or fine-grained uneven.

The fragments are indeterminately angular, and not particularly sharp-edged.

It is more or less translucent on the edges.

It is nearly as hard as common topaz.

It is brittle.

It is uncommonly easily frangible.

Specific gravity, 3.530, *Klaproth.*—3.514, *Haüy.*—3.535 and 3.503, *Haberle.*

Chemical Characters.

Before the blowpipe it is infusible without addition; with borax it melts into a pure transparent glass.

Physical Character.

Like topaz, it becomes electric by heating.

Constituent Parts.

Alumina,	51.00
Silica,	38.43
Fluoric Acid,	8.84
	98.27

Berzelius in Afhandlingar, vol. iv. p. 236.

Geognostic and Geographic Situations.

It occurs at Altenberg in Saxony, in a rock of quartz and mica, which forms an imbedded mass, included in porphyry. This mass is a compound of quartz, chlorite, mica, felspar, lithomarge, fluor-spar, iron-pyrites, copper-pyrites, arsenical pyrites, iron-glance, molybdena, wolfram, native bis-

muth,

muth, and bismuth-glance. At Schlackenwald in Bohemia, it is imbedded in an aggregate of quartz, tinstone, wolfram, and molybdena, which forms a mass in gneiss. In Siberia it occurs along with mica and quartz; and at Mauleon in France is imbedded in steatite.

Observations.

1. *Distinctive Characters.—a.* Between schorlite and *beryl.* The colour-suite of beryl is different from that of schorlite; both external and internal lustre of beryl is much higher than that of schorlite; and in beryl the lustre is vitreous, whereas it is resinous in schorlite; beryl is easily frangible, schorlite uncommonly easily frangible; beryl has a specific gravity of 2.7; schorlite is 3.5.—*b.* Between schorlite and *topaz.* The colour-suite of topaz is different from that of schorlite; both external and internal lustre of topaz much exceed that of schorlite, and the lustre is vitreous, not resinous, as is the case with schorlite; schorlite occurs in prismatic concretions, which is never the case with topaz; topaz is more transparent than schorlite; and, lastly, topaz is easily frangible, schorlite uncommonly easily frangible.

2. It received the name *schorlite* from Klaproth, on account of general resemblance to schorl. It may be named *schorlous topaz.*

Third

Third Subspecies.

Physalite, or Pyrophysalite.

Pyrophysalith, *Hisinger.*

Physalith, *Werner.*

Pyrophysalith, Afhandlingar i Fysik, Kemi och Mineralogie, 1. th. p. 111,–118.; Tillagning, p. 239, 240.; Annal. de Chem. 1806, n. 173. p. 113,–124. *Id. Steffens,* b. i. s. 40.—Topaz prismatoide, blanc-verdatre, translucide ou opaque, *Haüy,* Tabl. p. 18.—Gemeiner Topaz, *Haus.* b. ii. s. 648.—Pyrophysalite, *Aikin,* p. 191.

External Characters.

Its colours are greenish-white and mountain-green.

It is massive.

It occurs in coarse granular distinct concretions.

The lustre of the cleavage is splendent, of the cross fracture glistening or dull.

The cleavage is perfect, and the same as that of topaz.

The fracture is uneven or conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is translucent on the edges.

It is as hard as topaz.

Specific gravity 3.451.

Chemical Characters.

Before the blowpipe it becomes white and opaque, and acquires a slight vitreous glazing, at the same time disengaging minute bubbles of gas.

Constituent

Constituent Parts.

Alumina, - -	57.74
Silica, - -	34.36
Fluoric Acid, -	7.77
	99.87

Afhandlingar, vol. iv. p. 236.

Geographic Situation.

It is found imbedded in granite at Finbo, near Fahlun, in Sweden.

Genus VI.—EMERALD.

This genus contains two species, viz. Prismatic Emerald and Rhomboidal Emerald.

1. Prismatic

1. Prismatic Emerald, or Euclase *.

Euclas, *Werner*,
Euclase, *Haüy*.
Prismatischer Smaragd, *Mohs*.

Euclase, Journal des Mines, n. 28. p. 258.—Euclasius, *Lin.* Syst. Nat. ed. 13. Lipsiæ, 1793, t. iii. p. 442.—Euclase, *Daubenton*, Tabl. p. 6. *Id. Haüy*, t. ii. p. 531. *Id. Broch.* t. ii. p. 508. *Id. Lud.* b. i. s. 165. *Id. Suck.* 1r th. s. 165. *Id. Lucas*, p. 45. *Id. Brong.* t. i. p. 413. *Id. Brard*, p. 121. *Id. Kid*, vol. i. p. 133. *Id. Haüy*, Tabl. p. 32. *Id. Steffens*, s. 47. *Id. Hoff.* b. i. s. 592. *Id. Haus.* Handb. b. ii. s. 654.—Euclase, *Aikin*, p. 192.

External Characters.

Its colour passes, on one side, from greenish-white through mountain-green, and celandine-green, into dark sky-blue; on the other side into apple-green, with a trace of blue.

It has been hitherto found only crystallized.

The primitive form is a prism of 133° 24′. The following are all the scondary forms hitherto described, and which may be traced to the prism just mentioned:

1. Oblique four-sided prism, rather acutely acuminated by four planes, which are set on the lateral planes.
2. The preceding figure, slightly truncated on the lateral edges.
3. The preceding figure, in which two of the acuminating planes meet under an obtuse angle, so that the prism appears with a very oblique bevelment.

4. The

* The name *Euclase* is derived from the Greek ἐυ and κλαω, and refers to the great frangibility of the mineral.

4. The preceding figure, in which the bevelling planes are once broken.
5. Oblique four-sided prism, in which the lateral edges are bevelled, and the edges of the bevelment on the acute edges truncated. On the extremity of the prism there are three acuminations of four planes each, which are set on each other, and correspond to the lateral planes of the prism; but these planes are modified by a suite of bevelments, which are placed on their obtuse lateral edges; there is also a bevelment (with triangular planes) between these and the bevelment on the obtuse lateral edges of the prism; and, lastly, a truncation on each of the superior edges of the truncations on the acute lateral edges of the prism. Fig. 34. Pl. 2.

The lateral planes are more or less longitudinally streaked; seldom smooth. The streaks give to the planes a rounded appearance, and the prisms then appear reed-like.

Externally the crystals are shining and splendent, and vitreous; internally splendent.

The cleavage is perfect, straight, and in the direction of the smaller diagonals of the prism.

The fracture is small conchoidal.

The fragments are tabular, and frequently almost cubical.

It alternates from transparent to translucent, and refracts double.

It is harder than quartz, but softer than topaz.

It is very easily frangible.

Specific gravity, 3.06, *Haüy*.—2.907, *Lowry*, from a specimen in possession of Mr Rundell of London.—3.32, *Mohs*.

Chemical

Chemical Characters.

Before the blowpipe, it first loses its transparency, and then melts into a white enamel.

Constituent Parts.

Silica, -	35 to	36
Alumina, -	18	19
Glucina, -	14	15
Iron, - -	2	3
Loss, - -	31	27
	100	100

Vauquelin.

The loss in these analyses appears owing, partly to water of crystallization, and partly to an alkali.

Geognostic and Geographic Situation.

This rare and beautiful mineral was first found in Peru, from whence it was brought to Europe by the traveller Dombey. Very lately it has been brought from Brazil in isolated crystals, that appear to have been imbedded. The Brazilian euclase was discovered in the mine of Gerais near Casson.

Observations.

1. It is a very beautiful mineral; but, on account of its easy frangibility, cannot be used in jewellery.

2. It is named *euclase* by Haüy, on account of its very great frangibility.

3. The greater part of the description of this mineral was drawn up by M. Verina, from specimens in the possession of Mr Edmund Rundell, and Mr Heuland of London.

2. Rhomboidal

2. Rhomboidal Emerald *.

Rhomboedrischer Smaragd, *Mohs.*

THIS species is divided into two subspecies, viz. Precious Emerald and Beryl.

First Subspecies.

Precious Emerald †.

Schmaragd, *Werner.*

Gemma pellucidissima, Smaragdus, *Wall.* t. i. p. 253.—Emeraude du Perou, *Romé de Lisle,* t. ii. s. 245.—Schmaragd, *Wern.* Cronst. p. 102. *Id. Wid.* p. 271.—Emerald, *Kirw.* vol. i. p. 247.—Schmaragd, *Estner,* b. ii. p. 132.—Smeraldo, *Nap.* p. 122.—Emeraude, *Lam.* t. ii. p. 227. *Id. Broch.* t. i. p. 217.—Emeraude verte, *Haüy,* t. ii. p. 516.—Smaragd, *Reuss,* b. ii. th. 1. s. 165. *Id. Lud.* b. ii. s. 69. *Id. Suck.* 1r th. s. 205. *Id. Bert.* s. 308. *Id. Mohs,* b. i. s. 140. *Id. Hab.* s. 25.—Emeraude, *Lucas,* p. 44.—Beril emeraude, *Brong.* t. i. p. 417. *Id. Brard,* p. 119.—Emerald, *Kid,* vol. i. p. 130.—Glatter smaragd, *Karsten,* Tabell.—Emeraude verte, *Haüy,* Tabl. p. 32.—Schmaragd, *Steffens,* b. i. s. 41. *Id. Hoff.* b. i. s. 596. —Edler Smaragd, *Haus.* Handb. b. ii. s. 656.—Emerald, *Aikin,* p. 193.

External Characters.

Its characteristic, and, we may say, almost its only colour,

* Mohs names this species *rhomboidal,* because its principal figure, the regular six-sided prism, like all forms of the same description, can be traced to a rhomboid. This cannot be done with any of the pyramidal, tessular, or oblique prismatic forms.

† The true meaning of the name *Emerald,* is uncertain. In the writings of antiquaries, vague conjectures are proposed in regard to it, which may be read by those curious in such subjects.

lour, is emerald green, of all degrees of intensity, from deep to pale. The deep sometimes inclines a little to verdegris-green, and oftener to grass-green; the pale varieties sometimes nearly pass into greenish-white.

It seldom occurs massive, or in rolled pieces; most frequently crystallized.

The primitive form is an equiangular six-sided prism *, of which the following varieties occur:

1. Truncated on the lateral edges †.
2. Truncated on the terminal edges ‡.
3. On the terminal angles ||.
4. Terminal edges bevelled. When the truncations on the lateral edges increase, a
5. Twelve-sided prism is formed §.

The lateral planes are smooth; the terminal planes rough.

The crystals are middle-sized and small, very rarely large; and occur imbedded, or in druses.

Internally the lustre is intermediate between shining and splendent, and is vitreous.

The cleavage is straight, and fourfold, of which the folia are parallel with the lateral and terminal planes; but is difficultly discoverable.

The fracture is small, and imperfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It

* Emeraude primitive, Haüy.—Romé de Lisle, t. ii. p. 250. Pl. 4. fig. 18.

† Emeraude peridodecaedre, Haüy.—Romé de Lisle, t. ii. p. 252. var. 1. Pl. 4. fig. 22.

‡ Emeraude annulaire, Haüy.—Romé de Lisle, p. 254. var. 2. Pl. 6. fig. 46.

|| Emeraude épointée, Haüy.—Romé de Lisle, var. 3. Pl. 4. fig. 100.

§ Emeraude soustractive, Haüy.

It alternates from transparent to translucent, and refracts double in a moderate degree.

It is harder than quartz, and nearly as hard as topaz.

Specific gravity, 2.600, *Werner*.—2.775, *Brisson*.—2.7227 to 2.7755, *Hauy*.—2.692, of a cut specimen in possession of Mr Rundell, *Lowry*.—2.8, *Haüy* on Precious Stones.—2.6, 2.8, *Mohs*.

Chemical Characters.

If heated to a certain degree, (120°) it assumes a blue colour, but it recovers its own proper tint on cooling. If the heat is carried to 150°, it melts into a white vesicular glass.

Constituent Parts.

Silica,	64.5		68.50
Alumina,	16		15.75
Glucina,	13		12.56
Oxide of Chrome,	3.25		0.30
Lime,	1.6		0.25
Water,	2.0	Oxide of Iron,	1.0
		Loss,	1.70
	100.35		100.

Vauquelin, Jour. des Mines, N. 38, p. 98. — *Klaproth*, Beit. iii. 226.

Geognostic Situation.

It occurs in drusy cavities, along with iron-pyrites, calcareous-spar, and quartz, in veins that traverse clay-slate; also imbedded in mica-slate; and loose in the sand of rivers and other alluvial deposites.

Geographic

Geographic Situation.

The most beautiful emeralds are at present brought from Peru. The most ancient mine is that of de Manta, which is now exhausted; the other emerald mine is situated in the valley of Tunca, in the jurisdiction of Sante Fe, between the mountains of New Granada and Popayan. It occurs imbeded in mica-slate in Heubachthal, Salzburg. The Romans are said to have procured it from Æthiopia and Upper Egypt.

Use.

The colour which characterises this gem is extremely pleasing: the eye, after viewing the beautiful colours of the sapphire, oriental ruby, spinel and topaz, reposes with delight on the fresh and animating colour of the emerald, the charming emblem of the vegetable kingdom. It is rare, however, to find the colour pure and of good strength; hence such specimens are very highly valued, and are employed in the most expensive kinds of jewellery. It is valued next to the ruby; and when of good colour, is set without a foil, and upon a black ground, like brilliant diamonds. Emeralds of inferior lustre are generally set upon a green gold foil. These gems are considered to appear to greatest advantage when cut in the table form, and surrounded with brilliants, the lustre of which forms an agreeable contrast with the soft hue of the emerald. They are sometimes formed into pear-shaped ear-drops, necklaces and tiaras; but the most valuable stones are generally set in rings. In South America, it is a favourite mode of setting emeralds to form them into clusters of artificial flowers on gold stems.

The

The largest emerald mentioned by authors, is one said to have been in the possession of the inhabitants of the Valley of Manta, in Peru, at the time when the Spaniards first arrived there. It is recorded to have been as large as an ostrich's egg, and to have been worshipped by the Peruvians, under the name of the Goddess, or Mother of Emeralds. Of late years, specimens of emerald, from six to eight inches in length, and two inches in thickness, have been brought from Peru; but such are extremely rare.

Observations.

1. Emerald and Beryl have a strong resemblance to each other: thus both are green, their crystallizations differs but little, and fracture, hardness and weight, are nearly the same. Notwithstanding these agreements, they are distinguished from each other by the following characters: Emerald occurs only green, but beryl, besides green, is also yellow and blue; the crystals of beryl are long, those of emerald are short; the lateral planes of beryl are streaked, those of emerald are almost always smooth; the terminal planes of beryl are smooth, those of emerald are rough; beryl is more distinctly foliated than emerald; beryl often presents distinct concretions, emerald never; beryl often shews a formation by acicular shoots, emerald never; beryl has transverse rents, emerald never; and the crystals of beryl are larger than those of emerald; and beryl is rather softer than emerald.

2. Many of the emeralds described by the ancients appear to have been varieties of green fluor-spar. Even in more modern times, fluor-spar has been preserved for emerald. Mr Coxe examined the famous emerald table in the Abbey of Reichenau, near Constance, which he found to be a very fine green-coloured fluor-spar. The famous *sacro*

sacro cattino di smeraldo orientale, preserved at Genoa, and which could only be seen by an order from the Senate, is a mass of cellular glass. Many fine Ethiopian emeralds, which were bequeathed to monasteries, appear to have been sold by the monks, and coloured glass substituted in their place.

3. This mineral was named *smaragdus* by the ancients. Pliny distinguished twelve species of the smaragdus; but under this title he includes, besides the true emerald, also green jasper, prase, malachite, fluor-spar, serpentine, and translucent varieties of gypsum. Theophrastus also mentions the true emerald, which he says occurs in small quantity, and very rarely: he enumerates along with it another mineral of a green colour, which, he informs us, is found in masses ten feet long, and is probably a variety of serpentine. The emerald with which the hall of Assuerus was paved; the pillars of emerald in the temple of Hercules at Tyre, mentioned by Herodotus; and the large emeralds described by Pliny as having been cut into columns and statues, (thus, the statue of Serapis in Egypt, nine ells long, is said to be of emerald,) cannot be referred to the true emerald. The confusion that prevails in the descriptions of this mineral in ancient authors, has led some mineralogists to believe, that the true emerald was not known in Europe until after the conquest of Mexico and Peru by the Spaniards. The following facts, however, are in opposition to this opinion.

(1.) The emerald was so highly prized by the Romans, that when the luxurious and rich Lucullus landed at Alexandria, he was presented by Ptolemy with an emerald, on which was engraven a portrait of the king of Egypt; and this was considered as the most valuable present that could be offered to him.

(2.) In the National Museum in Paris, there is a fine emerald, on which is engraved an eye, which is known to by a very common Egyptian hieroglyphic.

(3.) In the mitre of Pope Julius II. which was presented to Pius VII. by Buonaparte, there is a fine deep green coloured emerald. As he died in 1513, and Peru was not discovered and conquered by Pizarro before 1545, it is highly probable that this emerald was brought from Africa.

(4.) Werner had in his possession several antique emeralds; and Mr Hawkins informed the Abbé Estner, that he had seen a necklace of emeralds, which was found among the ruins of Portici near Naples.

4. The ancients attributed many virtues to the emerald; thus they maintained, that the sight of its animating and refreshing colour chased away melancholy; that it completely prevented the fatal effects of poison, and even cured the most obstinate diseases.

5. The *Brazilian emerald* is a variety of Tourmaline; and the *Oriental emerald* is green-coloured Sapphire.

6. Emerald is one of the lightest and softest of the precious stones.

Second Subspecies.

Beryl *.

Edler Beril, *Werner.*

Beryllus, *Plin.* Hist. Nat. xxxviii. 5. 20.—Smaragdus, Aqua marina, et Smaragdus Berillus, *Wall.* t. i. p. 254.—Aigue marine

* The name *Beryl* is of great antiquity, being mentioned by Pliny; but its derivation is unknown.

marine de Siberie, *Romé de Lisle,* t. ii. p. 252. *Id. Born.* t. i. p. 71.—Edler Berill, *Wern.* Cronst. s. 100.—Beryl, *Kirw.* vol. i. p. 248.—Edler Beril, *Wid.* s. 274. *Id. Estner,* b. ii. s. 197.—Berillo, *Nap.* p. 125.—Aigue-marine, *Lam.* t. ii. p. 232.—Emeraude, *Haüy,* t. ii. p. 516.—Le Beril noble, *Broch.* t. i. p. 220.—Gestreifter Smaragd, *Reuss,* b. ii. th. 1. s. 102.—Edler Beril, *Lud.* b. i. s. 70. *Id. Suck.* 1r th. s. 208. *Id. Bert.* s. 310. *Id. Mohs,* b. i. s. 146.—Gestreifter Smaragd, *Hab.* s. 26.—Beril aigüe-marine, *Brong.* t. i. p. 415.—Emeraude vert-bleuatre, *Brard,* p. 12.—Beryl, *Kid,* vol. i. p. 128. —Emeraude vert-bleuatre et jaune-verdatre, *Haüy,* Tabl. p. 32.—Beril, *Steffens,* b. i. s. 44. *Id. Hoff.* b. i. s. 604. *Id. Haus,* b. ii. s. 656. *Id. Aikin,* p. 193.

External Characters.

Its principal colour is green, from which it passes on the one side into blue, and on the other into yellow. It is commonly mountain and celandine green: from these it passes through apple-green, grass-green, asparagus-green, oil-green, into honey-yellow, which approaches to wine-yellow. From celandine-green it passes into smalt, sky, and, in rare instances, into azure blue *.

Almost all its colours are pale, seldom deep, and scarcely ever dark. Sometimes two colours occur together, which alternate in layers, and occasionally it is iridescent.

It occurs massive, and this variety sometimes appears ar-arranged in straight and thin prismatic distinct concretions. It is often crystallized in long equiangular six-sided prisms, which are either perfect, or truncated on the lateral edges, as in fig. 35. Pl. 2.; truncated on the terminal angles, as

* A rose-coloured variety, associated with red tourmaline, has been found in Chesterfield, in Massachusets, in North America, and is in possession of Colonel Gibbs, a distinguished promoter of science in the United States.

in fig. 36. Pl. 2.; or on the terminal edges and angles, as in fig. 37. Pl. 2.

The truncations on the terminal edges sometimes become so large as to form six-planed acuminations, in which the apices appear deeply truncated, as in fig. 37. Pl. 2.

The lateral planes are deeply longitudinally streaked, but the terminal, acuminating, and truncating planes are smooth.

The lateral planes vary much in breadth; sometimes three planes are so large in comparison of the others, that the crystal appears almost trihedral: in other instances. four planes are so large, that the figure is almost tetrahedral. Sometimes the lateral planes are cylindrical convex, and then the crystals appear acicular or reed-like.

The crystals are sometimes jointed like basalt, having a concave surface at one extremity, and a convex surface at the other. They are seldom single; generally many occur together, and these cross each other in different directions, and are frequently superimposed and imbedded.

The crystals are small, large, and very large.

Transparent crystals occur a foot long, and four inches in diameter *.

Externally its lustre is shining and glistening; internally shining, which sometimes passes into glistening and splendent, and is vitreous.

The cleavage is the same as in precious emerald, but much more distinct, and more easily detected.

The fracture is small, and more or less perfect conchoidal.

The

* In Weiss's collection in Vienna, there is a druse of very large beryl crystals; two of the crystals, which are of a mountain-green colour, and cross each other, are a foot and a half in length, and one foot in diameter. Very large crystals are found in North America.

The fragments are indeterminate angular, and more or less sharp-edged.

It is commonly transparent, but sometimes passes into translucent, and it refracts double, but in a feeble degree. The translucent variety has cross rents.

It scratches quartz, and is nearly equal in hardness to topaz, with which the mountain-green variety has been often confounded.

It is easily frangible.

Specific gravity 2.6500 to 2.7590, *Werner*.—2.682 to 2.683 to 2.722, *Brisson*.—2.664, *Lowry*.—2.6, *Haüy*.

Chemical Characters.

Before the blowpipe it is difficultly fusible without addition, but with borax it melts easily.

Constituent Parts.

Silica,	69.50	68.0
Alumina,	14.00	15.0
Glucina,	14.00	14.0
		Lime, 2.0
Oxide of Iron,	1.00	1
	98.50	100
	Rose, in Karsten's Tabellen.	*Vauquelin*, Jour. des Mines, N. 43. p. 563.

Geognostic Situation.

It occurs in veins that traverse granite and gneiss, along with rock-crystal, felspar, topaz, schorl, and iron-ochre; also imbedded in granite, and dispersed through alluvial soil.

Geographic

Geographic Situation.

Europe.—It occurs in alluvial soil along with rock-crystal and topaz, in the upper parts of Aberdeenshire *. In Ireland, imbedded in granite, near Lough Bray, in the county of Wicklow, and near Cronebane in the same county †.

It occurs imbedded in granite on the south side of the Rathhausberg in Gastein in Salzburg, and on the highest summit of the Saualpe in Carinthia. In granite in the island of Elba, and in large crystals in veins of quartz that traverse granite near to Limoges; also at Marmagne, and a little to the west of Nantz in France.

Asia.—The finest beryls are found in veins that traverse the granite mountain Adon-Tschalon in Dauria; from which quarter nearly all the abundant supplies of Russian beryl are obtained. It also occurs, along with arsenical pyrites, in a kind of serpentine rock near Nertschinsk; in the mountain Tygirek (Mountain of Snow) in the Altain range; on the borders of the River Lena; near the town of Ajatskaja in the Uralian range; and in the circle of Alepasski in Persia.

America.—This gem is found in several districts in the United States, as near Baltimore in Maryland, where it is imbedded in granite; on the banks of the Schuylkill, and in Germantown in Pennsylvania, also in granite; in New-York, in veins which traverse gneiss near the city, and in granite at Singsing, thirty-five miles from the city; in different places in Connecticut in massive granite, and in granite veins traversing gneiss, where crystals seven inches in length,

* Vid. Memoirs of the Wernerian Society, vol. i. p. 445,—452.

† Fitton, Stephens, and Weaver, Geological Transactions, vol. i. p. 275.

length, by nine inches in diameter, have been found; at Chesterfield in Massachusets in granite, in crystals that vary from a small size to that of a foot in diameter; and in different places in the district of Maine, either in coarse granular granite, or in graphic granite veins that intersect gneiss, and the contiguous gneiss contains imbedded beryl crystals *.

Very beautiful varieties of beryl are found in Brazil.

Uses.

When pure, it is cut into ring-stones, seal-stones, brooches, intaglios, and necklaces, but is not so highly valued as emerald. The darkest green varieties are set upon a steel coloured foil, and the pale ones are either placed like the diamond on a black ground, or upon a silvery foil. Figures are sometimes engraved on it. In the royal library at Paris there is a portrait of Julia, the daughter of Titus, engraved on a green-coloured beryl. The largest ones are said to be in much esteem among the Turks for the handles of stilettos. The varieties most highly prized by the jeweller, are brought from Brazil, Siberia, and Ceylon; others of inferior value are found in Scotland, France, and the United States of America.

Observations.

This gem was well known to the ancients, who procured it from several places where it is at present found. Pliny has given a good description of it †; yet in later times this description

* Cleaveland's Mineralogy, p. 277.

† Plin. Hist. Nat. lib. xxxviii. c. 1.

description appears to have been forgotten; for we find it arranged with other precious stones, to which it had but little resemblance: thus the blue varieties were named Sapphire; the yellow, Topaz; and the green, Aqua-marine. Many years ago Werner obtained a complete suite of specimens of this mineral from Siberia, which enabled him to give it its proper place in the system.

Genus VII. TOURMALINE *.

This genus contains one species, viz. Rhomboidal Tourmaline.

1. Rhomboidal Tourmaline.

Rhomboedrischer Turmalin, *Mohs.*

It is divided into two subspecies, viz. Tourmaline and Schorl.

First

* *Tourmaline*, according to Thunberg, is a Ceylanese word, and is pronounced in the Malabar and Cingalese language *Turemali.*—Vid. Thunberg's Beschreibung der Mineralien und Edelgesteine der Insel Zeylon, in den Neuen Abhand. der Schwed. Acad. d. Wiss. Bd. 5. s. 70.

First Subspecies.

Tourmaline.

Turmalin, *Werner.*

Zeolites electricus, Turmalin, *Wall.* t. i. p. 329.—Schorl transparent rhomboidal, *Romé de Lisle,* t. ii. p. 344.—Brasilianischer Turmalin, *Wid.* p. 284.—Tourmaline, *Kirw.* vol. i. p. 271.—Sorlo Brasiliano, *Nap.* p. 150.—Tourmaline, *Lam.* t. ii. p. 295.—Le Schorl electrique, *Broch.* t. i. p. 229.—Tourmalines vertes et bleus, *Haüy,* t. iii. p. 31.—Edler Schorl, *Reuss,* b. ii. th. 1. s. 119. *Id. Lud.* b. i. s. 72. *Id. Suck.* 1r th. s. 221. *Id. Bert.* s. 191.—Turmalin, *Mohs,* b. i. s. 163. *Id. Hab.* s. 33. *Id. Lucas,* p. 54.—Tourmaline crystallisé, &c. *Brong.* t. i. p. 405.—Tourmaline, *Brard,* p. 140. *Id. Kid,* vol. i. p. 233. *Id. Steffens,* b. i. s. 51.—Electrischer Schorl, *Hoff.* b. i. s. 627.—Edler Turmalin, *Haus.* Handb. b. ii. s. 640. —Tourmaline, *Aikin,* p. 217.

External Characters.

Its principal colours are green and brown: from leek-green it passes into grass-green, pistachio and olive green, then into liver-brown, and yellowish and reddish brown; further into hyacinth-red, cochineal-red, rose-red, columbine-red, crimson-red, violet-blue, azure-blue, dark Berlin-blue, and, lastly, into indigo-blue *. It is never black. In some crystals the middle is of a red, but the exterior of a green colour.

Its colours are almost all dark, often a little muddy; and when

* Honey-yellow and white are mentioned as colours of tourmaline.

when it is nearly opaque, on account of the darkness of the colour, it appears almost black.

It occurs very seldom massive, or in prismatic concretions; scarcely ever disseminated; oftener in rolled pieces; but most frequently crystallized.

Its primitive form is a rhomboid of 133° 26′.

It occurs in the following forms, all of which may be traced to the rhomboid just mentioned.

Equiangular three-sided prism, *flatly acuminated* on the extremities with three planes, which on the one extremity are set on the lateral planes, on the other on the lateral edges.

The lateral edges are frequently bevelled, and thus a nine-sided prism is formed; when the edges of the bevelment are truncated, a twelve-sided prism is formed; and when the bevelling planes increase so much, that the original faces of the prism disappear, an equiangular six-sided prism is formed. The acuminations of these prisms exhibit very great variety of appearance; thus the angles, edges and extremities, are frequently truncated, and the angles bevelled. Fig. 39. Pl. 2. shews truncations on the angles of the acumination and bevelment of the lateral edges of the prism; PP, the original planes of the acumination; *o o*, the truncations on the angles. Fig. 40. Pl. 2.: in this figure the lateral edges of the prism are truncated. Fig. 41. Pl. 2. the angles formed by the meeting of two acuminating planes and one lateral plane bevelled; *x x* are the bevelling planes. When the truncations *o o*, on the angles of the acuminations, increase very much, there is formed a rather *acute acumination*, and the planes of the original acumination PP, appear as truncations on the edges formed by the meeting of the planes of this acumination, as in fig. 42. Pl. 2. When the truncations on the edges formed by the meeting

meeting of the acuminating planes increase very much in size, *a very flat acumination* is formed, and the planes of the original acumination appear as truncations on the angles formed by the meeting of two of these planes, and one of the lateral planes of the prism. In fig. 43. Pl. 2. PP are the original acuminating planes, truncated on the edges *n*. In fig. 44. Pl. 2. the truncations *nnn* form a very flat acumination, and the original planes PPP truncations on the angles of the acuminations, and the apex of the acumination is truncated, *k* being the truncating plane. Sometimes the prism is nearly awanting, as in fig. 45. Pl. 2. when a double three-sided pyramid is formed, in which the lateral planes of the one are set on the lateral edges of the other, and the remainder of the prism forms truncations on the edges of the common base.

The lateral planes are generally cylindrical convex, and deeply longitudinally streaked ; the acuminating planes are mostly smooth and shining : sometimes the planes on one extremity are smooth, but on the other rough.

The crystals are seldom large, more commonly middle-sized and small, and sometimes scopiformly aggregated, as is the case with the red variety from Siberia.

The crystals are usually imbedded.

Internally its lustre is splendent and vitreous.

The cleavage is threefold, and parallel with the sides of the rhomboid, 133° 26′.

The fracture is nearly perfect, and small conchoidal.

It alternates from nearly opaque to completely transparent. Refracts double in a middling degree.

When viewed perpendicular to the axis of the crystal, it is more or less transparent, but in the direction of the axis,

axis, even when the length of the prism is less than the thickness, it is opaque *.

It is as hard as quartz, some varieties even harder, but never so hard as topaz.

It is easily frangible.

Specific gravity.—Green tourmaline, 3.086, *Werner.*—3.086, *Brisson.*—From 3.0863 to 3.3626, *Hauy.*—Blue tourmaline, 3.155, *Werner.*—3.130, *Brisson.*—Green tourmaline, 3.191, *Lowry.*—3.0, 3.2 *Mohs.*

Physical Characters.

By friction, it exhibits signs of vitreous electricity; by heating, vitreous electricity at one extremity, and resinous electricity at the other. These electrical properties are stronger in some varieties than in others; the brown and hyacinth-red varieties shew the strongest electrical properties; the blue and green less, and the crimson-red the least. The electrical properties of this gem were known to the ancients, who named it *Lyncurium.*

Chemical Characters.

Before the blowpipe it melts into a greyish-white vesicular enamel; but the red-coloured Siberian tourmaline is infusible.

Constituent

* Werner had in his possession a tourmaline which is skye-blue in the middle, but violet-blue on the sides.

Constituent Parts.

Green Tourmaline from Brazil.		Violet Tourmaline from Siberia.		Red Tourmaline from Rosena.	
Silica, -	40.	Silica, -	42	Silica, -	43.5
Alumina,	39.	Alumina, -	40	Alumina,	42.25
Lime, -	3.84	Soda, -	10	Soda, -	9.
Oxide of Iron,	12.5	Oxide of Manganese, containing a little iron,	7	Oxide of Manganese,	1.5
Oxide of Manganese, -	2.	Loss, -	1	Lime, -	0.1
Loss, -	2.66			Water, -	2.4
	100 *		100		100
Vauquelin, Ann. de Chim. N. 88. p. 105.		*Vauquelin*, Ann. du Mus. t. iii. p. 243.		*Klaproth*, Journ. des Mines, N. 137. p. 383.	

Geognostic Situation.

Tourmaline generally occurs imbedded in beds, or in single strata, and but seldom distributed through the whole mass of a mountain. The rocks in which it most commonly occurs are gneiss, mica-slate, talc-slate, and indurated talc; and the accompanying minerals are rock-crystal, common quartz, felspar and mica. It occurs also in granite, but has not hitherto been discovered in any of the secondary rocks. It does not occur in primitive trap, nor in general it is associated with any of the subspecies of hornblende; in short, it appears to have little or no geognostic affinity with hornblende, although they have been frequently confounded together.

In alluvial countries it occurs in rolled pieces,

Geographic

* According to some late experiments, tourmaline would seem to contain Boracic acid.

Geographic Situation.

It was first discovered in the 16th century, in the island of Ceylon;—afterwards in Brazil, and since that period in several other countries, as appears from the following enumeration.

Europe.—Langoe near Krageröe in Norway; in the island of Utön in Sweden; near Freyberg, and at Ehrenfriedersdorf, Dorfschemnitz, in the Saxon Erzegebirge, or Metalliferous Mountains; at Altsattel in Bohemia; in Silesia, Bavaria, Moravia, the Tyrol, Stiria, Switzerland, Austria, Italy, Spain, and France.

Asia.—The red tourmaline occurs in Siberia, Ava, and Ceylon; and several of the other varieties in the same countries of Asia.

Africa.—Island of Madagascar.

North America.—The green, blue, yellow, and red varieties occur in the United States, imbedded in granite; and in primitive rocks in South Greenland.

South America.—Brazil.

Uses.

The green, blue, and brown varieties are sometimes cut and polished, and worn as ornamental stones; but, owing to the muddiness of their colours, are not in high esteem. When set as ring-stones, they are valued more on account of their electrical property, which can be excited by merely holding them to the fire, than for their colours, lustre, or transparency. The white rock-crystals of Catharinenburg, which contain delicate crystals of green tourmaline, as well as those inclosing crystals of actynolite and titanium, are cut and polished, and worn as ornamental stones.

Observations.

Observations.

1. *Distinctive Characters.—a.* Between tourmaline and *common schorl.* Common schorl has but one colour, whereas tourmaline has a considerable suite of colours. The fracture of common schorl is small-grained uneven; that of tourmaline conchoidal: common schorl is always opaque, tourmaline more or less translucent or semitransparent: common schorl generally occurs in distinct concretions, whereas tourmaline presents this character very rarely: and we may add, that schorl is very often massive and disseminated, but tourmaline very seldom.—*b.* Between tourmaline and *hornblende.* The colour-suite and crystallizations of this mineral are very different from those of tourmaline; hornblende has a very distinct cleavage, whereas in tourmaline, the cleavage is very rarely seen, and is indistinct; and hornblende is not so hard as tourmaline.

2. Different varieties of this mineral have received particular denominations. The following are some of these:

Names given to particular varieties of TOURMALINE.

1. Green Tourmaline, named	*Brazilian Emerald.*
2. Berlin-blue Tourmaline,	*Brazilian Sapphire.*
3. Indigo-blue Tourmaline,	*Indicolite.*
4. Honey-yellow Tourmaline.	*Peridot of Ceylon.*
5. Red Tourmaline,	*Rubelite, Siberite, Daourite, Tourmaline apyre, Red Schorl of Siberia.*

3. In the Island of Ceylon, the most frequent varieties are the brown and hyacinth-red, occasionally intermixed with

with those of a yellow, green, and red colour. In Brazil the green and blue are not uncommon: in Spain the principal variety is brown, and in other parts of Europe the dark-brown, approaching to black, is the most frequent variety. The peach-blossom red variety occurs in Moravia; the indigo-blue in the island of Uton in Sweden; and the apple-green and grass-green in dolomite in St Gothard. In the United States the blue, green, yellow and red varieties are met with.

4. The red tourmaline is arranged as a distinct subspecies, under the title *Rubellite*, by Karsten and Steffens; and Karsten and Dandrada describe the indigo-blue variety as a separate species, under the title *Indicolite.*

5. In the Grevillian collection, now in the British Museum, there is a large and fine specimen of red tourmaline, which was presented to Colonel Simes by the King of Ava *; and in the beautiful collection belonging to Baron Racknitz at Dresden, I observed a specimen of this variety nearly an inch in diameter, for which 400 rubles were paid. In Morgenbesser's cabinet at Vienna, there is a prism of red Siberian tourmaline which cost 800 rubles.

Second

* This specimen consists of many crystals, and was valued at £500 by the Commissioners who were appointed by Parliament to report on the value of the Greville collection, previously to its being purchased by Government for the British Museum.

Second Subspecies.

Common Schorl *.

Gemeiner Schörl, *Werner.*

Some of the varieties of Basaltes crystallizatus, *Wall.* t. i. p. 333. —Schwartzer-stangen schorl, *Wid.* p. 279.—Schorl, *Kirw.* vol. i. p. 265.—Sorlo-nero, *Nap.* p. 146.—Tourmaline, *Lam.* t. ii. p. 295.—Le Schorl noire, *Broch.* t. i. p. 226.—Tourmaline noire, *Haüy,* t. iii. p. 31.—Gemeiner Schorl, *Reuss,* b. ii. th. i. s. 129. *Id. Lud.* b. i. s. 71. *Id. Suck.* 1r th. s. 217. *Id. Bert.* s. 193. *Id. Mohs,* b. i. s. 177. *Id. Hab.* s. 33.—Tourmaline, *Lucas,* p. 54.—Tourmaline schorl, *Brong.* t. i. p. 407. —Tourmaline, *Brard,* p. 140.—Tourmaline, *Kid,* vol. i. p. 233. Schorl opaque et noire, *Haüy,* Tabl. p. 39.—Gemeiner Schorl, *Steffens,* b. i. s. 60. *Id. Hoff.* b. i. s. 647. *Id. Haus.* Handb. b. ii. s. 641.—Common Schorl, *Aikin,* p. 218.

External Characters.

Its colour is velvet-black, of various degrees of intensity.

It occurs often massive and disseminated, seldom in rolled pieces, and frequently crystallized, in three, six, and nine sided prisms, that present acuminations, truncations, and bevelments, of the same kinds as those that occur in tourmaline.

The crystals are mostly acicular; often appearing as if broken, and forming with the apparent fragments a peculiar

* Adelung says *Schorl* is derived from the old German word *Schor*, impure, or useless, because the schorl met with in the Saxon tin-mines, notwithstanding its resemblance to that ore in general aspect, does not belong to it, and is thrown away as useless.

liar kind of fragmented stone or breccia; and are imbedded. The lateral planes are longitudinally streaked, and alternate from shining to glistening.

It occurs in distinct concretions of different kinds; rarely coarse and small granular; sometimes thin, or thick, and straight prismatic. Sometimes the prismatic concretions are so thin, that they verge on fibrous; and such varieties are sometimes parallel, but most frequently scopiform diverging fibrous. These prismatic concretions are sometimes again collected into others, which are thick and wedge-shaped.

Internally its lustre is intermediate, between shining and glistening, and is vitreous.

The fracture is intermediate between perfect conchoidal, and small and coarse grained uneven, and inclines sometimes more to the one, sometimes more to the other.

The fragments are indeterminate angular, and somewhat sharp-edged.

It is opaque.

It affords a grey streak.

It is as hard as quartz.

It is very easily frangible.

Specific gravity, 3.092, *Brisson.*—3.150, *Gerhard.*—3.212, *Kirwan.*—3.0863 to 3.3636, *Haüy.*

Chemical Characters.

Before the blowpipe it melts pretty easily, without addition, into a blackish slag. Melted with borax, it forms a greenish-coloured glass.

Constituent

Constituent Parts.

	Common Schorl from Eibenstock.	Common Schorl from the Spessart.
Silica, -	36.75	36.50
Alumina, -	34.50	31.0
Magnesia,	0.25	1.25
Oxide of Iron,	21.0	23.50
Potash, -	6.0	5.50
Trace of Oxide of Manganese.		
	98.50	97.75

Klaproth's Beiträge, b. 5. s. 148, 149.

Physical Characters.

Exhibits the same electrical properties as tourmaline.

Geognostic Situation.

It occurs in imbedded masses and crystals in granite, gneiss, mica-slate, and clay-slate; as an essential constituent part of topaz-rock, and occasionally intermixed with quartz-rock.

It occurs in veins that traverse clay-slate and other rocks, along with quartz and tinstone, and sometimes also with felspar and mica. In these veins the schorl appears as if broken in pieces, and floating in a base of quartz. It has not been found in any of the secondary or flœtz-rocks, but occurs in alluvial deposites.

Geographic Situation.

Europe.—Perthshire, Banffshire, Ross-shire, Inverness-shire, Argylshire, and the Shetland islands; Cornwall; Norway, Sweden, Saxon Metalliferous Mountains (Erzgebirge), Hartz, Bohemia, Franconia, Moravia, Silesia, Suabia, Bavaria, Switzerland, the Tyrol, Hungary, France and Spain.

Asia.—Ceylon, borders of the Lake Baikal, and different parts of the Uralian range.

America.—Greenland, Hudson's Bay, United States, Mexico.

Observations.

1. It differs from *tourmaline* in colour, degree of lustre, fracture, transparency, and distinct concretions; also in its geognostic situation, for tourmaline occurs almost always imbedded and in single crystals; on the contrary, schorl is usually aggregated, and occurs in beds.

2. The *aphrizit* of D'Andrada is but a variety of schorl.

3. Large and beautiful crystals of common schorl are found in Spain, the Tyrol, Island of Madagascar, West Greenland; and of late years the United States of America have furnished splendid crystals of this mineral.

GENUS VIII.

Genus VIII.—CHRYSOLITE.

This genus contains one species, viz. Prismatic Chrysolite.

1. Prismatic Chrysolite.

Prismatischer Krisolith, *Mohs.*

Peridot, *Haüy.*

This species is divided into two subspecies, viz. Chrysolite, and Olivine.

First Subspecies.

Chrysolite *.

Krisolith, *Werner.*

Yellowish-green Topaz, Chrysolith, *Cronstedt,* § 46. 5. p. 54.—Gemma pellucidissima, duritia sexta, colore viridi, subflavo, in igne fugaci; Chrysolithus, *Wall.* gen. 18. spec. 119. p. 255.—Krysolith, *Wid.* s. 264.—Chrysolite, *Kirw.* vol. i. p. 262.—Krysolith, *Estner,* b. ii. s. 122. *Id. Emm.* b. i. s. 26.—Chrysolito nobile, *Nap.* p. 127.—Peridot, *Lam.* t. ii. p. 250.—La Chrysolithe, *Broch.* t. i. p. 170.—Peridot, *Haüy,* t. iii. p. 198.—Chrysolith, *Reuss,* b. i. s. 49. *Id. Lud.* b. i. s. 60. *Id. Suck.* 1r th. s. 540. *Id. Bert.* s. 138. *Id. Mohs,* b. i. s. 42. *Id. Leonhard,* Tabel. s. 1.—Peridot, *Lucas,* p. 74.—Peridot Chrysolithe, *Brong.* t. i. p. 440.—Peridot, *Brard,* p. 179.—Chrysolith,

* The name *Chrysolite* (χρυσολιθος, *Chrysolithus,* a gold-yellow stone) is of Grecian origin, but was by the ancients applied to the topaz.

lith, *Haus.* s. 98. *Id. Karsten,* Tabel. s. 40.—Chrysolite, *Kid,* vol. i. p. 120.—Peridot, *Haüy,* Tabl. p. 52.—Chrysolith, *Steffens,* b. i. s. 365. *Id. Lenz,* b. i. s. 203.—Harter Peridot, *Oken,* b. i. s. 333.—Krisolith, *Hoff.* b. i. s. 429. *Id. Haus.* Handb. b. ii. s. 680.—Chrysolite, *Aikin,* p. 229.

External Characters.

Its colour is pistachio-green, which sometimes approaches to olive-green, seldom to asparagus-green, and pale grass-green. Very rarely we observe in the same specimen, besides the green, also in a particular direction a pale cherry-red, inclining to broccoli-brown colour.

It occurs in angular pieces, (that appear to be original,) sometimes in roundish pieces which seem to be pebbles, and often crystallized. The primitive figure is a prism of 131° 48′. All the other figures may be traced to this prism. The following are some of the principal varieties of secondary forms.

1. Broad rectangular four-sided prism, in which the lateral edges are truncated. The broader lateral faces are generally cylindric convex. The prism is acuminated with six planes: of these planes, two are set on the broader lateral planes, and the other four on the truncating planes of the lateral edges. The apex of the prism is truncated, fig. 46*, Pl. 3.
2. The preceding figure, but acuminated with eight planes, which are set on the lateral and truncating planes

* Peridot triunitaire, Haüy.

planes of the prism, and the apex of the prism deeply truncated, fig. 47 *, Pl. 3.

3. The preceding figure, in which the edge between the truncating plane of the apex of the acumination, and the acuminating plane which rests on the smaller lateral plane, is truncated, fig. 48 †, Pl. 3.

4. Very oblique four-sided prism, in which the acuter edges are bevelled, and the edges of the bevelment truncated; and acuminated on the extremities with four planes, which are set on the lateral edges, and the apex of the acumination slightly truncated. This figure is formed from N° 1. when the truncations on the lateral edges increase, until the broader lateral planes disappear. Sometimes the bevelling and acuminating planes are very small, but the truncating planes of the bevelment large, so that the crystal appears like a four-sided table of heavy-spar, bevelled on the terminal planes, or it assumes a reed-like aspect ‡, fig. 49. Pl. 3.

5. Less oblique four-sided prism, in which the obtuse edges are truncated, the acute bevelled, and the bevelment truncated; acuminated on the extremities with eight planes, of which four are set obliquely on the lateral planes of the prism, four straight on the truncated lateral edges. The apex of the acumination truncated ||, fig. 50. Pl. 3.

6. N° 3

* Peridot monostique, Haüy.

† Peridot subdistique, Haüy.

‡ Peridot continu, Haüy.

|| Peridot doublant, Haüy.

6. N° 3. in which the lateral edges in place of being truncated, are bevelled *, fig. 51. Pl. 3.

Some crystals are very thin and reed-like, or table-shaped.

The crystals are middle-sized, small, and all around crystallized.

The external surface of the angular pieces, as also of the crystals, where they have suffered from attrition, are delicate splintery, or scaly and glistening: in unaltered crystals, on the contrary, the broader lateral planes in all the varieties, with exception of N° 4., are deeply longitudinally streaked; but the smaller lateral planes are often smooth, and the acuminating planes are always smooth.

Internally the lustre is splendent and vitreous.

The cleavage is in the direction of the smaller diagonal of the prism.

The fracture is perfect flat conchoidal.

The fragments are indeterminate angular and very sharp-edged.

It is transparent, and refracts double, particularly when viewed through the broader acuminating planes, and the obliquely opposite broader lateral planes of N° 1.

It scratches felspar, and sometimes even quartz.

It is brittle.

It is easily frangible.

Specific gravity, 3.340, 3.420, *Werner.*—3.428, *Haüy,* 3.301, 3.472, *Karsten.*—3.343, *Lowry.*—3.3, 3.5, *Mohs.*

Chemical Characters.

Its colours change, but it does not melt, without addition, before the blowpipe; but with borax, it melts into a transparent green glass.

Constituent

* Peridot quadruplant, Haüy.

Constituent Parts.

Silica, -	39.00	88.00	38.00
Magnesia,	43.50	39.50	50.50
Iron, -	19.00	19.00	9.50
	101.50	96.50	100
	Klaproth, Beit. b. i. s. 110.	Id. *Klap.* s. 107.	*Vauquelin.*

Geognostic Situation.

This mineral has hitherto been found only in a loose state: some mineralogists conjecture that it occurs in veins in serpentine, or greenstone; and also in newer trap rocks.

Geographic Situation.

It is brought to Europe from the Levant, and it is said to occur in Upper Egypt, and on the shores of the Red Sea; and it is alleged to have been detected in trap rocks in Bohemia, and the Isle de Bourbon *.

Uses.

This gem, which has an agreeable colour, and considerable lustre and transparency, is used in jewellery for necklaces, hair ornaments, and for ring-stones, when it is set with a gold foil. It is the softest of the precious stones; hence

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* Pliny, who describes it under the name Topaz, says that it is found in the island Topazos in the Red Sea, and also near the town of Alabastrum, near Thebais in Upper Egypt.

hence jewels of it become dull on the surface, if not carefully worn and kept *.

Observations.

1. This mineral is characterised by its pistachio-green colour, the other varieties occurring rarely; the fine splintery or scaly surface of the angular pieces; its crystallizations, internal lustre, fracture, inferior hardness, and weight.

2. *Distinctive Characters.—a.* Between Chrysolite and *Vesuvian.* If the vesuvian is in rolled pieces, it can be distinguished from chrysolite, by its wanting the fine scaly or splintery surface which characterises that mineral: if in crystals, by their being very slightly longitudinally streaked, having a fine-grained uneven fracture, and resinous internal lustre; whereas the crystals of chrysolite are deeply longitudinally streaked, the fracture is conchoidal, and the lustre is vitreous. A simple chemical distinctive character may be mentioned: vesuvian is fusible before the blowpipe, chrysolite is infusible.—*b.* Between Chrysolite and yellowish-brown and pistachio-green *Tourmaline.* Tourmaline becomes strongly electric by heating, but the chrysolite only by rubbing; tourmaline is harder than chrysolite; the crystallizations of tourmaline are different from those of chrysolite; and tourmaline is heavier than chrysolite.—*c.* Between Chrysolite and *Asparagus-stone* of Werner. Asparagus-stone is softer and lighter than chrysolite, and refracts single, whereas chrysolite refracts double.

3. Werner

* Dr Clarke mentions a mass the size of a turkey's egg, which was purchased by the lady of the Russian ambassador at Constantinople, and cut into a necklace and bracelets.

3. Werner is of opinion, that the stone described by the ancients under the name *Yellow Chrysolite*, is not the true chrysolite, but our topaz. The celebrated traveller Bruce, mentions an island in the Red Sea which was said to afford emeralds; but remarks, that the substance he there met with, was scarcely harder than glass. Dr Kid remarks, "May not this have been chrysolite, and this island the Topaz Island mentioned by Pliny?" Romé de Lisle and Born, describe the asparagus-stone of Werner under the name Chrysolite; and other writers have confounded it with Chrysoberyl, and oil-green Beryl.

Second Subspecies.

Olivine *.

Olivin, *Werner.*

Olivin, *Werner,* Bergm. Journ. 3. 2. s. 56.—Chrysolit en grains irreguliers, *De Born,* t. i. p. 70.—Olivin, *Wid.* s. 261. *Id. Kirw.* vol. i. p. 263. *Id. Emm.* b. i. s. 35.—Crysolito commune, *Nap.* p. 131.—Olivine, *Lam.* t, ii. p. 278. *Id. Broch.* t. i. p. 175.—Peridot granuliforme, *Haüy,* t. iii. p. 205.—Olivin, *Reuss,* b. ii. s. 49. *Id. Lud.* b. i. s. 61. *Id. Suck.* 1r th. s. 556. *Id. Bert.* s. 151. *Id. Mohs,* b. i. s. 45.—Chrysolith Olivin, *Hab.* s. 56.—Peridot granuliforme, *Lucas,* p. 74.—Olivin, *Leonhard,* Tabel. s. 2.—Peridot Olivine, *Brong.* t. i. p. 441.—Peridot granuliforme, *Brard,* p. 179.—Olivin, *Karst.* Tabel. s. 40. *Id. Kid,* vol. i. p. 122.—Peridot granuliforme, et lamelliforme, *Haüy,* Tabl. p. 52.—Olivin, *Steffens,* b. i. s. 363. *Id. Lenz,* b. i. s. 206.—Weicher Peridot, *Oken,* b. i.

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* The name *Olivine*, is given to this species on account of its predominating olive-green colour.

b. i. s. 334.—Olivin, *Hoff.* b. i. s. 437. *Id. Haus.* b. ii. s. 681. *Id. Aikin,* p. 229.

External Characters.

Its colour is olive-green, which passes on the one side into asparagus-green, on the other into oil-green, and into a colour intermediate between ochre and cream-yellow, and into pale yellowish-brown.

It occurs massive, in grains, in roundish pieces, from the size of a hemp-seed to that of a man's head, which are generally imbedded, and less frequently loose.

When crystallized, which is rarely the case, it is in the form of rectangular four-sided prisms, which are always imbedded.

The massive varieties occur in small and angulo-granular concretions.

Internally the lustre is shining and glistening, and is indeterminate between vitreous and resinous.

An imperfect double cleavage is sometimes discoverable.

The fracture is small-grained uneven, sometimes passing into imperfect small conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, passing into semi-transparent, seldom transparent.

It is hard, but in a lower degree than chrysolite.

It is brittle.

It is easily frangible.

Specific gravity, 3.225, *Werner.*—3.265, *Klaproth.*

Chemical Characters.

It is infusible before the blowpipe without addition; with borax, it melts into a dark-green bead. It loses its colour

colour in nitrous acid, the acid dissolving the iron, which is its colouring ingredient.

Constituent Parts.

	Olivine of Unkel.	Olivine of Karlsberg.
Silica, - -	50.0	52.00
Magnesia, -	38.50	37.75
Lime, - -	0.25	0.12
Oxide of Iron, -	12.00	10.75
	100.75	100.62
	Klaproth, Beit. b. v. s. 118.	Id. *Klaproth*, s. 121.

Geognostic Situation.

It occurs imbedded in basalt, greenstone, porphyry, and lava, and generally accompanied with augite.

Geographic Situation.

Europe.—It occurs in the secondary trap rocks of the Lothians, and other districts in Scotland; and in those of the Hebrides. Sparingly in trap rocks in the north of Ireland *. It is found in Iceland; and on the Continent, in Bohemia, Saxony, Stiria, Austria, Hungary, France, Italy, Spain, &c.

Africa.—Teneriffe; St Helena; Isle de Bourbon.

America.—Greenland; and the Cordilleras of South America.

Observations.

* Greenough.

Observations.

1. *a.* Olivine is distinguished from Chrysolite by its paler green colours, external shape, lower lustre, fracture, distinct concretions, inferior transparency, inferior hardness, and weight.

b. Olivine is nearly allied to Augite: this alliance is not so much a consequence of agreement in external characters, as rather a similarity in geognostic relations. Both species occur in the same kind of rock, and the one seldom without the other; and the large masses and grains of olivine sometimes contain small angular grains of augite, which take, as it were, the place of single distinct concretions,—a fact which shews their mutual affinity. It is distinguished from *Augite* by its paler colours, external shape, kind of lustre, fracture, superior transparency, and its inferior hardness and weight.

c. It is distinguished from *Common Green Garnet*, by its greater transparency, inferior hardness, and weight, and geognostic situation.

2. It frequently decays, or falls into an earth, which much resembles iron-ochre. When it begins to exhibit on its surface iridescent colours, it is a proof of its having already begun to decay.

3. A yellow substance, nearly allied to olivine, occurs in the Siberian meteoric iron.

GENUS IX.

GENUS IX.—AXINITE *.

THIS Genus contains but one species, viz. Prismatic Axinite.

1. Prismatic Axinite.

Prismatischer Axinit, *Mohs.*

Thumerstein, *Werner.*

Schorl transparent lenticulaire, *Romé de Lisle,* t. ii. p. 353.—Glass-schorl, or Glastein, *Wid.* p. 294.—Thumerstone, *Kirw.* vol. i. p. 273.—Glastein, *Klap.* b. ii. s. 118.—Tumite, *Nap.* p. 158.—Janolite, *Lam.* t. ii. p. 316.—La pierre de Thum, *Broch.* t. i. p. 236.—Axinite, *Haüy,* t. iii. p. 22.—Axinit, *Reuss,* b. ii. th. i. s. 200. *Id. Suck.* 1r th. s. 230.—Thumerstein, *Bert.* s. 184. *Id. Mohs,* b. i. s. 180. *Id. Lud.* b. i. s. 73. *Id. Hab.* s. 22.—Axinite, *Lucas,* p. 53. *Id. Brong.* t. i. p. 389. *Id. Brard,* p. 138. *Id. Kid,* vol. i. p. 240. *Id. Steffens,* b. i. s. 77. *Id. Haüy,* Tabl. p. 37. *Id. Hoff.* b. i. s. 678. *Id. Haus.* Handb. b. ii. s. 626. *Id. Aikin,* p. 215.

External Characters.

Its most common colour is clove-brown, of various degrees of intensity; from which it passes on the one side into plum-blue, on the other into pearl-grey, ash-grey, and greyish-black †.

It

* The name *Axinite,* from αξινη, *an axe,* on account of the axe-like shape of the crystals.

† It has sometimes a green colour, owing to intermixed chlorite, and crystals of this colour are alleged to be the most regular.—Brong. t. i. p. 390.

It is seldom found massive, often disseminated, but most frequently crystallized.

The primitive form is an oblique four-sided prism, whose bases are parallelograms, with angles of 101° 56′, and 78° 50′, or it is a very flat rhomboid, according to the Wernerian Crystallography. Two of the crystallizations of this species are represented in fig. 51. and 52. Pl. 3.; and the following are the descriptions, according to the Wernerian method:

1. In very flat rhomboids, in which the two opposite acute lateral edges are generally truncated. Fig. 51. Pl. 3.
2. Oblique four-sided table, in which two opposite terminal planes are set on obliquely; the other two bevelled; and two opposite acute angles truncated. The truncating planes are smooth, but the others are streaked. Fig. 52. Pl. 3.

The crystals sometimes intersect one another, forming a kind of cellular aggregation.

The massive varieties occur in curved lamellar distinct concretions, whose surface is shining and streaked.

Externally its lustre is generally splendent; internally, it alternates from glistening to shining, and is vitreous, slightly inclining to resinous.

The fracture is fine-grained uneven; in the translucent varieties it sometimes approaches to splintery; in the transparent varieties, to small and imperfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It alternates from perfectly transparent to feebly translucent.

It is harder than felspar, but not so hard as quartz.

It is very easily frangible.

Specific gravity, from 3.213 to 3.2956, *Haüy*—3.295, *Kirwan.*—3.250, *Gerhard.*—3. 3.3, *Mohs.*

Chemical

Chemical Character.

Is easily fusible with ebullition into a bottle-green glass, which by continuance of the heat becomes nearly black.

Constituent Parts.

Silica,	52.70	44.0	50.50
Alumina,	25.79	18.0	16.
Lime,	9.39	19.0	17.
Oxide of Iron,	8.63	14.0	9.50
—— of Manganese,	1.0	4.0	5.25
Potash,	-		0.25
	97.51	99.0	98.50
	Klaproth, t. 2. p. 126.	*Vauquelin*, Jour. d. Mines, n. 23.	*Klaproth*, t. v. p. 28.

Geognostic Situation.

This mineral occurs in primitive mountains, in rocks of gneiss, mica-slate, clay-slate and hornblende-rock. The massive varieties occur in beds, the crystallized in veins. In the Saxon metalliferous mountains, where it occurs in beds, it is associated with massive calcareous-spar, common chlorite, magnetic-pyrites, iron-pyrites, arsenical pyrites, copper-pyrites, blende, and probably also with actynolite and hornblende. At Kongsberg in Norway, it occurs along with native silver, galena, slaty glance-coal, and calcareous-spar. In the Felberthal in Salzburg, it occurs in mica-slate; and in the Hartz, along with quartz and asbestus; at Arendal in Norway, along with calcareous-spar, common actynolite, common iron-pyrites, felspar, epidote, and sphene. The axinite from Dauphiny, Savoy, and several other places, occurs in small veins, that traverse gneiss, in which it is generally the uppermost mineral. In these veins,

veins it is associated with crystallized felspar, rock-crystal, asbestus, epidote, octahedrite, mica, and chlorite.

Geographic Situation.

Europe.—It occurs in Carrarach-mine, two miles north of St Just's Church in Cornwall *, in a bed in clay-slate, associated with garnet, and common schorl. Upon the Continent of Europe, at Arendal and Kongsberg in Norway. At Thum, near Ehrenfriedersdorf, Schneeberg, and Siebenschlien in Upper Saxony, and at Treseburg in Lower Saxony; also in the Black Forest (Schwartzwald) in Swabia; in the valley of Lauterbrun in the Canton of Berne, the valley of Ferrera in Graubunden, and the valley of Chamouny in Switzerland; at Ayarsun in Guipusco in Spain; and in Dauphiny and Alsace.

Africa.—In Mount Atlas.

Observations.

1. *Distinctive Characters.*—Between axinite and *common felspar.* Felspar has a different suite of colours from that of axinite: felspar has a distinct cleavage, axinite a compact fracture; felspar does not occur in curved lamellar concretions, as is the case with axinite; felspar is softer than axinite; felspar has a specific gravity of 2.4 to 2.7, axinite 3.21 to 3.29; and felspar melts before the blowpipe into a white-coloured enamel; axinite to a blackish-coloured glass.

2. The first crystal of axinite was described by Romé de Lisle, but he arranged it with schorl: it was Werner who established it as a distinct species.

3. Werner named it Thumerstone, from Thum in Saxony, where it was first found: Haüy's name Axinite, is derived

* Greenough.

derived from the shape of the crystals, which somewhat resembles that of an axe. When first discovered, it was named Dauphiny-Schorl, Glass-Schorl, and Violet-Schorl.

Genus X.—GARNET *.

This Genus contains three species, viz. Pyramidal Garnet, Dodecahedral Garnet, and Prismatic Garnet.

1. Pyramidal Garnet.

Pyramidaler Granat, *Mohs.*

This species contains three subspecies, viz. Vesuvian, Egeran, and Gehlenite.

First Subspecies.

Vesuvian †.

Vesuvian, *Werner.*

Idocrase, *Haüy.*

Hyacinth du Vesuve, *Romé de Lisle,* t. ii. p. 291.—Vulcanischer Schorl, *Wid.* s. 290.—Vesuvian, *Estner,* b. ii. s. 177. *Id. Emm.* b. i. s. 342.—Hyacinthe, *Lam.* t. ii. p. 323.—La Vesuvienne, *Broch.* t. i. p. 184.—Idocrase, *Haüy,* t. ii. p. 574.—Vesuvian, *Reuss,* b. ii. th. i. s. 91. *Id. Lud.* b. i. s. 63. *Id. Suck.* 1r th. s. 197.

* The name *Garnet,* is conjectured to be derived either from *granum,* a grain, this gem occurring often in the granular form ; or from *granate,* the pomegranate tree, the flowers of which have a red colour resembling that of the garnet,

† The name *Vesuvian* was given this mineral, from its frequent occurrence at Mount Vesuvius.

s. 197. *Id. Bert.* s. 156. *Id. Mohs,* b. i. s. 68. *Id. Hab.* s. 27. —Idocrase, *Lucas,* p. 48. *Id. Brong.* t. i. p. 391. *Id. Brard,* p. 128.—Vesuvian, *Kid,* vol. i. p. 252.—Idocrase, *Haüy,* Tabl. p. 34.—Vesuvian, *Steffens,* b. i. s. 358. *Id. Hoff.* b. i. s. 472. —Idocras, *Haus.* Handb. b. ii. s. 622. *Id. Aikin,* p. 224.

External Characters.

Its principal colours are green and brown; the most frequent green colour is blackish-green, less frequent are leek-green, pistachio-green, olive-green, and oil-green; the most frequent brown colour is liver-brown, less frequent varieties are blackish-brown, and reddish-brown. It is rarely of a blue colour.

It occurs massive, disseminated, and in coarse and small granular concretions; but more frequently crystallized.

The primitive form is a pyramid of 129° 30′ and 74° 12′. The following varieties of form can be referred to this pyramid.

1. Rectangular four-sided prism, flatly acuminated by four planes, which are set on the lateral planes; the lateral edges and summits of the acumination truncated. Fig. 53. Pl. 3.
2. Preceding figure, in which the lateral edges are bevelled, and the edges of the bevelments truncated. Fig. 54. Pl. 3.
3. Preceding figure, in which the acuminating edges are truncated. Fig. 55. Pl. 3.
4. When the four-sided prism, acuminated by four planes, becomes so low, that the acuminating planes touch each other, a flat double four-sided pyramid is formed, in which the summits and the angles on the common base are truncated*.

The

* Professor Beavois observed in Piedmont vesuvian crystals having cylindrical and very deeply longitudinally streaked lateral planes; but these, according to M. Verina, appear to be groupes of acicular crystals.

The crystals are generally short and middle-sized; sometimes all around crystallized, at other times superimposed.

The lateral planes of the prism are longitudinally streaked; but the truncating and terminal planes are smooth.

Externally the crystals are splendent; internally glistening, approaching to shining, and the lustre is vitreo-resinous.

The cleavage is in the direction of the diagonals of the prism, but imperfect.

The fracture is small-grained uneven.

It alternates from translucent to translucent on the edges; and refracts double.

It scratches felspar, but not quartz.

It is brittle, and rather easily frangible.

Specific gravity, 3.409, *Werner.*—3.0882 to 3.409, *Haüy.*—3.365 to 3.420, *Klaproth.*—3.4412, *Karsten.*—3.3 to 3.4, *Mohs.*

Physical Characters.

It becomes electrical by friction, but not by heating.

Chemical Characters.

Before the blowpipe it melts without addition into a yellowish and faintly translucent glass.

Constituent

Constituent Parts.

	Vesuvian of Vesuvius.	Of Siberia.
Silica,	35.5	42.
Lime,	33.0	34.
Alumina,	22.25	16.25
Oxide of Iron,	7.5	5.5
Oxide of Manganese, -	0.25	
Loss, -	1.5	2.25
	100	100

Klaproth, Beit. b. ii. s. 32, & 38.

Geognostic and Geographic Situations.

Europe.—It was first found in the vicinity of Vesuvius, where it still occurs in considerable abundance, in unaltered ejected rocks, composed of granular limestone, mica, hornblende, melanite, garnet, quartz, epidote, felspar, chlorite, and specular iron-ore.

These rocks are supposed to be part of the primitive mass in which that celebrated volcanic mountain is situated; and are probably disposed in beds.

The rare blue variety is found at Souland, in Tellemark, in Norway, along with a hard peach-blossom coloured mineral named *Thulite* *.

Other varieties occur in small irregular veins traversing gneiss, in the vicinity of Monte Moro, eastward of Monte Rosa; and in a rock named Testa Ciarva, in the Plain of Musa in Piedmont, in veins traversing serpentine. Beautiful transparent oil-green varieties are found at Corbassiera in Piedmont; brown varieties, in talc-slate in the district

* The Thulite Mr Heuland informs me is also found in Greenland.

strict of Balme in Piedmont *. In large crystals upon Mount St Gothard; and near Pitigliano in the district of Sienna. In gneiss, along with hornblende, precious garnet, and magnetic ironstone, at San Lorenzo in Spain. In Ireland, (according to my friend and pupil Dr Fitton †), it occurs at Kilranelagh in primitive country, in a rock composed of garnet, quartz and felspar; also at Donegal, in a rock composed of quartz, granular limestone, and a fibrous substance supposed to be tremolite.

Asia.—It occurs in Kamschatka, at the mouth of the rivulet Achtergada, which flows into the Wilui, in a pale greenish-grey coloured steatite, which contains crystallized magnetic ironstone; also in serpentine, and in a rock composed of chlorite and calcareous-spar ‡.

Uses.

At Naples, it is cut into ring-stones, and is sold under various names: the green-coloured varieties are denominated Volcanic Chrysolite; and the brown, Volcanic Hyacinth.

Observations.

1. *Distinctive Characters.—a.* Between vesuvian and *garnet.* The planes of garnet are glistening, or glistening inclining to shining; those of vesuvian splendent: garnet is harder and heavier than vesuvian: the most frequent forms of

* Mr Heuland, and Mr J. Marryat *junior*, possess magnificent specimens of the oil-green vesuvian. Mr Marryat's collection of Piedmontese minerals is unique.

† Transactions of the Geological Society, vol. i. p. 274.

‡ This variety has been described under the name *Wiluite.*

of garnet, are the garnet dodecahedron and leucite figure, neither of which occur in vesuvian: garnet is not so transparent as vesuvian: lastly, garnet is not so fusible as vesuvian, and yields rather a black scoria than a translucent glass.—*b.* Between vesuvian and *zircon.* The pyramid of zircon is flatter than that of vesuvian, and is much more frequent; and zircon is harder and heavier.—*c.* Between vesuvian and *chrysolite.* Chrysolite is distinguished from vesuvian, by colour, form, greater transparency, superior internal lustre and kind of fracture.—*d.* Between vesuvian and *Brazilian tourmaline.* Brazilian tourmaline differs from vesuvian in colour, and by its becoming electrical by heating, which is not the case with vesuvian, this latter mineral showing electrical properties only by friction.

2. It has been described under a variety of names, as Volcanic Schorl, Chrysolite, Hyacinth, and Topaz. Werner first established it as a distinct species, and gave it its present name.

3. The Peridote Idocrase of Bonvoisin, which is found in the Alps of Musa in Piedmont, along with garnet in serpentine, is a variety of vesuvian.

Second Subspecies.

Egeran *.

Egeran, *Werner.*

External Characters.

The colour is reddish-brown, sometimes passing into liver-brown.

It

* *Egeran*, from Eger in Bohemia, where it is found.

It occurs massive, and sometimes crystallized, in rectangular four-sided prisms, with cylindrical convex lateral planes. The prisms are long, and deeply longitudinally streaked.

It occurs in thin, and very thin distinct concretions, which are scopiform or promiscuous, and collected into large angulo-granular concretions.

Externally it is shining; internally glistening and shining, and lustre vitreous, slightly inclining to resinous.

The cleavage is twofold, in the direction of the sides of the rectangular prism.

The fracture is uneven, passing into small and imperfect conchoidal.

It is feebly translucent on the edges.

It scratches felspar, but not quartz.

It is brittle.

Specific gravity 3.294, *Breithaupt.*

Chemical Character.

Before the blowpipe it melts into a black scoria.

Geognostic and Geographic Situations.

It occurs at Haslau near Eger in Bohemia.

It is generally associated with quartz and calcareous spar, sometimes also with garnet, or with asbestous tremolite, and is contained in a bed of felspar and hornblende, subordinate to mica-slate.

Third

Third Subspecies.

Gehlenite *.

Gehlenit, *Fuchs*, in Brocchi, Über das Thal Fassa.—Stylobat, *Breithaupt*, in Leonhard's Taschenbuch.

External Characters.

Its colours are olive-green inclining to leek-green, oil-green, liver-brown, greenish-grey, and greenish-white. All the colours are muddy.

It occurs crystallized in rectangular four-sided prisms, which are so short as to appear as tables. The planes are rough and dull, or very feebly glimmering.

The crystals are small and very small, and seldom middle sized; are superimposed, or on one another; and sometimes imbedded in calcareous spar.

Internally glistening; often nearly dull, and intermediate between resinous and vitreous.

The cleavage threefold and rectangular; but very imperfect.

The fracture fine splintery.

Is strongly translucent on the edges; or nearly opaque.

It is rather easily frangible.

It is harder than felspar; but not so hard as quartz.

Specific gravity 2.98.

Chemical Characters.

Before the blowpipe it melts into a brownish-yellow transparent glass, which soon becomes opaque and scoriform, when acted on by the interior part of the flame.

Geographic

* *Gehlenite*, in honour of Gehlen the chemist.

Geographic Situation.

It occurs along with calcareous spar in the valley of Fassa in the Tyrol.

2. Dodecahedral Garnet.

This species contains nine subspecies, viz. 1. Pyreneite, 2. Grossulare, 3. Melanite, 4. Pyrope, 5. Garnet, 6. Allochroite, 7. Colophonite, 8. Cinnamon-stone, 9. Helvin.

First Subspecies.

Pyreneite *.

Pyreneit, *Werner.*

External Characters.

Its colour is greyish-black.

It occurs massive, and crystallized in the form of rhomboidal dodecahedrons.

The crystals are small, all around crystallized, and imbedded.

Externally it is glistening, inclining to shining, and metallic-like.

Internally it is glistening and vitreous.

The fracture is small-grained uneven.

The fragments are indeterminate angular, rather sharp-edged.

It is opaque.

It is hard.

Specific gravity 2.500? *Raymond.*

Chemical

* So named from the Pyrenees, where it occurs.

Chemical Characters.

It loses its colour before the blowpipe, intumesces and melts with great ease into a yellowish-green vesicular enamel.

Constituent Parts.

Silica, - -	43
Alumina, - -	16
Lime, - -	20
Oxide of Iron, -	16
Water, - -	4
	99

Vauquelin, Journal des Mines, N. 44. p. 571.

Geognostic and Geographic Situations.

It occurs in primitive limestone in the Pic of Eres-Lids near Bareges in the French Pyrenees. The massive varieties are disposed in thin layers, with limestone; the crystals are imbedded in the same rock.

Observation.

This subspecies was discovered in the Pyrenees by Raymond.

Second Subspecies.

Grossulare *.

Grossular, *Werner.*

Grossular, *Steffens,* b. i. s. 93.—Olivengrün Granat aus Siberien, *Klaproth,* b. iv. s. 319. *Id. Haüy,* Tabl. p. 58.—Grossular,

* The name *Grossulare* is derived from the [Ribes] grossularia, or gooseberry, because this mineral resembles some varieties of that fruit in colour and general form.

sular, *Hoff.* b. i. s. 479.—Gemeiner Granat, *Haus.* Handb. b. ii. s. 599.

External Characters.

Its colour is asparagus-green, approaching to mountain-green.

It has been hitherto found only crystallized, and in the following form:

Leucite crystallization; or the acute double eight-sided pyramid, flatly acuminated on both extremities by four planes; the acuminating planes set on the alternate edges of the double eight-sided pyramid.

The crystals are middle-sized and small, and are all around crystallized.

The planes of the crystals are smooth.

Externally it is shining; internally shining, and the lustre is resinous.

The fracture is intermediate between conchoidal and uneven.

It is strongly translucent.

It is hard.

It is rather easily frangible.

Specific gravity 3.351, *Werner.*—3.372, *Klaproth*, 3.600, *Gerhard.*—3.562, *Blöde.*

Chemical Characters.

It melts like garnet before the blow-pipe, and into a brown vesicular bead.

Constituent

Constituent Parts.

Silica,	- -	44
Lime,	- -	33.50
Alumina,	-	8.50
Oxide of Iron,	-	12.
Loss,	- -	2
		100

Klaproth, Beit. b. iv. s. 323.

Geognostic and Geographic Situations.

It occurs imbedded in small crystals, along with vesuvian, in a pale greenish-grey claystone, near the river Wilui in Siberia; also in the Bannat of Temeswar.

Observations.

1. This garnet was discovered in Siberia in the year 1780, by Counsellor Laxman; and was first mentioned by Pallas, in the fifth volume of the Neue Nordische Beiträge.

2. In the centre of some crystals portions of the matrix occur, and these also contain minute grains of the grossulare, thus exhibiting appearances of the same nature as those observed in the leucite imbedded in trap-rocks.

Third Subspecies.

Melanite *.

Melanit, *Werner.*

Melanit, *Broch.* t. i. p. 191. *Id. Reuss,* b. ii. th. i. s. 136. *Id. Suck.* 1r th. s. 194. *Id. Bert.* s. 162. *Id. Mohs,* b. i. s. 76. *Id. Lud.*

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* *Melanite,* from μελας, *black,* the only colour of this mineral.

Lud. b. i. s. 64.—Grenat Melanite, *Brong.* t. i. p. 397.—Schlackiger Granat, *Karsten,* Tabel.—Grenat noire emarginé, *Haüy,* Tabl. p. 33.—Melanit, *Steffens,* b. i. s. 92.—Melanit, *Hoff.* b. i. s. 488. *Id. Haus.* b. ii. s. 664. *Id. Aikin,* p. 226.

External Characters.

Its colour is velvet-black, which sometimes inclines to greyish-black.

It occurs in roundish grains, but most frequently crystallized.

Its regular form is the rhomboidal dodecahedron, truncated on all the edges.

It is all around crystallized.

The crystals are middle-sized and small.

The surface of the grains is rough and uneven, that of the crystals is sometimes rough and uneven, but more frequently smooth and shining, sometimes approaching to splendent. Internally it is shining, inclining to glistening; and is resino-vitreous.

The fracture is flat and imperfect conchoidal: sometimes with traces of a threefold cleavage parallel with the acuminating planes of the dodecahedron.

The fragments are indeterminate angular and sharp-edged; sometimes rhomboidal.

It is opaque.

Is as hard as quartz.

It is rather easily frangible.

Specific gravity 3.730, *Klaproth.*—3.7, *Hausmann.*—3.729—3.774, *Breithaupt.*—3.791, *Vauquelin.*

Constituent

Constituent Parts.

Silica, - -	35.5
Alumina, - -	6.
Lime, - -	32.5
Oxide of Iron, -	25.25
Oxide of Manganese,	0.4
Loss, - -	0.35
	100

Klaproth, Beiträge, b. v. p. 168.

Geognostic and Geographic Situations.

It is found in a rock at Frescati near Rome, which contains besides melanite, also felspar, vesuvian, and basaltic hornblende. At Monte Somma near Naples it occurs in granular limestone; and in grains in the basalt of Bohemia; and in the iron-mines of Swappavara at Tornea in Lapmark.

Observations.

1. *Distinctive Characters.—a.* Between melanite and *precious garnet.* Red is the only colour of precious garnet, and it exhibits several varieties of it; whereas velvet-black is the only colour of melanite: In precious garnet, the suite of crystals extends from the garnet or rhomboidal dodecahedron to the double eight-sided pyramid acuminated by four planes, or the leucite form; whereas the melanite has but one figure, which is the rhomboidal dodecahedron truncated on its edges. The internal lustre of precious garnet is vitreous, that of melanite resino-vitreous; precious garnet alternates from transparent to translucent, melanite is opaque: precious garnet scratches quartz more readily

readily than melanite; and the specific gravity of precious garnet is 4.2, that of melanite only 3.7.—*b*. Between melanite and *common garnet.* The colours of common garnet are green and brown, colours that do not occur in melanite: common garnet occurs most commonly massive, melanite never; the suite of crystallizations of common garnet is the same as in precious garnet, therefore very different from melanite: the fracture of common garnet is uneven, that of melanite conchoidal: common garnet occurs in granular concretions, which is never the case with melanite; and common garnet is more or less translucent, but melanite is always opaque.

Fourth Subspecies.

Pyrope *.

Pyrop, *Werner.*

Pyrop, *Broch.* t. ii. p. 498. *Id. Lud.* b. i. s. 67. *Id. Hab.* s. 28. *Id. Mohs,* b. i. s. 97. *Id. Lucas,* p. 265.—Grenat Pyrope, *Brong.* t. i. p. 369.—Pyrop, *Karst.* Tabl.—Grenat, rouge de feu, granuliforme, *Haüy,* Tabl. p. 33.—Pyrop, *Steffens,* b. i. s. 94. *Id. Hoff.* b. ii. s. 521. *Id. Haus.* Handb. b. ii. s. 596. *Id. Aikin,* p. 227.

External Characters.

Its colour is dark blood-red, which, when held between the eye and the light, falls strongly into yellow †.

* It used to be considered as a variety of precious garnet, and was generally known under the name *Bohemian Garnet,* from its occurring in Bohemia in great beauty and perfection. Its name is of Grecian origin, from πῦρ and ὄπτομαι, from the blood or fire red colour it exhibits when held opposite the light.

† Pyrope and garnet, when cut and polished, are easily distinguished from spinel and sapphire, by the dark tinge which their colours possess.—Haüy, t. ii. p. 545.

It occurs in small and middle-sized roundish and angular grains.

Its lustre is splendent, and vitreo-resinous.

The fracture is small, and perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is transparent, and refracts double.

It scratches quartz more readily than precious garnet.

Specific gravity 3.718, *Klaproth.*—3.714,—3.719, *Breithaupt.*

Constituent Parts.

Silica, - -	40.0
Alumina, - -	28.50
Magnesia, - -	10.00
Lime, - -	3.50
Oxide of Iron, -	16.50
——— Manganese, -	0.25
Acid of Chrome, -	2.00
Loss, - -	1.25
	100.75

Klaproth, B. v. s. 171.

The magnesia which it contains distinguishes it in a chemical view from precious garnet. The richness of its red colour is conjectured to be owing to the chromic acid.

Geognostic Situation.

It occurs imbedded in trap-tuff, wacke, claystone and serpentine.

Geographic Situation.

In trap-tuff at Ely in Fifeshire; and in claystone in Cumberland. Meronitz in Bohemia, imbedded in trap-tuff and wacke,

wacke; also in alluvial soil, formed from these rocks by decomposition, where it is associated with sapphire, zircon, melanite, olivine, and iron-sand. At Zœblitz in Saxony it is imbedded in serpentine.

Use.

This beautiful gem is employed in almost every kind of jewellery, and is generally set with a gold foil. The best way of cutting it is *en cabochon*, with a row or two of small facets, round the girdle of the stone. When cut in steps, the colour appears too deep, but when *en cabochon*, it displays a bright and rich blood-red. The small and very small grains are pounded, and used in place of emery, in cutting softer stones.

Observations.

1. *Distinctive Characters.*—Between pyrope and *precious garnet.* Precious garnet possesses a considerable colour suite; pyrope but one colour, which is blood-red: precious garnet occurs crystallized, which is never the case with pyrope: the internal lustre of precious garnet is shining; that of pyrope is splendent: precious garnet exhibits several varieties of fracture; pyrope is only conchoidal; precious garnet refracts single; pyrope double: precious garnet is softer than pyrope, and has a higher specific gravity: and, lastly, pyrope contains 10 *per cent.* of magnesia, an earth that does not occur in precious garnet; and it is more difficultly fusible

Fifth Subspecies.

Garnet *.

This subspecies is divided into two kinds, viz. Precious Garnet and Common Garnet.

First Kind.

Precious Garnet.

Edler Granat, *Werner.*

Carbunculus, *Plin.* Hist. Nat. xxxvii. 7. 1. 25. (in part.)—Granatus, *Wall.* t. i. p. 262.—Grenat, *Romé de Lisle,* t. ii. p. 316. *Id. Born,* t. i. p. 147.—Oriental Garnet, *Kirw.* vol. i. p. 258. —Edler Granat, *Emm.* b. i. s. 358.—Almandin, *Karst.* Tabel. —Grenat, *Haüy,* t. ii. p. 540.—Le Grenat noble, *Broch.* t. i. p. 193.—Almandin, *Reuss,* b. i. th. i. s. 69.—Edler Granat, *Lud.* b. i. s. 64.—Almandin Granat, *Suck.* 1r th. s. 173.—Edler Granat, *Bert.* s. 271. *Id. Mohs,* b. i. s. 79.—Grenat, *Lucas,* p. 46.—Grenat noble, *Brong.* t. i. p. 395.—Grenat, *Brard,* p. 123.—Garnet, *Kid,* vol. i. p. 147.—Grenat, *Haüy,* Tabl. p. 33.—Edler Granat, *Steffens,* b. i. s. 84. *Id. Hoff.* b. i. s. 492.—Almandine, *Haus.* Handb. b. ii. s. 595. *Id. Aikin,* p. 225.

External Characters.

All the colours of this gem are dark-red, which generally fall into blue; the principal colour is columbine-red, which

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* This gem was named ανθραξ by the Greeks, and by the Romans *Carbunculus*, carbuncle, (from *carbo*), because it was said to shine in the dark like a glowing coal. But the ancients included under the name *Carbunculus* also varieties of ruby and spinel. The name *Garnet* is of comparatively modern date, being first mentioned by Albertus Magnus.

which passes into cherry-red, brownish-red, and blood-red, and it appears even to pass into hyacinth-red.

It occurs very seldom massive, sometimes disseminated, and in angular pieces, but most commonly in roundish grains, and crystallized, in the following forms:

1. Rhomboidal dodecahedron, which is the primitive figure. Fig. 56. Pl. 3. *.
2. Rhomboidal dodecahedron, truncated on all the edges †. Fig. 58. Pl. 3.
3. Acute double eight-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and the summits deeply and flatly acuminated with four planes, which are set on the alternate lateral edges. It is the form of the mineral named Leucite; hence is often named the Leucite form. Fig. 57. Pl 3. ‡.
4. The preceding figure, in which the eight acute angles, formed by the meeting of the acuminating and lateral planes, and the alternate angles on the common basis, and all the edges are truncated. Fig. 60. Pl. 3.
5. Rectangular four-sided prism, acuminated with four planes set on the lateral edges.

The surface of the grains is generally rough, uneven, or granulated; that of the crystals is almost always smooth, only the lateral and acuminating planes of the leucite form are delicately streaked in the direction of the longer diagonal.

The

* Grenat primitif of Haüy.—Romé de Lisle, t. ii. p. 322. var. 1. Pl. 4. fig. 106.

† Grenat emarginé, Haüy.—Romé de Lisle, p. 324. var. 2. Pl. 4. fig. 107.

‡ Grenat trapezoidal, Haüy.—Romé de Lisle, p. 327. var. 111,—102.

The rhomboidal dodecahedrons occur from very large to very small; the other forms are middle-sized, small, and very small.

The crystals are always all around crystallized, and the grains imbedded; they are generally single, seldom collected in groupes.

Externally the lustre of the crystals and grains is glistening; internally it is shining, bordering on splendent; and is vitreous, inclining slightly to resinous.

The fracture is more or less conchoidal, which sometimes passes into coarse and small-grained uneven. Rarely an imperfect sixfold cleavage is to be observed *.

The fragments are indeterminate angular, and more or less sharp-edged.

It sometimes occurs in lamellar distinct concretions †.

It alternates from completely transparent to translucent, according to the kind of fracture ‡, and refracts single.

It scratches quartz, but does not affect topaz.

It is brittle.

It is rather difficultly frangible.

Specific gravity, 4,230, *Werner*.—4.085, *Klaproth*.—4.352, *Karsten*.—4.188, *Brisson*.—4.1888, *Haüy*.—3.964, —4.142, *Breithaupt*. §

Constituent

* The conchoidal variety has the greatest, and the coarse-grained uneven the least lustre.

† The distinct concretions occur most frequently in the garnet of Greenland.

‡ The transparent varieties are often impure in the middle.

§ After Zircon, it is the heaviest of the precious stones.

Constituent Parts.

Silica, -	35.75	Silica, -	36	Silica, -	39.66
Alumina,	27.25	Alumina,	22	Alumina,	19.66
Oxide of Iron,	36.00	Lime, -	3	Black oxide of Iron,	39.68
Manganese,	0.25	Oxide of Iron,	41	Oxide of Manganese,	1.80
Loss, -	0.75				
	100		102		100.80
Klaproth, b. ii. s. 26.		*Vauquelin.*		*Berzelius*, in Afhandlingar, vol. iv. p. 385.	

Chemical Character.

Before the blowpipe it melts pretty easily into a black scoria or enamel.

Geognostic Situation.

It occurs imbedded in primitive rocks; most frequently in mica-slate, chlorite-slate, and gneiss, less frequently in granite, quartz-rock, hornblende-rock, primitive greenstone and serpentine. Primitive metalliferous beds, such as those of ironstone and of cobalt, occasionally contain crystals of precious garnet.

Geographic Situation.

Europe.—In Scotland, it occurs in Perthshire, Aberdeenshire, Inverness-shire, Ross-shire, Sutherland, the outer range of the Hebrides, as Harris and Lewis; and in several of the Shetland islands, as Mainland and Unst.

Upon the Continent of Europe, it occurs in Norway, Lapland, Sweden, Saxony, Bohemia, Silesia, Switzerland, Stiria, the Tyrol, Salzburg, Hungary, and France.

Asia.—It is found in many parts of Siberia, also in Armenia, Pegu, and Ceylon.

Africa.

Africa.—Ethiopia and Madagascar.

America.—Greenland, United States, Mexico, Brazil, and Chili.

Use.

This beautiful gem is not so highly valued at present as it was a century ago. The larger kinds are used as ring-stones, and, after cutting and polishing, are set either *au jour*, or are provided with a silver or violet-blue foil *. When facet-cut, on account of the deepness of its colours, it is generally formed into thin tables, which are frequently hollowed out on their under-side. Cut stones of this description, when skilfully set with a bright silver foil, have been sold as rubies. The smaller kinds are used for necklaces, ear-drops and bracelets. Many fine pieces of engraving have been executed on this mineral. In the National Museum in Paris, there are several beautiful engraved garnets, and among others, a very fine head of Louis XIII. One of the finest engraved garnets is that executed by the celebrated artist Cali, in the possession of Lord Duncannon, which represents the Dog Sirius.

Crystals sometimes occur the size of a fist, or even larger: these are cut into small vases, which are very highly valued, particularly if they are free of flaws, and possess a good colour, and considerable degree of transparency.

Some varieties of garnet, when cut in a particular manner, reflect a star of four rays. They are much prized, and are sometimes sold under the name *Aventurine garnet.*

The

* The silver-foil is mentioned by Pliny, in his Hist. Nat. lib. 37.

The coarser kinds are used as emery, for polishing other minerals; for this purpose, they are previously repeatedly heated and quenched in water, reduced to powder in an iron-mortar, and, lastly, diffused through water, poured into other vessels, and allowed to settle, in order to obtain an uniform powder. In this state it is known to artists by the name of *red emery*.

This gem is successfully imitated by the following composition, which, when well and judiciously cut and polished, equals the garnet in lustre and transparency:

Purest white glass, 2 ounces.
Glass of antimony, 1 ounce.
Powder of Cassius, 1 grain.
Manganese, 1 grain.

The garnets of commerce are imported from Brazil, Ceylon, and Pegu. Those of Pegu are the most highly valued.

Observations.

1. *Distinctive Characters.*—Between precious garnet and *common garnet.* Brown and green are the most common colours of common garnet, but red is the only colour of precious garnet: the lustre of common garnet is resino-vitreous and glistening, but that of precious garnet is vitreous, slightly inclining to resinous, and is shining inclining to splendent: the fracture of common garnet is fine-grained uneven, that of precious garnet conchoidal: common garnet is only translucent, whereas precious garnet is semi-transparent, and transparent: common garnet occurs in granular concretions, precious garnet never: common garnet is usually small, and very small, seldom middle-sized, whereas precious garnet is sometimes large, and often middle-sized: common garnet has a specific gravity of 3.7, that

that of precious garnet is 4.2.—*b.* Between dodecahedral garnet and *dodecahedral zircon.* If the dodecahedral garnet be viewed as a six-sided prism, the dodecahedral zircon will appear as a four-sided prism; and in the garnet, the adjacent planes meet under angles of 120°, but in the zircon under angles of 124° 12′, and 117° 54′.

2. Karsten considers precious garnet as a distinct species, and places it in his system between zircon and garnet, under the name *Almandine;* he considering it as identical with the *alabandicus* (Pliny, Hist. Nat. lib. xxxvii. sect. 25.) of the ancients.

3. The precious garnet is sometimes named Syrian Garnet, not from Syria, but from Syrian, a town in Pegu, now destroyed, where it was met with in great beauty. Some naturalists maintain that Syrian is from *soranus,* which signifies a red stone, and not from Syrian.

Second Kind.

Common Garnet.

Gemeiner Granat, *Werner.*

Le Grenat commun, *Broch.* t. i. p. 198.—Granat, *Reuss,* b. ii. th. i. s. 79.—Gemeiner Granat, *Suck.* 1r th. s. 181. *Id. Bert.* s. 160. *Id. Lud.* b. i. s. 65. *Id. Mohs,* b. i. s. 85.—Grenat commun, *Brong.* t. i. p. 396.—Grenat brun, rougeatre, verdatre, &c. *Haüy,* Tabl. p. 33.—Gemeiner Granat, *Steffens,* b. i. s. 87. *Id. Hoff.* b. i. s. 503. *Id. Haus.* b. ii. s. 599.—Common Garnet, *Aikin,* p. 225.

External Characters.

Brown and green are its most common colours. Of brown it occurs liver-brown, yellowish-brown, and reddish-brown,

brown; and of green, blackish-green. From liver-brown it passes into olive, pistachio, blackish and leek green, and from this even into mountain-green: from yellowish-brown it passes into isabella yellow: from reddish-brown into a middle colour between hyacinth and blood red: from blackish-green into greenish-black. In many specimens different colours occur together.

It occurs most commonly massive, but never in grains or angular pieces: Sometimes crystallized, and possesses all the figures of the precious garnet.

The crystals are never above middle-sized, and seldom occur imbedded and single, but are generally superimposed and aggregated in druses.

The surface of the rhomboidal dodecahedron is smooth, but the lateral and acuminating planes of the leucite form are streaked in the direction of the longer diagonal.

It occurs in small, and fine angulo-granular distinct concretions, which sometimes pass into coarse granular.

The lustre is sometimes shining, sometimes glistening, very rarely splendent.

Internally the lustre is glistening, seldom shining, and is intermediate between resinous and vitreous.

The fracture is fine-grained uneven, sometimes slightly inclining to imperfect conchoidal, or to splintery.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is more or less translucent; the black nearly opaque.

It is a little softer than precious garnet.

It is rather difficultly frangible.

Specific gravity, 3.757 to 3,754, *Werner*.—3.668, 3.664, *Karsten*.—3.692, *Hausmann*.

Chemical

Chemical Character.

It melts more easily before the blowpipe than precious garnet.

Constituent Parts.

Silica, - -	38.0
Alumina, - -	20.6
Magnesia, - -	00.0
Lime, - -	31.6
Iron, - -	10.5
	100

Vauquelin in Haüy's Traité, t. ii. p. 543.

Geognostic Situation.

It occurs massive or crystallized, in drusy cavities, in beds, in mica-slate, clay-slate, chlorite-slate, and primitive-trap, where it is accompanied by different ores, as magnetic ironstone, red ironstone, magnetic pyrites, common iron-pyrites, arsenical pyrites, copper-pyrites, vitreous copper-ore, blende and galena, and by various earthy minerals, as actynolite, hornblende, epidote, augite, coccolite, tremolite, and schaalstone. It sometimes also forms the whole mass of beds. It also occurs imbedded in serpentine. Humboldt mentions it as occurring in veins in Mexico.

Geographic Situation.

Europe.—According to Dr Fitton and Mr Stephens, it occurs

occurs at Kilranelagh and Donegal in Ireland *. Upon the Continent, it occurs at Arendal and Drammen in Norway, where it is accompanied with granular limestone, common quartz, felspar, augite, hornblende, mica, axinite, and apatite; less frequently with epidote, coccolite, scapolite, and fluor-spar. At Kemi, in Russian Lapland, in chlorite-slate. In Sweden, it occurs in beds in mica-slate at Langbannshytta and Sunnerskog; it is also found at Dannemora, Fahlun, and Garpenberg, in Sweden. It occurs in several places in the Saxon Erzgebirge, as at Berggiesshübel, along with brown blende, calcareous-spar, and copper-pyrites; at Breitenbrun, with quartz, common actynolite, and magnetic ironstone; and at Geier, along with quartz, hornblende, common iron-pyrites, and magnetic ironstone, also mixed with quartz, brown blende and copper-pyrites; at Hohenstein, Kupferberg, Presnitz, &c. in Bohemia; Moravia; in the Boberthal in Silesia, in a bed along with calcareous-spar, actynolite, quartz, malachite, and copper and iron pyrites; at Dobschau in Hungary, in dodecahedral crystals, imbedded in serpentine. The ejected masses of Monte Somma, near Vesuvius, which, as formerly mentioned, are compounds of granular limestone, mica, felspar, vesuvian, &c. contain common garnet. Sometimes it occurs in small imbedded crystals, sometimes in massive portions of a reddish-brown or hyacinth-red colour, disposed in granular concretions, which occasionally pass into crystals. The crystals are generally of a hyacinth-red colour, and transparent. In the massive varieties, imbedded crystals of vesuvian are sometimes met with. The reddish-brown and hyacinth-red garnets, which are intermediate between precious and common garnet,

* Transactions of the Geological Society, vol. i.

net, occur in beds along with actynolite, and other minerals, in Carinthia, Stiria, Bayreuth, also near Disentis in Switzerland.

Asia.—New Holland.

Use.

On account of its easy fusibility and richness in iron, it is frequently employed as a flux in smelting rich iron-ores, and as an addition to poor ores. In some countries it is named Green Iron-ore, and Green Iron-garnet. It is seldom cut or polished for ornamental purposes, but is occasionally used by lapidaries in place of emery for cutting minerals.

Observations.

1. It is distinguished from the *precious garnet* by colour, degree of transparency, lustre, kind of fracture, distinct concretions, druses, aggregation of crystals, specific gravity, occurring in beds, and very rarely imbedded.

2. The mineral named *Topazolite* by Bonvoisin, and which is found at Mussa in Piedmont, is a variety of garnet intermediate between precious and common, but more inclined to the precious. The *Hyacinth Garnet* is also a variety of common garnet.

Sixth Subspecies.

Allochroite *.

Allochroit, *Werner.*

Allochroit, *Dandrada,* Journ. de Phys. t. 51. p. 235. *Id. Broch.* t. ii. p. 552. *Id. Reuss,* b. ii. th. ii. s. 478. *Id. Lud.* b. ii. s. 159. *Id.*

* The name *Allochroite* given to this mineral is derived from the Greek, (αλλος and χροα), and refers to its change of colour before the blowpipe.

Id. Suck. 1r th. s. 716. *Id. Bert.* s. 163. *Id. Lucas,* p. 330. *Id. Brong.* t. i. p. 401. *Id. Brard,* p. 399.—Splittriger Granat, *Karst.* Tabel.—Allochroit, *Haüy,* Tabl. p. 57. *Id. Steffens,* b. i. s. 98. *Id. Hoff.* b. i. s. 512.—Dichter Granat, *Haus.* Handb. b. ii. s. 601.—Allochroit, *Aikin,* p. 226.

External Characters.

Its most frequent colours are greenish-grey and yellowish-grey; and both incline much to brown, and therefore incline sometimes to liver-brown, sometimes to olive-green, and pass into a colour between asparagus and oil green. Sometimes several colours occur together.

It occurs massive.

Externally it is glimmering; internally glimmering, rarely glistening, and the lustre is resinous.

The fracture is sometimes small-grained, uneven; sometimes even, or even passing to flat conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is feebly translucent on the edges.

It gives sparks with steel, but does not scratch quartz.

It is rather easily frangible.

Specific gravity 3.575, *Dandrada.*—3.58, *Brard.*—3.50, *Brongniart.*—3.637, *Blöde.*

Chemical Characters.

According to Vauquelin, it is fusible without addition, before the blowpipe, into a black, smooth, and opaque enamel. It melts readily with phosphoric salts: if allowed to cool slowly, its colour is first reddish-yellow, next green, and, lastly, a muddy yellowish-white colour.

Constituent

Constituent Parts.

Silica, -	35.	37.
Lime, -	30.5	30.
Alumina, -	8.	5.
Oxide of Iron,	17.	18.5
Carbonate of Lime,	6.	
Oxide of Manganese,	3.5	6.25
Loss, -		3.25
	100	100
	Vauquelin, in Lucas, Tabl. p. 30.	*Rose*, in Karsten, Tabel. 33.

Geognostic and Geographic Situations.

It has hitherto been found only in Viuls iron-mine near Drammen in Norway, where it is associated with calcareous spar, reddish-brown garnet, and magnetic ironstone.

Observations.

1. This mineral was first particularly described and named by Professor Schumacher of Copenhagen, and M. Dandrada.

2. It is distinguished from *common garnet*, the only mineral with which it could be confounded, by its lighter colours, inferior lustre and transparency, general appearance of the fracture, inferior hardness and weight, and by its never occurring crystallized, or in distinct concretions.

Seventh

Seventh Subspecies.

Colophonite, or Resinous Garnet.

Kolophonit, *Simon,* in Journ. f. d. Chem. & Phys. iv. 3. 405.—Pechgranat, *Karst.* Tabel. s. 32.—Grenat resinite, *Haüy,* Tabl. p. 33.—Kalophonit, *Haus.* Handb. b. ii. s. 603.—Colophonite, *Aikin,* p. 226.

External Characters.

Its colour is yellowish-brown, which passes into brownish-black, hyacinth-red, oil-green, and olive-green.

It occurs massive, in angulo-granular concretions, which are easily separable; and crystallized in rhomboidal dodecahedrons, either perfect, or truncated on the edges.

The surface of the crystals appears as if melted.

Internally it is shining; externally splendent.

The lustre is resino-adamantine.

The fracture is imperfect conchoidal.

It is translucent, or only translucent on the edges.

Specific gravity, 4.0, *Simon.*

Constituent Parts.

Silica, - -	37.00
Oxide of Iron, -	7.50
Alumina, -	13.50
Lime, - -	29.00
Magnesia, - -	6.50
Oxide of Manganese,	4.75
Oxide of Titanium,	0.50
Water, - -	1.00
	99.75

Simon, in Journ. de Chem. et Phys. iv. 3. 410.

Geognostic and Geographic Situations.

It occurs in beds of magnetic ironstone, which are subordinate to gneiss, at Arendal in Norway; and in talc-slate at Salvagnengo in Piedmont*. It is also found in the Island of Ceylon †.

Observations.

The *Succinite* of Bonvoisin is a variety of Colophonite.

Eighth Subspecies.

Cinnamon Stone.

Kanelstein, *Werner.*

Essonite, *Haüy.*

Hiacint, *Mohs,* Journ. des Mines, n. 130. p. 139.—Kanelstein, *Klap.* in Karst. Tabel.; also in Beit. b. v. p. 138. *Id. Haüy,* Tabl. p. 62. *Id. Steffens,* b. i. s. 97. *Id. Hoff.* b. i. s. 417.—Cinnamon-stone, *Aikin,* p. 227.—Essonite, *Haüy,* Traité des Pierres Precieuses, p. 50.

External Characters.

Its principal colour is intermediate between hyacinth-red and orange-yellow, and passes sometimes into the one, sometimes into the other. It also occurs yellowish-brown and honey-yellow. When held between the eye and the light, and at a distance from the eye, it is orange-yellow, but when held near the eye, the colour is yellow, without mixture of red.

It

* Heuland.

† Bournon.

It occurs massive, and in granular distinct concretions.

Internally it is shining, approaching to glistening; and the lustre is resino-vitreous.

It is said that an indistinct cleavage is sometimes visible, indicating an oblique prism of 102° 40′ *.

The fracture in every direction is rather imperfect, and flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is transparent and semitransparent; but it is generally so impure and full of cracks, that faultless specimens rarely occur. It refracts single.

It is softer than garnet, but harder than quartz.

It is brittle.

It is rather difficultly frangible.

When cut, it feels somewhat greasy.

Specific gravity is 3.602 to 3.640, *Mohs* and *Haüy.*

Chemical Characters.

Before the blowpipe it fuses into a blackish-brown enamel.

Constituent Parts.

Silica, - -	38.8
Alumina, - -	21.2
Lime, - -	31.25
Oxide of Iron, - -	6.5
Loss, - - -	2.25
	100

Klaproth, Beit. b. v. s. 138.

L 2 *Geognostic*

* If this observation prove correct, then cinnamon-stone will form a distinct species.

Geognostic and Geographic Situations.

It is found in alluvial deposites, and associated with quartz, tabular spar, and ironstone, in gneiss, in the Island of Ceylon *.

Use.

It is cut as a precious stone, and, when free of flaws, is of considerable value.

Observations.

1. *Distinctive Characters*:—*a*. Between cinnamon-stone and *pyrope*. The only colour of pyrope is blood-red; but cinnamon-stone has several colours, and none of them are distinct blood-red; pyrope scratches quartz more readily than cinnamon-stone: cinnamon-stone occurs in granular concretions, which is not the case with pyrope: pyrope has not the greasy feel which is observed in cut and polished cinnamon-stone; pyrope is heavier than cinnamon-stone; and we do not observe in pyrope the numerous rents and flaws that occur in cinnamon-stone.—*b*. Between cinnamon-stone and *vesuvian*. Vesuvian has a different colour-suite from cinnamon-stone: vesuvian occurs crystallized; cinnamon-stone is not crystallized: the internal lustre of vesuvian is vitreo-resinous, and the fracture small-grained uneven; whereas that of cinnamon-stone is resino-vitreous, and the fracture conchoidal.

2. Quisst distinguishes two sorts of hyacinth; one whose specific gravity is but 3.6, and is fusible; another which is infusible, and has a specific gravity of 4.3. The first is evidently the cinnamon-stone; the other the hyacinthine zircon.

3. This gem is placed here at present, until its characters are better ascertained.

Ninth

* For this interesting observation we are indebted to Dr Davy.

Ninth Subspecies.

Helvine *.

Helvin, *Werner.*

Helvin, *Friesleben's* Beiträge zur Mineralogischen Kenntniss von Sachsen, b. i. s. 126.

External Characters.

Its most frequent colour is wax-yellow, which approaches to pale oil-green; rarely to siskin-green.

It occurs disseminated, sometimes in small granular concretions, and crystallized in small tetrahedrons, which are perfect or truncated on the angles.

The crystals are imbedded, or rest upon each other.

Internally it is glimmering or shining.

Externally it is vitreous; internally it inclines to resinous.

It sometimes displays an imperfect cleavage.

The fracture is small-grained uneven.

The crystals are strongly translucent.

It is softer than quartz, but harder than felspar.

It is brittle.

Specific gravity, 3.2, 3.3.

Chemical Characters.

It melts easily before the blowpipe into a blackish-brown glass.

Geognostic

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* The name *Helvine* is derived from the Greek word ἑλη, and refers to its colour.

Geognostic and Geographic Situations.

It occurs along with slate-spar, brown blende, fluor-spar, and chlorite, in beds subordinate to gneiss, near Schwarzenberg in Saxony.

Observations.

We still want a satisfactory description of this mineral. It appears to be nearly allied to garnet; hence it is placed in this part of the System.

3. Prismatic Garnet or Grenatite.

Prismatischer Granatit, *Mohs.*

Granatit, *Werner.*

Staurotide *, *Haüy.*

Grenatite, *Saussure,* § 1900. *Id. Lam.* t. ii. p. 290. *Id. Broch.* t. ii. p. 406.—Staurotide, *Haüy,* t. iii. p. 93.—Staurolith, *Reuss,* b. i. th. i. s. 196.—Grenatit, *Lud.* b. i. s. 66. *Id. Suck.* 1r th. s. 227. *Id. Bert.* s. 289. *Id. Mohs,* b. i. s. 94.—Staurolith, *Hab.* s. 34.—Staurotide, *Lucas,* p. 58. *Id. Brong.* t. i. p. 402. *Id. Brard,* p. 151.—Staurolite, *Kid,* vol. i. p. 251. *Id. Haüy,* Tabl. p. 43.—Staurolith, *Steffens,* b. i. s. 191.—Staurotide, *Hoff.* b. i. s. 515. *Id. Haus.* Handb. b. ii. s. 629. *Id. Aikin,* p. 189.

External Characters.

Its colour is dark reddish-brown, which sometimes inclines to reddish-brown.

It

* The name *Staurolith* given to this mineral by some mineralogists, is borrowed from the Greek words σταυρος, a *cross,* and λιθος, a *stone,* and refers to the cross-form of some of its crystals.

It occurs only crystallized, and all the varieties of form which it exhibits may be reduced to a prism of 129° 30′.

The following are the principal varieties of secondary forms.

1. Very oblique four-sided prism, truncated on the acuter lateral edges; or it may be named an *unequiangular six-sided prism.* Fig. 61. Pl. 3.
2. The preceding figure, acutely bevelled on the extremities; the bevelling planes set on the obtuse lateral edges, and the edge of the bevelment truncated. Fig. 62. Pl. 3.
3. Twin-crystal, formed by two perfect six-sided prisms crossing each other at right angles. Fig. 63. Pl. 3.
4. Twin-crystal, formed by two perfect six-sided prisms crossing each other obliquely. Fig. 64. Pl. 3.

The crystals are small and middle-sized; all around crystallized, and therefore originally imbedded.

The surface of the crystals is rough and glistening, and seldom smooth and shining, passing into splendent.

Internally the cleavage is shining and splendent; that of the fracture glistening and glimmering, with a resino-vitreous lustre.

The cleavage is in the direction of the smaller diagonal of the prism.

The fracture is small-grained uneven, which sometimes approaches to small conchoidal.

The fragments are indeterminate angular, and not very sharp-edged.

It is often opaque, sometimes translucent, and very rarely semitransparent.

It is hard; scratches quartz feebly.

It is brittle, and easily frangible.

Specific

Specific gravity, 3.286, *Haüy.*—3.510, 3.765, *Klaproth.*—3.3, 3.8, *Hausmann.*—3.287, 3.338, *Breithaupt.*—3.3, 3.8, *Mohs.*

Chemical Character.

Infusible before the blow-pipe.

Constituent Parts.

	From Morbihan.	St Gothard.		St Gothard.
Alumina,	44.	52.25		41.
Silica,	33.	27.		37.5
Lime,	3.84			
Oxide of Iron,	13.	18.5		18.25
Oxide of Manganese,	1.	0.25	Magnesia,	0.5
Loss,	5.16	2.		2.75
	100	100		100
	Vauq. Jour. des Min. N° 53.	*Klap.* Bullet. des Scien. de la Soc. Phil. t. i. p. 171.		*Klap.* ibid.

Geognostic Situation.

The geognostic relations of this mineral are nearly the same with those of precious garnet, with this difference, that precious garnet occurs in a greater variety of rocks. It has been hitherto found only imbedded in mica-slate, talc-slate, clay-slate, and sometimes in gneiss, and very generally accompanied with kyanite and precious garnet.

Geographic Situation.

Europe.—It occurs in clay-slate near Ardonald, between Keith and Huntly in Aberdeenshire; in a micaceous rock at the

the Glenmalur lead-mines in the county of Wicklow in Ireland *. Upon the Continent of Europe, it occurs in the Tyrol; in Switzerland, as at St Gothard, imbedded in mica-slate, with kyanite and precious garnet; on the north side of the Glacier of Gries in the Vallais, in mica-slate; and in the Piora Alp, also in mica-slate; Transilvania; at St Jago di Compostella in Gallicia in Spain; in Brittany, and other places in France.

America.—It occurs in different places in the United States, as near Baltimore in Maryland, imbedded in mica-slate along with kyanite; in Pennsylvania in mica-slate; in Connecticut in cross crystals along with garnets in mica-slate, and in granite with kyanite; and in Maine in mica-slate *.

Observations.

1. *Distinctive Characters.*—Between grenatite and *precious garnet.* The red colours of precious garnet are more or less intermixed with blue, those of grenatite with brown: precious garnet exhibits a suite of crystallizations, extending from the rhomboidal dodecahedron to the leucite form; grenatite occurs in the form of a particular oblique four-sided prism, and its various derivative forms: precious garnet is harder and heavier than grenatite: and, lastly, precious garnet is fusible before the blowpipe; grenatite is infusible.

2. It is more nearly allied to precious garnet and pyrope than to common garnet.

GENUS XI.

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* Dr Fitton, in Geological Transactions, vol. i. p. 275.

† Cleaveland's Mineralogy, p. 203.

GENUS XI.—GADOLINITE.

THIS genus contains but one species, viz. Prismatic Gadolinite.

1. Prismatic Gadolinite *.

Prismatischer Gadolinit, *Mohs.*

Gadolinit, *Karsten.*

Gadolinit, *Geyer,* in V. Crell's Chem. Annal. 1788, b. i. s. 229.—Gadolin, in K. Sv. Acad. n. Handl. 1794, 11.—Gadolinite, *Haüy,* t. iii. p. 141. *Id. Reuss,* b. ii. th. ii. s. 7. *Id. Karst.* Tabel. s. 22. *Id. Haüy,* Tabl. p. 47. *Id. Hoff.* b. iii. s. 308. *Id. Haus.* Handb. b. ii. s. 608. *Id. Aikin,* p. 194.

External Characters.

Its colours are velvet-black, sometimes greenish-black, less frequently brownish-black, and very rarely hyacinth-red.

It occurs massive, and disseminated; the massive varieties are sometimes composed of granular or prismatic concretions; the surfaces of which have frequently a whitish or bluish aspect, and vary from glistening to dull. It very rarely occurs crystallized, and its primitive figure appears to be an oblique four-sided prism, in which the obtuse angle is nearly 110°. This prism sometimes occurs with six lateral planes.

Internally it is shining, and the lustre is resinous, inclining to vitreous.

The fracture is generally conchoidal; seldom uneven.

It

* This species was named *Gadolinite,* in compliment to Dr Gadolin, the the discoverer.

It is faintly translucent on the thinnest edges, and then it appears blackish-green.

It is harder than felspar, but softer than quartz.

Its streak is greenish-grey.

It is brittle.

It is difficultly frangible.

When pure, it does not appear to affect the magnet.

Specific gravity 4.2230, *Geyer.*—4·0280, *Gadolin.*—4.2370, *Klaproth.*—4.0497, *Haüy.*—4, to 4.2, *Mohs.*

Chemical Characters.

It intumesces very much before the blowpipe, and at length melts into an imperfect slag, which is magnetical. It loses its colour in nitric acid, and gelatinises.

Constituent Parts.

	Gadolinite from Finbo.	Gadolinite from Broddbo.
Silica, -	25.80	24.16
Yttria, -	45.00	45.93
Oxide of Cerium,	16.69	16.90
Oxide of Iron, .	10.26	11.34
Volatile matter,	0.60	0.60
	98.35	98.93

Berzelius in Afhandlingar, vol. xiv. p. 217.

Geognostic and Geographic Situations.

It occurs, along with yttrotantalite, at Ytterby near Waxholm in Roslagen, in beds of a coarse granular red felspar, which are situated in mica-slate; at Finbo, near Fahlun, also in Sweden, in a coarse granular granite, along with pyrophysalite and tinstone. In both places the gadolinite is invested with an ochre-yellow earthy crust, which appears to be hydrate of iron. This mineral is said to have been discovered in the Island of Bornholm, and in syenite rocks in Finland.

GENUS XII.

Genus XII.—IOLITE *.

This genus contains one species, viz. Prismato-Rhomboidal Iolite.

Prismato-Rhomboidal Iolite.

Iolith, *Werner.*

Iolith, *Karst.* Tabel.—Iolithe, *Haüy,* Tabl. p. 61, & 221.—Dichroite, *Cordier,* Journ. des Mines, t. 25. p. 129.—Iolith, *Steffens,* b. i. s. 369. *Id. Hoff.* b. i. s. 589.—Dichroït, *Haus.* b. ii. s. 659.—Iolite, *Aikin,* p. 194.

External Characters.

Its colour is intermediate between violet-blue and blackish-blue. When viewed in the direction of the axis of the crystals, the colour is dark indigo-blue; but perpendicular to the axis of the crystals, pale brownish-yellow.

It occurs massive, disseminated, in pebbles or rolled pieces, and rarely crystallized.

1. Perfect equiangular six-sided prism.
2. Six-sided prism, truncated on the lateral edges.

The crystals are small, and their surface is rough and dull.

Internally it is glistening, and sometimes shining, and the lustre is vitreous.

The cleavage is imperfect, four-fold, and in the direction of the lateral and terminal planes of the six-sided prism.

The fracture is small-grained uneven, and sometimes small and imperfect conchoidal.

The fragments are indeterminate angular and sharp-edged.

It

* *Iolite,* from *ιον,* a *violet,* and refers to its violet-blue colour.

It is translucent in the direction of the axis of the crystal, and transparent at right angles to it. It refracts double.

It scratches quartz, but with difficulty.

It is easily frangible.

Specific gravity 2.560, *Cordier.*—2.7, *Haüy.*—2.541, *L. Gmelin.*

Chemical Characters.

It melts with difficulty before the blowpipe, into a very pale greenish-grey enamel. The same result is obtained when melted with borax and carbonate of soda.

Constituent Parts.

Silica, - -	43.6
Alumina, - -	37.6
Magnesia, - -	9.7
Potash ? - -	1.0
Oxide of Iron, -	4.5
——— Manganese, a trace.	
Leopold Gmelin.	99.5

Geognostic and Geographic Situations.

It is found at Orijarvi, near Abo in Finland*; at Bodenmais in Bavaria; in the country of Salzburg; at Granatillo near Nijar, in Spain, imbedded in an aggregate of quartz, precious garnet, mica and felspar, which is included in basalt; and in a bed of trap-tuff in the Bay of San Pedro, also in Spain. Large rolled pieces are found in Siberia. Giesecké met with it imbedded in felspar, in North Greenland, and in mica in South Greenland†. Rolled pieces or pebbles of iolite are brought from the Island of Ceylon.

Use.

It is cut, polished, and worn as a gem.

Observations.

* Heuland.

† In Heuland's magnificent collection, there are crystals of Iolite from Greenland two inches and a half in length, and one inch and a half in breadth.

Observations.

1. Iolite is characterised by its colour, crystallization, cleavage, hardness and weight.

2. It is distinguished from *sapphire* (with which it has been confounded) by colour, inferior lustre, cleavage, inferior transparency, hardness and weight. Its colour, inferior transparency and hardness, distinguish it from beryl and emerald.

3. It is the *sapphire d'eau* of collectors.

4. Werner describes a mineral under the name *Peliom*, which appears to be but a variety of the prismato-rhomboidal Iolite.

Genus XIII. QUARTZ *.

This genus contains two species, viz. Rhomboidal Quartz and Indivisible Quartz †.

1. Rhomboidal Quartz.

Quartz, *Werner.*

Rhomboedrischer Quartz, *Mohs.*

This species contains fourteen subspecies, viz. 1. Amethyst, 2. Rock Crystal, 3. Milk Quartz, 4. Common Quartz, 5. Prase, 6. Cats-eye, 7. Fibrous Quartz, 8. Iron Flint, 9. Hornstone,

* The name *Quartz* is of German origin, and appears to have been formed from the sound which pieces of this mineral emit when rubbed against each other or any other hard bodies.

† All the subspecies of what is called *rhomboidal quartz*, have a rhomboidal cleavage, or pass into those varieties that possess it. The subspecies of *indivisible quartz*, have no cleavage, or cannot be divided or split in the direction of natural folia.

9. Hornstone, 10. Flinty Slate, 11. Flint, 12. Calcedony, 13. Heliotrope, 14. Jasper.

First Subspecies.

Amethyst *.

This subspecies is divided into two kinds, viz. Common Amethyst, and Thick Fibrous Amethyst.

First Kind.

Common Amethyst.

Gemeiner Amethyst, *Werner.*

Gemeiner Amethyst, *Reuss,* b. ii. th. i. s. 205. *Id. Lud.* b. i. s. 74. *Id. Suck.* 1r th. s. 280. *Id. Bert.* s. 225. *Id. Mohs,* b. i. s. 193.—Amethyst-Quartz, *Hab.* s. 4. *Id. Karst.* Tabel.—Quartz-hyalin Amethyste, *Brong.* t. i. p. 279.—Quartz-hyalin Violet, *Haüy,* Tabl. p. 25.—Amethyst, *Steffens,* b. i. s. 110.—Gemeiner Amethyst, *Hoff.* b. ii. s. 3.—Stänglicher Bergkrystal, *Haus.* b. ii. s. 380.—Amethyst, *Aikin,* p. 176.

External Characters.

Its principal colour is violet-blue, of all degrees of intensity. It passes on the one side from dark violet-blue, through plum-blue into clove-brown, and a particular kind of brownish-black; on the other side, from pale violet-blue through pearl-grey, ash-grey, greyish-white, greenish-white, olive-green, into pistachio-green †, which latter is uncommonly rare.

In

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* The name *Amethyst*, which is of great antiquity, is derived from the Greek *αμεθυςος,* from *α* and *μεθυω,* it being supposed to possess the power of preventing intoxication. Indeed, it was worn as an amulet for that purpose.

† The green varieties are the chrysolite of some authors.

In the massive varieties, several colours occur together, and these are disposed in stripes, or fortification-wise.

Besides massive, it occurs in rolled pieces, and in angular pieces.

The massive varieties are commonly in distinct concretions, which are straight and thick prismatic, obliquely transversely streaked, and when free at the extremities, shoot into the pyramidal form.

These concretions are generally intersected by others which are lamellar, and fortification-wise bent: and the colour delineations are arranged in the direction of these lamellar concretions.

Sometimes the prismatic concretions, when they are very short, (which is very seldom the case), approach in shape to coarse granular concretions.

The most frequent regular figure is

1. A rather acute simple six-sided pyramid. It very seldom occurs in the form of a
2. Double six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other; and this is either
   - a. Perfect, or
   - b. Truncated on the common basis. By the increase of this truncation it passes into a
3. A six-sided prism, acuminated with six planes. Sometimes the edges between the acuminating and lateral planes are deeply truncated, as in fig. 65. Pl. 3.

The crystals occur always in druses, and the simple pyramids are side by side; but the double are superimposed on each other.

The crystals are middle-sized, and small.

Externally

Externally the crystals are smooth, and alternate from splendent to glistening.

It alternates from translucent to transparent.

It is harder than felspar, but not so hard as emerald.

Internally it is splendent, shining, or approaching to glistening, according to the fracture; and the lustre is vitreous.

The fracture is perfect conchoidal, or imperfect conchoidal, which sometimes passes into uneven and coarse splintery.

It is brittle.

It is rather easily frangible.

Specific gravity 2.632, deep-blue, *Lowry.*—Dark violet-blue from Ceylon 2.781, *Karsten.*—Violet-blue from Saxony 2.750, *Werner.*

Chemical Characters.

Lampadius exposed it for four hours to the strongest heat of a wind furnace, when it suffered no other change than the loss of its colour, and about one and a quarter *per cent.* of its weight *. According to Eherman, when exposed to a stream of oxygen gas, it loses its colour, and melts into a transparent bead.

Constituent Parts.

Silica,	-	97.50
Alumina,	-	0.25
Oxide of Iron,	-	0.50
Trace of Manganese.		
		98.25

Rose, Karsten's Tabell. s. 23.

* Lampadius, Samml. pract. chem. Abhandl. b. i. s. 225.

Geognostic Situation.

It occurs in agate-balls in amygdaloid, greenstone, and porphyry, and in veins in primitive and secondary rocks. In the agate balls, it is associated with layers of calcedony, carnelian, flint, and other quartzose minerals, and is usually the uppermost layer of the series. When it occurs in veins, it is associated either with ores of particular kinds, or with agate, or with fibrous amethyst. It occurs also in rolled pieces in alluvial country.

Geographic Situation.

Europe.—In veins and drusy cavities in the secondary or flœtz greenstone of Fifeshire, particularly in those varieties that occur in the vicinity of Burntisland; in amygdaloid near Montrose; in amygdaloid and greenstone in the Hill of Kinnoul, near Perth, and in many other parts of Scotland. Near Cork in Ireland.

It occurs in the flœtz or secondary trap rocks of Iceland, and the Faroe Islands.

Upon the Continent of Europe, it occurs at Dannemora in Sweden; in the Clausthal and other parts of the Hartz; at Annaberg, Kunnersdorf, &c. in Upper Saxony; Bohemia; Silesia; Bavaria; Stiria; Salzburg; Carniola; Switzerland; Hungary; Transilvania; Spain; and France.

Asia.—At Catharinenburg, Nertschinsk, Mursinska, and other places in Siberia; Cambay in India; Persia; and the Island of Ceylon.

America.—Guanaxuato in Mexico; and in the United States.

Use.

Uses.

The most highly valued amethysts are those brought from the continent of India, and the Island of Ceylon. The next in esteem are the Brazilian. Formerly the Saxon and Bohemian amethysts were highly prized in Turkey, and were exported by the way of Venice to Constantinople. At present, very beautiful varieties are found at Catharinenburg in Siberia; near the town of Vique in Murcia in Spain; and sometimes in the Val-Louise in the High Alps.

When the colour is deep and pure, and uniformly diffused, and the transparency is considerable, it forms a gem of great beauty. It is cut into necklaces, ear-drops, and bracelets; but as it is difficult to find a number of perfect stones with the same tint of colour, such pieces of jewellery are very much valued. One of the finest necklaces of this gem in England is said to be in the possession of the Queen. Amethyst is sometimes cut as a ring-stone, and then it appears to much advantage when set round with diamonds. Pale-coloured stones require the assistance of a blue foil. It should be set in gold rather than in silver, as the yellow colour forms a more agreeable contrast with it than the white. When the colour is irregularly diffused, jewellers expose it for a short time, in a mixture of sand and iron-filings, to a moderate heat, by which it is rendered more uniform. When it is wished to conceal the want of uniformity of the tint of colour, jewellers are in the practice of cutting many facets on the stone. A red or reddish-brown colour may be given to amethyst, by inclosing it in a piece of charcoal, igniting it, and allowing it to consume slowly.

The massive varieties, when sufficiently compact, which is not always the case, owing to the easily separable prismatic concretions, are cut into snuff-boxes, and other ornamental articles.

The ancients wore this gem in the form of seal-stones, of which many are preserved in cabinets.

In the Royal Library at Paris there are many fine engraved amethysts; one of the largest is that on which is represented the bust of Trajan; another of great beauty, with the figure of an Achille Cytharide. It was also, when ornamented with figures of the sun or moon, used as an amulet against poison.

Observations.

1. *Distinctive Characters.—a.* Between amethyst and *rock-crystal.* The colour-suite of amethyst does not agree with that of rock-crystal: amethyst occurs principally in the pyramidal form; whereas rock-crystal is generally prismatic: the fracture of amethyst is imperfect conchoidal or splintery; that of rock-crystal is perfect conchoidal: rock-crystal has sometimes a distinct cleavage, which is not the case with amethyst; the lustre of amethyst is lower than that of rock-crystal: the crystals of amethyst do not attain the same magnitude as rock-crystals: amethyst is not so perfectly transparent as rock-crystal: and, lastly, amethyst occurs in prismatic concretions, a form very seldom assumed by rock-crystal; and in lamellar concretions, a form never observed in rock-crystal.—*b.* Between amethyst and *rose* or *milk quartz.* The colour-suites of the two minerals are very different: rose quartz occurs only massive, whereas amethyst occurs both massive and disseminated; and more frequently crystallized than massive: the lustre of

of rose quartz is shining and vitreo-resinous; but that of amethyst extends from splendent to glistening, and is vitreous: rose quartz is translucent, approaching to semitransparent: amethyst alternates from semitransparent to transparent.

Second Kind.

Thick Fibrous Amethyst.

Dickfasriger Amethyst, *Werner.*

Dickfasriger Amethyst, *Reuss,* b. ii. th. i. s. 210. *Id. Mohs,* b. i. s. 148.—Fasriger Quartz, *Steffens,* b. i. s. 125.—Fasriger Amethyst, *Hoff.* b. ii. s. 10.

External Characters.

It has generally a pretty dark violet-blue colour, which, when pale and light, borders on pearl-grey, and from this latter passes into milk and yellowish white.

It occurs only massive and in rolled pieces, never in crystals.

It occurs in thin prismatic concretions, which are collected into large angulo-granular concretions, that incline to wedge-shaped.

Internally its lustre is glistening and vitreous.

The fracture is imperfect conchoidal, and sometimes splintery, and fine-grained uneven.

The fragments are indeterminate angular or wedge-shaped, and are sharp-edged.

It is generally translucent; some varieties incline to semitransparent.

It agrees in the remaining characters with the preceding kind.

Geognostic

Geognostic Situation.

It is found in agate veins, and is generally accompanied with common amethyst. When both kinds occur together in the same vein, the fibrous always adheres to the wall.

Geographic Situation.

Nearly the same as the former.

Observations.

1. The absence of regular forms, the low degree of lustre, the distinct concretions, the inferior transparency, and the frequently occurring white colour, characterize this kind of amethyst, and distinguish it from the other.

2. It is distinguished from *fibrous quartz* by colour, coarse-granular concretions, and its occurrence with common amethyst.

3. The older mineralogists, when they distinguished fibrous amethyst from common amethyst, named it *prime d'amethyste*, because when both kinds occurred together, the common always rested upon the fibrous.

Second Subspecies.

Rock or Mountain Crystal *.

Bergcrystal, *Werner*.

Crystallus, *Plin.* Hist. Nat. xxxvii. Ed. Bip. v. 397.—Quartzum pellucidum cristallizatum, *Wall.* p. 226.—Cristal de roche, *Romé*

* Formerly this gem was simply named *Chrystal*, an appellation derived from the Greek, (*κρύος, cold,* and *στέλλεσθαι, to freeze,*) signifying a body congealed

Romé de Lisle, t. ii. p. 70.—Bergcrystal, *Wern.* Cronst. p. 111. *Id. Wid.* p. 296.—Mountain Crystal, *Kirw.* p. 241.—Bergcrystal, *Emm.* b. i. p. 217. *Id. Estner*, b. ii. s. 318.—Quarzo, *Nap.* p. 170.—Quartz, *Lam.* t. ii. p. 119.—Le Cristal de Roche, *Broch.* t. ii. p. 243.—Quartz, *Haüy*, t. ii. p. 406.—Berg Krystal, *Reuss*, b. ii. s. 212. *Id. Lud.* b. i. s. 75, 76.—Edler Quarz, *Suck.* 1r th. s. 284. *Id. Bert.* s. 253.—Berg Crystal, *Mohs*, b. i. s. 200–220. *Id. Hab.* s. 4.—Quartz hyalin, *Lucas*, p. 32. *Id. Brong.* t. i. p. 273. *Id. Brard*, p. 90.—Transparent Quartz, *Kid*, vol. i. p. 195.—Quartz hyalin, *Haüy*, Tabl. p. 24.—Berg Crystal, *Steffens*, b. i. s. 105. *Id. Hoff.* b. ii. s. 12.—Edler Berg Krystal, *Haus.* Handb. b. ii. s. 378.

External Characters.

Its principal colour is white; brown occurs often, but yellow is much less frequent. It very rarely occurs snow-white, more frequently greyish-white, which passes into pearl-grey and blue; further yellowish-white, yellowish-grey, pale ochre-yellow, which sometimes inclines to wine-yellow, yellowish-brown, clove-brown, which is sometimes so dark that it approaches to brownish-black, sometimes inclines to red, and nearly to hyacinth-red. It is often iridescent, particularly the white varieties.

It occurs very seldom massive: often in rolled pieces, most frequently in crystals. The primitive figure, or that to

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gealed by cold, because the ancients believed that rock-crystal was formed in the same manner as ice, and that it was water hardened by cold, but in a higher degree than in common ice. When it was afterwards found that many minerals, and even artificial substances, occurred in equally regular forms with what they called Crystal, this word by degrees changed its signification, and was applied to all minerals, or chemical productions having regular forms. This subspecies of quartz was then named *Crystallus montanus*: hence the English name Rock-crystal, and the French Cristal de roche.

to which all the others can be reduced, is a rhomboid of 94° 15′, and 85° 45′. The following are the principal varieties of secondary forms, which can be traced back to this rhomboid.

1. Equiangular six-sided prism, rather acutely acuminated on both extremities by six planes, which are set on the lateral planes *. Fig. 66. Pl. 4.
2. When the prism becomes shorter, a double six-sided pyramid is formed, in which the lateral planes of the one are set on the lateral planes of the other, and the remains of the prism form a truncation on the common basis; or the truncation is entirely wanting †. Fig. 67. Pl. 4.
3. N° 1. in which the alternate angles formed by the meeting of the acuminating and lateral planes are truncated ‡. Fig. 68. Pl. 4.
4. N° 1. in which all the angles formed by the meeting of the acuminating and lateral planes are truncated ||. Fig. 69. Pl. 4.
5. The prism is sometimes so broad, that it resembles a rectangular four-sided table, in which the terminal planes are bevelled §.
6. N° 2. in which three alternate planes in each pyramid become larger than the others, and thus a figure approaching to the cube is formed

7. N° 1.

* Quartz-hyalin prismé, Haüy.—Romé de Lisle, t. ii. p. 82. var. 3. Pl. 6. fig. 28.

† Quartz-hyalin dodecaedre, Haüy.—Romé de Lisle, p. 70. Pl. 6. fig. 19.

‡ Quartz-hyalin rhombifère, Haüy.—Romé de Lisle, p. 37. Pl. 6. fig. 38.

|| Quartz-hyalin plagiedre, Haüy.

§ Quartz-hyalin comprimé, Haüy.—Romé de Lisle, p. 85. var. 4. Pl. 6. fig. 29. & 30.

7. N° 1. in which the lateral planes converge towards one extremity *.
8. An acute simple six-sided pyramid.
9. N° 1. in which the alternate and unconformable lateral planes converge towards both extremities of the prism.
10. An acute double three-sided pyramid; originates from the preceding figure.

The proportional size both of the lateral and acuminating planes vary so much, as to render it at first sight somewhat difficult to determine the form of the crystal.

The crystals are from uncommonly large to small; but are most frequently middle-sized and large. The prisms are in general larger than the pyramids †.

The crystals are seldom singly imbedded, more frequently attached by one extremity, or by a lateral plane, also variously intersecting each other, and forming druses. Sometimes twin-crystals occur, and these are formed by one crystal penetrating another longitudinally.

The blunt-edged pieces and the balls have a rough surface. The lateral planes of the six-sided prism, and the planes in the other figures that correspond to these, are transversely streaked; but the acuminating planes are smooth. Sometimes the crystals are invested with a rough translucent crust of quartz.

It

* Romé de Lisle, p. 126. var. 12. Pl. 6. fig. 36.

† In the Alps of Switzerland, prisms measuring from two to three feet in length, and from four to seven feet in circumference, have been met with. —Baumer's Naturgeshichte des Mineralreiches, th. 1. s. 244. In the Museum of Natural History in Paris, there is a fragment of a rock-crystal, of so great a size, that it is conjectured the original crystal to which it belonged must have weighed more than a thousand pounds.—Pujoulx, Mineralogie des Gens du Monde, p. 131.

It very rarely occurs in granular and prismatic distinct concretions *.

Externally, the crystals are generally splendent or shining.

Internally, they are splendent and vitreous.

A cleavage is sometimes observed, the folia of which are parallel with the planes of a double six-sided pyramid of 133° 48′, 103° 20′. Of these folia three are more easily detected than the others, and these are parallel with the planes of the primitive rhomboid.

The fracture is almost always perfect conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is generally transparent †, sometimes semitransparent or translucent; it refracts double, but feebly.

It scratches felspar, but does not affect topaz.

It is rather easily frangible.

Specific gravity 2.650, rock-crystal from Madagascar, *Brisson.*—2.605, clove-brown crystal, *Karsten.*—2.888, snow-white transparent, from Marmerosch, *Karsten.*—2.5813, *Haüy.*

Physical Characters.

When two pieces are rubbed against each other, they become phosphorescent, and exhale an odour like that of the electric fluid.

Chemical

* The rare variety in prismatic concretions is one of the links which connects rock-crystal with amethyst.

† In transparent crystals, we generally find the basis or point of adherence nearly opaque.

Chemical Characters.

It is completely infusible before the blowpipe, but, when exposed to a stream of oxygen gas, it melts into a nearly transparent bead. Coloured rock-crystal, if carefully exposed to a gentle heat, loses its colour, but retains its transparency.

Constituent Parts.

Silica, -	$99\frac{5}{8}$
Trace of ferruginous Alumina.	
	100

Bucholz, Gehlen's Journ. 1808, p. 150.

It appears from this analysis, that rock-crystal is an anhydrous silica; other chemists maintain that it contains one or two *per cent.* of moisture.

Geognostic Situation.

1. Although rock-crystal occurs more frequently, and in more numerous geognostic relations than amethyst, yet it is not the most common subspecies of quartz. It appears most frequently, and in the largest and most transparent crystals, in primitive rocks, where it occurs in beds, veins, and large drusy cavities.

These veins often contain large drusy cavities. In the valley of Chamouni, and other districts in Switzerland, in searching for rock-crystals, the principal symptom is the quartz veins in the granite or gneiss. When a vein is discovered, the miner moves only in its line of direction, striking with a hammer, which he continues until a hollow sound is is heard; here he stops, breaks into the cavity underneath, and finds the rock-crystal.

In the year 1720, a magnificent cavity was opened in a quartz vein in the Grimsel, in the Canton of Berne. The vein which led to the cavity was three feet wide, but the cavity was eighteen feet wide, and one hundred and twenty feet deep, and lined with numerous beautiful rock-crystals. Many of them were one hundred weight, others four or five hundred weight, and even six or eight hundred weight. In other mountains in the Alps, cavities have been opened, containing rock-crystals, weighing upwards of fourteen hundred weight, and measuring in diameter three and a half feet, in length two and a half, and each lateral plane one and a half feet broad. In the Royal Museum in Paris there is a groupe of rock-crystals, weighing three hundred and twenty-five pounds, from the Fischbach in the Vallais; and belonging to the same magnificent collection, there is a hexahedral prism of transparent rock-crystal, which, on account of its enormous weight, could not be placed in the gallery of the Museum.

The drusy cavities, as well as the other parts of these veins, contain other minerals besides rock-crystal. Thus in Switzerland, France and Scotland, they contain also adularia, common felspar, epidote, chlorite, and calcareous spar; and in Siberia and other countries, topaz, beryl, and mica. In these veins we very seldom meet with ores, and when they do occur, it is but in small quantities; and almost the only species hitherto observed, are specular iron-ore, iron-pyrites, and octahedrite.

In other situations, however, it is associated with considerable variety and abundance of ores, and not only in veins, but also in beds. Thus in Hungary, Transilvania, Saxony, and other countries, it occurs in veins along with galena

galena or lead-glance, blende, copper-pyrites, and iron-pyrites; and in beds in the tin formation of Zinnwald.

These are its principal geognostic relations in primitive mountains; and there, it may be added, it occurs more frequently and abundantly in granite, gneiss and mica-slate, than in other rocks of that class.

It occurs rarely in secondary rocks, and principally in limestone, marl and greenstone.

It may also be noticed, that rock-crystal forms one of the constituent parts of the variety of granite named *graphic granite.*

2. Various substances are found inclosed in rock-crystal: Thus it occasionally contains cavities, which are either wholly or partially filled with air, water, or petroleum; when the cavity is partially filled with water or petroleum, the air-bubble, or space unoccupied by the water, is visible in moving the crystal in different directions. The following are other minerals observed inclosed in rock-crystal; epidote, schorl, garnet, chlorite, mica, asbestus, actynolite, fluor-spar, heavy-spar, native silver, specular iron-ore, needles of manganese-ore, and of grey antimony-ore, and crystals and grains of arsenical pyrites, and rutile. Sometimes the crystals of grey antimony-ore, manganese, and rutile, are decomposed and carried away by some agent unknown to us, and then the rock-crystal appears traversed by a number of hollow prismatic canals.

Geographic Situation.

Europe.—Crystals of great size and beauty are found in different parts of Scotland; the rock-crystals of the Island of Arran, which occur in drusy cavities in granite, are well known; but the largest and most valuable are found in the neighbourhood

neighbourhood of Cairngorm, in the upper part of Aberdeenshire, where they occur in granite, or in alluvial soil, along with beryl and topaz. Small but beautiful rock-crystals occur in the secondary greenstone of Burntisland in Fifeshire. It is comparatively rare in England,—a circumstance which ought not to excite surprise, when it is known that the rocks which generally afford this gem occupy but a small part of that portion of the island. It occurs at Dennyval slate quarries, and near Scorrier in Cornwall; near Snowdon in Caernarvonshire; near Bristol; and at Allenheads in Northumberland. On the Continent of Europe it is very widely, and often abundantly distributed. Thus it is found at Kongsberg in Norway, along with native silver; and in the same country, in beds of quartz, in primitive greenstone; likewise in drusy cavities in granite, in the Hartz; in Upper Saxony, in a tinstone formation; Bohemia; in Silesia, in granite; in clay-slate in Bavaria; Tyrol; Carinthia; Carniola; Italy; Hungary; Transilvania; Switzerland, particularly in Mont Blanc; Spain; and France, particularly in Dauphiny, where very magnificent groupes of crystals are found.

Asia.—Island of Ceylon; Catharinenburg; Adon-Tschelon, along with beryl; at Nertschinsk.

Africa.—Large and beautiful crystals, which are sometimes traversed by crystals of rutile, are found in Madagascar *.

America.—Beautiful small crystals are found at Cape Diamond near Quebec; in West Greenland, and many other

* It is mentioned in Fresange's Voyage to Madagascar, that crystals twenty feet in circumference occur in that island. Here we must suppose that massive quartz and rock-crystal have been confounded together.—An. des Voyages, de la Geographie, et de l'Histoire, par Malte Brun, Paris, t. ii.

other parts in North America, particularly the United States.

Large and beautiful crystals are found in the Brazils, in the Caraccas, and other districts of South America.

Uses.

Rock-crystal is cut and polished as an inferior kind of gem or ornamental stone. It receives the required shape by sawing, splitting, and grinding. The sawing is effected by means of an extended copper-wire fixed to a bow; the wire is coated with a mixture of oil and emery, and is drawn backwards and forwards until the operation is finished. As this process is a very tedious one, particularly when the mass is large, a more expeditious, although less certain, method is sometimes followed: The crystal is heated red-hot, and then a wet cord is drawn across in the direction we intend to split it; by the rapid cooling thus effected in the direction of the cord, the stone easily splits, and generally in the desired direction, by a single blow of a hammer. The grinding is done by means of emery; and the polishing with tin ashes and tripoli *. It is most advantageously

* The cutting and polishing of gems differs considerably from that of diamond-cutting, already described. The form intended to be given to the gem being determined on, it is cemented to the end of a stick, and the facets are set on, not by cutting its surface by means of a diamond, but by applying it to the mill. The mill is a plate of copper, or of an alloy of lead and tin, to which a horizontal motion is given by a simple piece of machinery. Its surface being charged with diamond-powder and oil, or with fine emery and water, (the former of these, however, is preferred, the rapidity with which it works being such as to make up for the difference of price between the two materials), a thick peg of wood, called a guage, pierced with small holes in all directions, is set upright on the lapidary's bench, close to the mill; and

advantageously cut into steps, when used either for seals, or for other purposes; the breadth of the table should be proportioned to the fulness of the colour, and it should be set with an appropriate foil of a pale colour.

Different kinds of work in rock-crystal must be perforated, and the perforation is executed by means of the diamond-splitter and a drill machine. It is cut into ring-stones, seal-stones, necklaces and ear-drops; and when the masses are large, into snuff-boxes, vases, and ornaments for chandeliers.

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and the process of setting the facets takes place in the following manner:—The stone is placed on the surface of the mill, the opposite end of the stick to which it is cemented being inserted in one of the holes of the guage. In this position, it is kept steady by the workman with the right hand, while with the other he puts the mill in motion, by turning a winch. The direction of the motion given to the mill, is such as tends to draw the stick out of the guage; for, if given in a contrary direction, it would soon flaw and tear up the folia of the stone. The skill of the lapidary depends on regulating the velocity of the mill, and pressing with more or less force on the stick, with an almost imperceptible tendency to one or other direction, in different stages of the work, examining each facet at very short intervals, in order to give as great precision as possible to its size and form. This being completed, the cutting-mill is taken out, and replaced by one of brass, on which the polishing is performed, by means of fine emery, tripoli, and rotten-stone, exactly in the same manner as practised in the first stage of the process for setting diamonds.

Considerable judgment is required in determining the form and proportions best adapted to show the beauty of any particular stone. If the colour of the stone is deep, and its transparency perfect, the best form to give it is the brilliant; but if the colour is pale and light, the most advantageous mode of cutting it, is to cut the table side in the brilliant form, and the collet side in steps: by this means the table will be left dark, while all the light reflected from the steps on the under side of the stone, will be thrown up into the facets, by which the table is surrounded. When the stone possesses opalescence, play of colour, &c. such as opal and Labrador felspar, they ought to be cut more or less hemispherical or elliptical, without any flat facets, but highly polished. In France, certain dark-coloured gems, as garnet, and semitransparent ones as chrysoprase, are cut *en cabochon*, with a single row of small facets surrounding the base.—*Mawe's Treatise on Precious Stones.*

chandeliers. The ancients valued vases of this stone very highly, particularly when of considerable size. Such were the two cups which the tyrant Nero broke into pieces in a fit of despair, when he was informed of the revolt which caused his destruction. One of these was estimated at 15,000 livres. At Briançon there was formerly a manufactory, where the rock-crystal of Dauphiny was worked into ornaments for chandeliers.

When perfectly pure, it is much in request by opticians, who cut it into glasses for those spectacles which are called *pebbles*, and who use it for various optical instruments. The best crystal is imported from Brazil and Madagascar, in blocks, not unfrequently from 50 lb. to 100 lb. weight. It is sold at various prices, from five to twenty shillings a-pound, according to its quality.

The deep wine-yellow, and clove-brown coloured varieties are those most highly esteemed as articles of jewellery, and are made up into necklaces and ear-drops, or are cut into seal-stones and brooches. It is an excellent stone for engraving upon, and hence, occasionally, beautiful figures and groupes are cut on it. These beautiful varieties are found in different parts of Scotland, but particularly in the granite mountains towards the source of the Dee. Of these mountains the most universally known is Cairngorm, and hence these stones are in trade known under the name *Cairngorum Stones*. The rock-crystal of Brazil and Madagascar, is in general of a deeper and richer colour than that of Scotland, and can be purchased at a cheaper rate; and as there is a natural prejudice in favour of the productions of our own country, these also are sold under the name Cairngorum Stones. The deep coloured yellow varieties, when well cut and set, are sold as topazes. The clove-brown varieties are known to jewellers under the name

Smoke Topaz, but these, and all other varieties of rock-crystal, may be readily distinguished from topaz, even when polished, by the following characters: Topaz scratches rock-crystal, but it is not affected by rock-crystal; topaz has a specific gravity of 3.5, whereas that of rock-crystal is only 2, 6.5; and topaz retains the electricity it acquires by friction twenty-four hours and upwards, but rock-crystal seldom half an hour, and often much less; and, lastly, the topazes of Brazil and Siberia, and also many of those of Saxony, become electrical by heating, which is not the case with rock-crystal.

We sometimes observe on the surface, or in the interior of rock-crystals, a beautiful iridescence. This property, when superficial, is owing to a slight covering of metallic oxide; but when internal, it is caused by the refraction of light, in numerous fissures. This appearance may be artificially produced by heating rock-crystal nearly red hot, and then plunging it into hot water *. Such varieties are esteemed by collectors.

The varieties of rock-crystal that contain vesicular cavities with air and water, and which are known to French collectors under the name *quartz limpide aërohydre*, are much prized by collectors, and sell at a considerable price.

The varieties inclosing crystals of titanium, the *Venus Hair-stones* of amateurs, and those containing crystals of actynolite, or the *Thetis Hair-stones*, are also in much repute with collectors, and sell at a considerable price, when of good colour and transparency. These, and several other varieties, such as those containing chlorite, or needles of manganese, are cut and polished, and worn as ring-stones or brooches.

Different

* This variety of rock-crystal is conjectured to be the *Iris* of Pliny.

Different colours may be communicated to the white varieties of rock-crystal: Thus, if they are heated, and plunged into a solution of indigo, they acquire a blue colour; if into a decoction of cochineal, a red colour; or if into a solution of copper, a blue tint. A clove-brown colour may be given to white-coloured crystals, by exposing them to the vapour of burning wood. Artists sometimes communicate beautiful colours to rock-crystals, by forming them into *doublets*. Two modes are followed. In the one, we take a semibrilliant of rock-crystal, and hollow it underneath, and fill the hollow with a liquor of the colour we wish the stone to exhibit, and then inclose it by a plate of glass. If this kind of doublet is dexterously made, we do not readily discover that the stone is hollow underneath, and only coloured in the middle, but the whole mass appears of an uniform tint. The second kind of doublet is formed, by cementing a coloured plate of glass on the base of a roset or brilliant cut rock-crystal, by means of which the whole stone acquires the colour of the plate.

Rock-crystal is sometimes imitated by artificial pastes; but these can be distinguished from the true stone by their inferior hardness, and their containing roundish air-vesicles irregularly distributed throughout the mass.

Of these pastes, the most celebrated is that known under the name of *Strass paste*.

Observations.

1. This subspecies of quartz is characterized by its frequent pale colours, its constant regular form, its lustre, cleavage, fracture, and perfect transparency. It is distinguished from *amethyst* by its colours, its prisma-

tic figure, its perfect conchoidal fracture, imperfect cleavage, which seldom occur in amethyst; lastly, its greater transparency, and different geognostic situation. Its stronger lustre and transparency, and conchoidal fracture, distinguish it from *common quartz.* Its low degree of lustre distinguishes it from the *diamond*, which is remarkable for its high adamantine lustre; and pure rock-crystal has a higher degree of transparency than that gem. The same characters enable us to distinguish it from zircon and white sapphire.

2. Transparent snow-white rock-crystal resembles glass in its general appearance; but, independent of other characters, the vesicles and rents that occur in both afford an easy mode of distinguishing them; the air-bubbles or vesicles in glass being irregularly diffused, and nearly of a globular shape; while in rock-crystal they are disposed in the same plane or parallel planes; and generally in the form of clouded specks.

Third Subspecies.

Rose or Milk Quartz *.

Milch Quartz, *Werner.*

Rosen rother Quarz, *Wid.* s. 301.—Rosy red Quartz, *Kirw.* vol. i. p. 245.—Milch Quarz, *Emm.* b. i. s. 136.—Quartz laiteux, *Lam.* t. ii. p. 123.—Quartz laiteux, ou Quartz Rose, *Broch.* t. i. p. 246.—Quartz-hyalin-rose, *Haüy,* t. ii. p. 418.—Milch Quarz, *Reuss,* b. ii. th. i. s. 221. *Id. Lud.* b. i. s. 76. *Id. Suck.* 1r th. s. 283. *Id. Bert.* s. 255. *Id. Mohs,* b. i. s. 220. *Id. Hab.* s. 4.

Quartz

* *Rose Quartz*, from its rose-red colour; *Milk Quartz*, from the opaline milky appearance it often exhibits, particularly when cut.

—Quartz rose, *Lucas*, p. 32.—Quartz-hyalin, *Brong.* t. i. p. 278. —Quartz rose, *Brard*, p. 93.—Transparent rose-red Quartz, *Kid*, vol. i. p. 199.—Quartz rose, *Haüy*, Tabl. p. 25.—Milch Quarz, *Steffens*, b. i. s. 112.—Rosen Quarz, & Milch Quarz, *Haus.* Handb. b. ii. s. 382.—Milch Quarz, *Hoff.* b. ii. s. 31. Milk Quartz, *Aikin*, p. 177.

External Characters.

Its most common colours are rose-red and milk-white. The rose-red colour sometimes inclines to flesh-red, and passes into crimson-red, reddish-white, pearl-grey, and, lastly, into milk-white, which reflects a yellowish light, and often passes into blue.

It occurs only massive.

Some varieties shew a tendency to straight and thick lamellar distinct concretions.

Internally its lustre is shining, sometimes passing to splendent, and is vitreous, slightly inclining to resinous.

The fracture is more or less perfect and flat conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is more or less translucent, even approaching to semi-transparent.

The other characters are the same as those of rock-crystal.

Constituent Parts.

It is supposed to be silica coloured with manganese.

Geognostic Situation.

It occurs in masses, included in beds of quartz subordinate to granite and gneiss, and in veins of manganese in granite.

Geographic

Geographic Situation.

Europe.—It was first discovered in Bavaria, where it occurs in beds of quartz in granite near Zwiesel; also in the Hörlberg in the Forest of Bohemia, and in the Harlachberg, near Bodenmais. Pale rose-red, and milk-white varieties occur near Hohenstein in Saxony; rose-red at Arendal in Norway; milk-white in Spain; rose-red at Chateau-neuf in Auvergne and Moisin in France; and pale rose-red and milk-white in the Island of Coll, one of the Hebrides.

Asia.—Very beautiful rose-red semitransparent varieties occur in the Kolywan mountains, and in the Tigerezkeschen snow mountains.

America.—At Topsham in Mainè, in the United States, and in South Greenland.

Uses.

It is employed in jewellery, and the larger masses are cut into vases *. It takes a fine polish, and when the colour is good, the ornaments made of it are beautiful. When cut and polished, and of a good colour, it is sold for spinel; yet its deficiency in hardness, transparency, and fire, is so great, that the deception is easily detected †.

Observations.

1. This subspecies is distinguished from Rock-crystal, the only one of the subspecies of the quartz species with which

* M. Dedrée has in his possession a beautiful vase of rose quartz.

† In the district of Kolyvan in Siberia, it is cut into elegant vases.

which it could be confounded, by its colour, massive external shape, fracture, lustre, and lamellar concretions.

2. The milk or bluish-white variety of this mineral, is by some jewellers named *false sapphire*, or *occidental sapphire.*

3. It loses its colour by keeping, particularly in a warm place.

Fourth Subspecies.

Common Quartz.

Gemeiner Quartz, *Werner.*

Quartzum rude, *Wall.* t. i. p. 220. *Id. Romé de Lisle.*—Gemeiner Quartz, *Wid.* p. 300.—Quartz, *Kirw.* vol. i. p. 242. *Id. Estner,* b. ii. s. 265. *Id. Emm.* b. i. s. 125.—Quarzo, *Nap.* p. 170. *Id. Lam.* t. ii. p. 119.—Quartz hyalin amorphe, *Haüy,* t. ii. p. 423.—Le Quartz commune, *Broch.* t. i. p. 248.—Gemeiner Quarz, *Reuss,* b. ii. s. 44. *Id. Lud.* b. i. s. 76. *Id. Mohs,* b. i. s. 222–245. *Id. Bert.* s. 250. *Id. Suck.* 1r th. s. 290. *Id. Hab.* s. 5.—Quartz hyalin opaque, *Lucas,* p. 32.—Quartz hyalin amorphe, *Brong.* t. i. p. 274.—Quartz hyaline opaque, *Brard,* p. 94.—Quartz amorphe, *Haüy,* Tabl. p. 25.—Gemeiner Quarz, *Steffens,* b. i. s. 119. *Id. Hoff.* b. ii. s. 34.

External Characters.

The colours of common quartz are very various. The most common are white and grey ; less frequent are yellow, brown and red, and the rarest are green, blue and black. Of white, the following varieties have been observed : snow-white, greyish-white, yellowish-white, greenish-white, and reddish-white: from greenish-white it passes into a colour intermediate between verdigris-green and mountain-green, and

and into pale olive green. The varieties of grey are ash-grey, smoke-grey, yellowish-grey, pearl-grey, and bluish-grey. From bluish-grey it passes into dark indigo-blue, Berlin-blue, and violet-blue. From yellowish-grey it passes into wax and honey yellow; from pearl-grey into flesh-red, blood-red, brick-red, and further into hyacinth-red, reddish-brown, and pale chesnut-brown. From dark ash-grey into greyish-black.

The varieties of external shape are even more numerous than those of colour.

It occurs most commonly massive, disseminated, in blunt-edged pieces, in grains of different sizes and forms: also in plates, stalactitic, reniform, botryoidal, globular, specular, corroded, vesicular, ramose, amorphous, cellular, and with impressions; of the cellular it presents the following varieties, hexagonal, polygonal, and circulo-cellular; and of this latter form, the parallel, double and spongiform varieties.

The impressed forms are tabular, cubical, pyramidal, and conical.

It sometimes occurs in distinct concretions. These are granular, prismatic, and rarely lamellar. The granular concretions vary from very large to small, and are round, angulo-granular, and date-shaped granular, and often one or two varieties occur included in the other. The granular variety is sometimes flexible. The prismatic concretions are parallel and scopiform diverging, varying from thick to very thin. The lamellar concretions are thick and straight.

It occurs in true and supposititious crystals.

The following are the true crystals, which conjoin those of rock-crystal and amethyst.

1. Six-sided prism acuminated on both extremities by six

six planes. It is either crystallized on both extremities, and then it is imbedded, or crystallized only at one extremity, and then it adheres.

2. Simple six-sided pyramid. The crystals of this figure are either single, resting on each other, or are aggregated in form of a bud.
3. Double six-sided pyramid, which is sometimes aggregated in rows.

The surface of the crystals is the same as in rock-crystal.

The following are the supposititious crystals:

1. Double six-sided pyramid, hollow, and the surface drusy. Originates from calcareous-spar.
2. Single and double three-sided pyramid, hollow, and surface drusy. Originates from calcareous-spar.
3. Regular octahedron, sometimes hollow, and surface drusy. Originates from fluor-spar.
4. Cube. Originates from fluor-spar.
5. Rectangular four-sided table, hollow, and surface drusy. Originates from heavy-spar.
6. Oblique four-sided table, surface drusy. Originates from heavy-spar.
7. Eight-sided table, sometimes hollow, sometimes partly filled with straight lamellar heavy-spar, and the surface drusy. Originates from heavy-spar.
8. Lens, hollow, and surface drusy. Originates from gypsum.

The crystals occur of every size, from very small to very large, but they never attain the magnitude of rock-crystal. The prisms are generally larger than the pyramids.

Externally

Externally the lustre of the true crystals varies from splendent to glistening; that of the rolled pieces is glimmering, passing into dull.

Internally it is shining, which sometimes borders on glistening, and sometimes approaches to glimmering, and is vitreous.

Its cleavage, which is very rarely discoverable, is imperfect.

The fracture is coarse splintery, and sometimes small-grained uneven, which latter passes into small and imperfect conchoidal. It sometimes occurs slaty.

The fragments are indeterminate angular, and sharp-edged.

It is generally translucent, seldom semitransparent *, and the darker varieties are only translucent on the edges.

The other characters the same as those of rock-crystal.

Chemical Characters.

It is infusible without addition before the blowpipe, but when exposed to a stream of oxygen gas, it melts into a milk-white porcellanous bead.

Geognostic Situation.

This is one of the most abundant minerals in nature, and appears in many different geognostic situations. It occurs in primitive, secondary, alluvial and volcanic rocks, and either as a constituent part of these rocks, or associated with them in the form of beds and veins. Thus it forms a principal constituent part of granite, one of the most frequent and abundant of rocks; it is also one of the component

* It is only in the crystallized varieties that semitransparency occurs.

component parts of gneiss, mica-slate, and topaz-rock: occurs imbedded in grains and crystals in porphyry, and accidentally intermixed with clay-slate and limestone. Beds of quartz occur in granite, gneiss, mica-slate, and clay-slate: and these beds are sometimes several hundred fathoms thick, and form whole hills, or ranges of hills.

Most of the veins that traverse primitive rocks, with the exception of those that afford fluor-spar, heavy-spar, and some other minerals, contain common quartz. These veins are frequently entirely composed of quartz, and are of great width and extent; indeed they are so large, that Dolomieu and others maintain, although erroneously, that quartz occurs more abundantly in veins than in any other kind of repository.

It also occurs in metalliferous beds along with ores of different kinds, as galena or lead-glance, tinstone, and various pyritical minerals.

It occurs in vast abundance in secondary mountains, in the form of sandstone, and also in beds subordinate to gypsum and limestone. The numerous veins that traverse the different rocks of the secondary or flœtz class are very often particularly distinguished by the common quartz which they contain.

The alluvial deposites so abundantly and widely spread over the face of the earth, contain enormous accumulations of quartz, in the form of rolled pieces, gravel, and sand.

Its distribution in true volcanic rocks is not well understood.

Geographic Situation.

Europe.—This mineral, in the form of quartz-rock, occurs very abundantly in the Highland Districts of Scotland, where

where it is disposed in beds or veins in primitive and secondary rocks. Its various geognostic relations may be studied with great advantage in many of the Hebrides, particularly in Isla and Jura, and on the mainland on the coasts of Caithness, Sutherland, Ross-shire, Inverness-shire, and Argyleshire. Whole hills, and ranges of hills, of quartz-rock occur in the interior of Scotland, and it abounds in many of the Hebrides and Shetland islands. In the form of sandstone, it skirts the east coast of Scotland, almost uninterruptedly from Berwick to Stonehaven, and, after an interruption of primitive rocks, continues to bound the shores from Buckie to the Pentland Frith. The sandstone also forms extensive tracts on the west coast, and many considerable tracts of this rock extend from the coast into the interior parts of the country. Some groupes of islands, such as the Orkneys, are almost entirely composed of quartz, in the form of sandstone.

It occurs in the Primitive Mountains of England; but not so abundantly as in Scotland. It also forms a principal constituent part of the different sandstones of the lower and flatter parts of England, and appears in veins that traverse not only sandstone but also limestone, trap, and other rocks.

It is abundant in the primitive and secondary mountains of Ireland.

In the alluvial districts in the different parts of Britain and Ireland, it abounds in the form of gravel and sand.

On the Continent of Europe it is very abundantly and widely distributed; indeed we cannot name a country, from the coast of Norway to the Black Sea, and from the Arctic Ocean to the Mediterranean Sea, that does not contain much common quartz

Asia.

Asia.—A beautiful indigo-blue variety, along with the common varieties, occurs in the Island of Ceylon. In Siberia it occurs in vast abundance, either as a constituent part of mountain rocks, or in beds alternating with them, or in veins traversing them. In the peninsula of India, it appears as a constituent part of granite, gneiss, and mica-slate, in the form of quartz-rock, also accidentally mixed with clay-slate, and as a constituent part of various sandstones.

Africa.—At the Cape of Good Hope it occurs in veins, and as a constituent part of granite; and the great ranges of mountains to the north of that promontory are formed of sandstone, of which this mineral forms a principal ingredient. The vast sandy desarts that occupy so great a portion of the surface of Africa, contain much common quartz.

America.—The great tracts of primitive and secondary rock in the northern and southern parts of North America abound in common quartz. The limestone districts afford smaller portions of it, but in some places on the coasts of the ocean it abounds in the form of sand.

In South America it is an abundant mineral, appearing in its usual geognostic situations, in the primitive, secondary, and alluvial strata which form that vast continent. The flexible variety was first found in Brazil, and has been lately observed in North America *.

Uses.

It is employed in the manufacture of glass and artificial gems; also in the preparation of smalt, and as an ingredient in porcelain and different kinds of pottery. The vesicular

* Greenough.

sicular and corroded variety forms a most excellent mill-stone, known in commerce under the name of *Buhr-stone.* This buhr-stone has hitherto been found only in France; but it is so much esteemed in this country, that the Society of Arts of London have for many years past offered annually a considerable reward for its discovery in Great Britain.

Some porous varieties are used as filtering-stones, or quartz-sand is so arranged as to form a filtering-apparatus. When it is pure, and the grains are of equal size, it is used for polishing glass.

In the form of sand, it is used with quicklime, in the composition of mortar, and in agriculture, for the improvement of particular kinds of soil. Sometimes the massive varieties are employed as paving stones, and in the coarser kinds of masonry.

Some varieties of common quartz exhibit numerous points or spots that glitter like gold. This appearance is sometimes owing to the intermixture of scales of mica; in other instances it is caused by reflection from numerous small rents or fissures in the stone. These varieties have received the name Aventurine, from the following circumstance: A French workman having by accident, *(par aventure)* dropped filings of brass or copper into a vitreous mixture in a state of fusion, gave the name *Aventurine* to the glittering mixture thus formed, and of which artists make vases and other ornamental articles. Mineralogists have applied the same name to those varieties of common quartz that exhibit a nearly similar appearance. These are cut into various ornamental articles, and are sometimes sold at a very high price. The natural aventurine is found in Arragon in Spain; at Face-bay in Transylvania; and in the vicinity of Quimper in Brittany.

Mr

Mr Greenough found it near Fort-William, in the Highlands of Scotland; and I observed it in Mainland, one of the Shetland islands.

Observations.

1. It is distinguished from *rock-crystal* by its colour-suite; its various particular and supposititious forms; the greater regularity of its crystallizations; its lower degree of lustre and transparency; splintery or imperfect conchoidal fracture; and distinct concretions.

2. The *indicolite* and *siderite*, which occur in veins in gypsum, in the country of Salzburg, and which have been considered either as new species or varieties of quartz, are iolite. The blue quartz of Finland, named by some *Steinheilite*, which I have never seen, has been referred both to the quartz and iolite species.

3. There occurs near Nantz in France, a variety of common quartz, (imbedded in granite), of a grey colour, conchoidal, passing to splintery fracture, and semitransparent, which, when broken, exhales a disagreeable smell, somewhat resembling that of sulphureted or carbonated hydrogen. It is by Steffens arranged as a distinct subspecies of common quartz, under the title *Stink-quartz*.

4. The *flexible sandstone*, or granular quartz of Brazil, is described by some mineralogists, as Steffens, under the name *gelenk-quartz*. It is not a pure quartz, being also intermixed with scales of mica, which give its flexible character, and also with grains of schorl. A micaceous granular quartz of the same description has been found by Esmark in Tellemark in Norway.

5. The red crystallized variety of common quartz, found in gypsum near Compostella in Spain, used to be described under the title of *Compostella Hyacinth*.

Fifth

Fifth Subspecies.

Prase *.

Prasem, *Werner.*

Quartzum coloratum viride? *Wall.* t. i. p. 214.—Prasem, *Wern. Cronst.* s. 116.—Lauchgruner Quartz, *Wid.* p. 301.—Prasium, *Kirw.* vol. i. p. 249. *Id. Estner,* b. ii. s. 207. *Id. Emm.* b. i. s. 103.—Quarzo verde di porro, *Nap.* p. 171.—La Prase, *Broch.* t. ii. p. 252.—Quartz hyalin verd obscur, *Haüy,* t. iii. p. 419.—Prasem, *Reuss,* b. ii. s. 235. *Id. Lud.* b. i. s. 76–77. *Id. Suck.* 1r th. s. 299–300. *Id. Bert.* s. 171. *Id. Mohs,* b. i. s. 163. *Id. Hab.* s. 5.—Quartz hyalin vert obscur, *Lucas,* p. 32.—Quartz Prase, *Brong.* t. i. p. 280.—Quartz hyalin vert obscur, *Brard,* p. 93.—Prase, *Kid,* vol. i. p. 203. *Id. Haüy,* Tabl. p. 25.—Prase, *Steffens,* b. i. s. 113.—Prasem, *Hoff.* b. ii. s. 56. *Id. Haus.* b. ii. s. 383. *Id. Aikin,* p. 177.

External Characters.

Its colour is leek-green, of various degrees of intensity, very rarely inclining to olive-green.

It occurs generally massive: the massive varieties occur in distinct concretions, which are cuneiform, prismatic, and sometimes coarse granular.

It seldom occurs crystallized; and its crystallizations are the following:

1. Six-sided prism, acuminated by six planes, like quartz.
2. Six-sided pyramid, truncated on the common basis, and either single or double.

The

* The name *Prase* is from the Greek word πράσιος, *leek-green,* which is the principal colour of this mineral.

The crystals are small, and middle sized, and the surface is generally rough or drusy.

The surface of the concretions is rough and transversely streaked.

Its lustre is shining, approaching to glistening, and is resino-vitreous.

The fracture is imperfect, and flat conchoidal, passing into coarse splintery.

The fragments are indeterminate angular, and more or less sharp-edged.

It is translucent.

It is hard.

It is rather difficultly frangible.

Specific gravity 2.677, *Karsten.*—2.66,—2.685, *Breithaupt.*

Constituent Parts.

Silica,	-	98.5
Alumina with Magnesia,		0.5
Oxide of Iron,	-	1.0
		100

Bucholz in Journ. für die Chem. & Phys. vi. H. 1. s. 151.

Geognostic Situation.

It occurs in mineral beds, which are composed of magnetic ironstone, magnetic pyrites, iron-pyrites, copper-pyrites, galena or lead glance, blende, quartz, calcareous-spar and common actynolite. These beds are probably connected with primitive trap.

It also occurs in small quantity in clay-slate. It does not occur as a constituent part of any rock, nor has it been hitherto found in veins.

Geographic Situation.

Europe.—It is found in small quantity in the island of Bute, in the Frith of Clyde: and on the banks of Loch Hourn *; also in Borrodale, and elsewhere, in the neighbourhood of the English lakes †. On the Continent, it occurs in metalliferous beds at Breitenbrun near Schwartzenberg in Saxony; at Mummelgrund in Bohemia; at Bojanowitz in Moravia; at Kupferberg in Silesia; island of Elba in the Mediterranean; and near the Lake Onega in Finland.

Asia.—Siberia.

America.—In Maryland and Massachusetts.

Uses.

It is sometimes cut and polished as an ornamental stone, but is not highly esteemed. When set, it should have a gold foil. It is sometimes used for leaves of trees in mosaic work.

Observations.

Its leek-green colour appears to be owing to oxide of iron, and not to an intimate mixture of actynolite and quartz, as was formerly conjectured.

Sixth

* MacCulloch. † Greenough.

Sixth Subspecies.

Cat's-Eye *.

Katzenauge, *Werner.*

Achates Pseudopalus; Oculus cati, *Wall.* t. i. p. 296.—Oeil de chat, *Romé de Lisle,* t. ii. p. 145.—Variety of Mondstein, or Adularia, *Wid.* p. 344.—Cat's-eye, *Kirw.* vol. i. p. 301. —Katzenauge, *Emm.* b. i. s. 188.—Occhio di gatto, *Nap.* p. 225.—Oeil de chat, *Lam.* t. ii. p. 152. *Id. Broch.* t. i. p. 292. —Quartz agathe chatoyant, *Haüy,* t. ii. p. 427.—Katzenauge, *Reuss,* b. ii. th. i. s. 47. *Id. Lud.* b. i. s. 86,–87. *Id. Suck.* 1r th. s. 319,–321. *Id. Bert.* s. 263. *Id. Mohs,* b. i. s. 185,–187.—Quartz agathe chatoyant, *Lucas,* p. 33.—Quartz hyalin chatoyant, *Brong.* t. i. p. 277.—Quartz agathe chatoyant, *Brard,* p. 96.—Cat's-eye, *Kid,* vol. i. p. 229.—Schiller Quarz, *Karst.* Tabel.—Quartz agathe chatoyant, *Haüy,* Tabl. p. 27. —Katzenauge, *Steffens,* b. ii. s. 122. *Id. Hoff.* b. ii. s. 185. *Id. Haus.* b. ii. s. 384.—Cat's-eye, *Aikin,* p. 177.

External Characters.

Its principal colour is *grey,* of which it presents the following varieties: yellowish, greenish, and ash grey; from yellowish-grey it passes into yellowish-*brown,* and into a kind of isabella-*yellow;* and further, into a yellowish, reddish, and hair brown, and into a colour intermediate between hyacinth and brick *red.* From greenish-grey it passes into mountain *green* and olive-green; and from ash-grey into greyish-*black.*

* This mineral, when cut in a roundish form, reflects in particular directions a floating whitish light, like the eye of a cat in the dark: hence the name *Cat's-eye* given to it.

It exhibits a beautiful opalescence, particularly when cut in a convex form *.

It is found in blunt-edged pieces, in rolled pieces, and also massive.

Internally it is shining, and the lustre is vitreo-resinous.

The fracture is small, and rather imperfect conchoidal, sometimes approaching to uneven.

The fragments are indeterminate angular, and more or less sharp-edged.

It is generally translucent, sometimes also semitransparent, and translucent on the edges.

It is hard.

It is easily frangible.

Specific gravity from 2.625 to 2.600, *Klaproth.*—2.647, *Lowry.*

Chemical Characters.

In the heat of a porcelain furnace it loses its hardness, lustre, and transparency, and partly its colour, but is not melted. Before the blowpipe, according to Saussure, it melts with great difficulty.

Constituent Parts.

Silica,	95.00	94.50
Alumina,	1.75	2.00
Lime,	1.50	1.50
Oxide of Iron,	0.25	0.25
Loss,	1.50	1.75
	100	100

Klaproth, Beit. t. i. p. 90.

Geognostic

* It is usually brought into Europe cut in a convex form.

Geognostic Situation.

In the Hartz it is said to occur in cotemporaneous veins along with quartz, amianthus, asbestus, axinite, and calcareous-spar, in primitive trap; and in gneiss in the Island of Ceylon.

Geographic Situation.

Europe.—In the vicinity of Treseburg in the Hartz in Hanover, and near Hoff in Bareuth.

Asia.—Island of Ceylon, and coast of Malabar.

Africa.—It is said to occur in Egypt.

America.—In North Greenland *.

Uses.

It is generally cut into ring-stones; and the most advantageous form for displaying its peculiar lustre is the oval, with a convex surface. The red and olive-green varieties are the most highly prized.

Observations.

I. It has been by some mineralogists referred to Opal, by others to Felspar: it is, however, sufficiently distinguished from opal by its hardness and weight; and its fracture distinguishes it from felspar.

2. The beautiful opalescence of this gem appears to be owing to minute fibres, distributed through it, which have a brighter colour, but lower transparency, than the mineral itself, and from which the light producing the opalescence is reflected.

Seventh

* Giesecké.

Seventh Subspecies.

Fibrous Quartz.

Faser Kiesel, *Werner*.

Faser Kiesel, *Hoff.* b. ii. s. 189.

External Characters.

Its colours are greenish and yellowish-white. It is often stained yellowish-brown in the rents with iron-ochre.

It occurs massive, and in rolled pieces.

It occurs in curved fibrous concretions, which sometimes cross each other promiscuously.

Internally it is glistening or glimmering, and is pearly.

The fracture is curved slaty.

The fragments are indeterminate angular, wedge-shaped, and splintery.

It is highly translucent on the edges, passing into translucent. When cut in a convex form, it shews a feeble opalescence, like that of the cat's-eye.

It is nearly as hard as quartz.

It is not very difficultly frangible.

Specific gravity 3.123, 3.192? *Breithaupt.*

Geognostic and Geographic Situations.

It occurs on the banks of the Moldare in Bohemia.

Observations.

1. Colour, fracture, fragments, degree of transparency, opalescence, and weight, distinguish it as a subspecies of quartz.

2. It

2. It is distinguished from *Cat's-eye* by its lighter colours, delicate prismatic concretions, inferior hardness, inferior opalescence, and greater weight.

3. Werner is of opinion, that it is an intimate mixture of quartz and asbestous actynolite.

Eighth Subspecies.

Iron-Flint.

Eisenkiesel, *Werner.*

Le Cailloux ferrugineux, *Broch.* t. i. p. 238.—Quartz rubigineux, *Haüy,* Tabl. p. 25.—Eisenkiesel, *Reuss,* b. ii. th. i. s. 300. *Id. Lud.* b. i. s. 73. *Id. Suck.* 1r th. s. 347. *Id. Bert.* s. 270. *Id. Mohs,* b. i. s. 187.—Quartz rubigineux, *Brong.* t. i. p. 281.—Eisenkiesel, *Haus.* s. 6. *Id. Steffens,* b. i. s. 126. *Id. Hoff.* b. ii. s. 60. *Id. Oken,* b. i. s. 270. *Id. Haus.* Handb. b. ii. s. 395.

External Characters.

The principal colours are brown and red. The brown colours are yellowish-brown, which sometimes approaches to ochre-yellow; farther, a colour intermediate between chesnut and liver brown, and brownish-black. The only red colour is one intermediate between brownish-red and blood-red.

It occurs most commonly massive, but also crystallized in small equiangular six-sided prisms, which are acuminated on both extremities by three or six planes, which are set on the lateral planes.

It occurs almost always in small angulo-granular distinct concretions, which approach sometimes to the fine, and more rarely to the coarse granular.

Externally

Externally its lustre is shining, approaching to glistening; internally it is glistening, and is vitreo-resinous.

The fracture is imperfect, and small conchoidal, which, in some varieties, approaches to uneven.

The fragments are angular, and rather sharp-edged.

It is opaque.

It gives sparks with steel.

It is rather difficultly frangible.

Specific gravity, 2.627, 2.691, 2.814, 2.838, *Haberle.*
2.576, 2.618, 2.746, *Hoffmann.*

Chemical Character.

Is infusible without addition before the blowpipe.

Constituent Parts.

Yellow Iron-Flint.		Yellowish-brown Iron-Flint.	
Silica, -	93.5	Silica, -	92.00
Oxide of Iron,	5.0	Oxide of Iron,	5.75
Volatile matter,	1.0	Oxide of Manganese,	0.00
		Volatile matter,	1.00
Bucholz,	99.5	*Bucholz,*	99.75

Red Iron-Flint.	
Silica, - -	$76\frac{5}{6}$
Alumina, - -	$\frac{1}{4}$
Red Oxide of Iron, -	$21\frac{4}{6}$
Volatile matter, -	1
Bucholz,	$99\frac{3}{4}$

Geognostic Situation.

It occurs in veins of ironstone; the red variety in red ironstone, the brown, in brown ironstone; and also in trap rocks.

Geographic

Geographic Situation.

Europe.—In rocks near Bristol; in trap rocks that lie over white limestone, island of Rathlin, off the coast of Ireland *; and in trap rocks at Dunbar in Scotland. At Orpes, Hohenstein, and Sedlitz in Bohemia; in the Fichtelgebirge in Franconia; in brown ironstone veins at Ilfeldt and Fischbach in the Hartz; in ironstone veins at Altenberg, Eibenstock in Upper Saxony, and at Oberstein on the Rhine.

Asia.—According to M. Von Moll, it occurs in Siberia.

Observations.

1. It appears to be a chemical compound of quartz and iron-ochre.

2. It renders the iron-ore along with which it occurs, very difficult of fusion.

3. It is intermediate between common quartz and jasper. It is distinguished from *common quartz* by colour, lustre, distinct concretions, opacity, and rather greater weight; from *jasper*, by its tendency to a regular form, its distinct concretions, resinous lustre, greater hardness and weight.

Ninth

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* Greenough.

Ninth Subspecies.

Hornstone *.

Hornstein, *Werner.*

This subspecies is divided into three kinds, viz. Splintery Hornstone, Conchoidal Hornstone, and Woodstone.

First Kind.

Splintery Hornstone.

Splittriger Hornstein, *Werner.*

Splittriger Hornstein, *Wern.* Pabst. t. i. p. 247.—Petrosilex squamosus, *Wall.* t. i. p. 280.—Splittriger Hornstein, *Emm.* b. i. s. 251. *Id. Estner.*—Le Hornstein ecailleux, *Broch.* t. i. p. 255.—Splittriger Hornstein, *Reuss,* b. ii. th. i. s. 325. *Id. Lud.* b. i. s. 77. *Id. Suck.* 1r th. s. 356,–360. *Id. Bert.* s. 234. *Id. Mohs,* b. i. s. 248. *Id. Hab.* s. 14.—Silex corné, *Brong.* t. i. p. 319.—Quartz agathe grossier, *Haüy,* Tabl. p. 27.—Splittriger Hornstein, *Steffens,* b. i. s. 167. *Id. Hoff.* b. ii. s. 65. *Id. Lenz,* b. i. s. 366. *Id. Oken,* b. i. s. 299. *Id. Haus.* b. ii. s. 402.

External Characters.

Its principal colours are grey, red, and green, of which the following varieties occur: Of grey; bluish, greenish, yellowish, smoke and pearl grey: From pearl-grey it passes into flesh-red, brick-red, brownish-red, and reddish-brown: it seldom inclines to ochre-yellow: from greenish-grey it passes into mountain and pale olive green; and from pale smoke-grey into greyish-white, and yellowish-white.

It

* The name *Hornstone* given to this mineral, originated with the splintery kind, which resembles horn in colour, fracture, and translucency.

It occurs generally massive, sometimes also in large balls, and seldom with pyramidal impressions from calcareous spar.

It occurs in lenticular, and six-sided prismatic supposititious crystals.

The globular varieties occur in thick concentric lamellar distinct concretions.

Internally it is always dull.

The fracture is splintery, generally small, and fine, seldom coarse splintery; the latter sometimes approaches to large conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is more or less translucent on the edges, but some varieties that incline to quartz, and which are coarse splintery, are translucent.

It is hard, but not in so high a degree as quartz or flint.

It is difficultly frangible.

Specific gravity, 2.536, 2.602, 2.626, 2.635, *Hoffmann.*

Chemical Characters.

Infusible without addition before the blowpipe.

The fusible varieties mentioned by some mineralogists, are compact felspar.

Constituent Parts.

Pearl-grey from Schneeberg.

Silica, - -	98.25
Alumina, - -	0.75
Oxide of Iron, -	0.50
Water, - -	0.50
	100

Klaproth, Beit. b. vi. s. 232.

Geognostic

Geognostic Situation.

It occurs in veins in primitive country, along with ores of silver, lead, zinc, copper, and iron; also in the shape of balls in pitchstone and limestone, and forming the basis of hornstone porphyry.

Geographic Situation.

Europe.—In Scotland it occurs sometimes in veins, but most frequently in the form of porphyry, as in the island of Arran, in Perthshire, Argyleshire, Ross-shire, Inverness-shire, Sutherlandshire, Fifeshire, Mid-Lothian, and the Shetland islands. It is a frequent mineral on the Continent of Europe, occurring more or less abundantly in the various countries that extend from Scandinavia to the shores of the Black Sea. In Sweden it occurs in veins, also forming the basis of porphyry, as at Dannemora and Garpenberg; at Drammen and other parts in Norway; in the Hartz; Lusatia; in the Saxon metalliferous mountains (Erzgebirge), where it occurs in veins associated sometimes with ores of silver, galena, and zinc, and sometimes with grey copper-ore, and frequently in veins of red ironstone; in the same country it occurs in balls in pitchstone, and forming the basis of hornstone porphyry.

Asia.—In the silver-mine of Zmeof in the Altain range, in many places in the Uralian Mountains, and in Nepaul.

America.—Mexico, and the United States.

Uses.

Hornstone, in the state of porphyry, forms in some countries an object of considerable importance in an economical point of view. Thus, at Elfdal in Sweden, it is quarried in considerable quantities, and is cut into vases, plates, candlesticks, and a variety of other articles.

ticles. It is sometimes raised in large blocks, which, when tastefully cut and polished, have an uncommonly beautiful appearance. The pedestal of the statue of Gustavus III. in Stockholm, and many other beautiful ornaments with which that capital is adorned, are constructed of this hornstone porphyry *.

Observations.

1. *Distinctive Characters.—a.* Between splintery hornstone and *compact felspar.* Compact felspar has a foliated fracture conjoined with the splintery, whereas splintery hornstone is simply splintery: compact felspar has a glimmering, inclining to glistening, lustre, whereas splintery hornstone is dull: compact felspar is not so hard as splintery hornstone: and, lastly, compact felspar melts without addition before the blowpipe, whereas splintery hornstone is infusible.—*b.* Between splintery hornstone and *conchoidal hornstone.* In splintery hornstone, the colours are duller than in conchoidal hornstone, and are always simple; internally, splintery hornstone is dull, whereas conchoidal hornstone is glimmering or glistening: the fracture of splintery hornstone is splintery, but that of conchoidal hornstone, conchoidal; and splintery hornstone is softer, and more difficultly frangible, than conchoidal hornstone.

2. It passes into compact felspar and claystone; also into quartz, and common jasper; and into calcedony, flint, and flinty-slate.

3. It appears to contain more silica than compact felspar, but less than quartz; hence it is harder than compact felspar, but softer than quartz.

4. Some

* Thomson's Travels in Sweden.—Gottingische's Taschenbuch, v. h. 1813, 135.

4. Some of the varieties of the petrosilex of Dolomieu, Lelievre, Brongniart, and Haüy, appear to be splintery hornstone; others seem to be compact felspar.

5. The Paliopetré and Neopetre of Saussure, appear to include both the splintery hornstone and common flinty-slate of Werner.

6. The Halleflinta of the Swedes (Petrosilex semipellucidus, Wall. Syst. Min. t. i. p. 27.), Petrosilex of the French, which occurs at Sala, Hällefors, Dannemora in Sweden, and which has been arranged along with hornstone, is generally compact felspar, or an intimate mixture of felspar and quartz.

Second Kind.

Conchoidal Hornstone.

Muschlicher Hornstein, *Werner.*

Muschlicher Hornstein, *Wern.* Pabst. b. i. s. 250.—Petrosilex æquabilis, *Wall.* t. i. p. 281.—Le Hornstein conchoide, *Broch.* t. i. p. 250.—Muschlicher Hornstein, *Reuss,* b. ii. s. 328. *Id. Lud.* b. i. s. 78. *Id. Suck.* 1r th. s. 360. *Id. Bert.* s. 236. *Id. Mohs,* b. i. s. 255. *Id. Hab.* s. 14. *Id. Steffens,* b. i. s. 169. *Id. Hoff.* b. ii. s. 69. *Id. Lenz,* b. i. s. 368. *Id. Oken,* b. i. s. 360. *Id. Haus.* Handb. b. ii. s. 403.

External Characters.

Its principal colours are grey, white, and red, of which, it exhibits the following varieties, yellowish-grey, greenish-grey, and pearl-grey; from yellowish-grey it passes into isabella-yellow, yellowish-white, and greyish-white; from pearl-

pearl-grey into flesh-red and cherry-red; and from greenish-grey into mountain-green. The colours are almost always light, and sometimes they occur in spotted, clouded, and striped delineations.

It occurs most frequently massive, sometimes stalactitic, often in globular forms, rarely with six-sided pyramidal impressions; and very seldom in the following supposititious crystals:

1. Flat double three-sided pyramid.
2. Acute double six-sided pyramid.
3. Six-sided prism, acuminated with three planes.
4. Perfect six-sided prism.

These figures originate from calcareous spar.

Internally it is glimmering, sometimes approaching to glistening, and the lustre is vitreous.

The fracture is more or less perfect and flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, but in a lower degree than splintery hornstone.

It is hard; it is harder than splintery hornstone, but not so hard as quartz.

It is rather difficultly frangible.

Specific gravity, 2.572, 2.580, 2.601, *Hoffmann.*

Geognostic Situation.

It occurs in metalliferous veins and agate veins; also, in imbedded portions, in pitchstone porphyry, and in striped jasper. The metalliferous veins contain, besides the hornstone, sometimes ores of silver, of lead, or of cobalt, but never of red ironstone, the ore which frequently accompanies splintery hornstone. In agate veins it is associated with calcedony, &c. Haberle says, that it sometimes forms the

the basis of a porphyry which constitutes whole mountains *; and further, that it passes into pitchstone, and occurs in beds and kidneys in claystone.

Geographic Situation.

It is found along with claystone in the Pentland Hills near Edinburgh; also in Saxony and Bohemia.

Observations.

It is nearly allied to striped jasper.

Third Kind.

Woodstone.

Holzstein, *Werner.*

Holzstein, *Wid.* p. 329.—Woodstone, *Kirw.* vol. i. p. 315.—Le bois petrifié, ou le Holzstein, *Broch.* t. i. p. 259.—Holzstein, *Reuss,* b. ii. th. i. s. 322. *Id. Lud.* b. i. s. 78. *Id. Bert.* s. 236. *Id. Mohs,* b. i. s. 256. *Id. Hab.* s. 14.—Quartz-agathe xyloide, *Haüy,* Tabl. p. 28.—Holzstein, *Steffens,* b. i. s. 171.—*Id. Hoff.* b. ii. s. 72. *Id. Lenz,* b. i. s. 370. *Id. Oken,* b. i. s. 300.

External Characters.

Its most common colour is ash-grey, from which it passes into a greyish-black, and into greyish-white; further into yellowish-grey, sometimes into smoke-grey and pearl-grey, flesh-red, blood-red, and brownish-red. The yellowish-grey passes into wood-brown and hair-brown, and ochre-yellow. It occurs rarely greenish-grey, and mountain-green.

In

* Hoffmann says that it never forms whole beds or mountain-masses.

In general, several colours occur together, and these are arranged in irregular clouded and striped delineations.

It occurs in rolled pieces, and in the shape of trunks, branches, and roots.

Its external surface is uneven and rough.

Internally it is sometimes dull, sometimes glimmering and glistening, according as it is more or less of the nature of the two preceding subspecies.

The cross fracture is imperfect conchoidal; the longitudinal fracture is splintery and fibrous.

The fragments are angular, and rather sharp-edged; sometimes splintery.

It is generally translucent on the edges; sometimes feebly translucent.

It is hard in a low degree.

It is rather difficultly frangible.

Rather heavy.

Specific gravity 2.561, 2.624, 2.636, *Hoffmann.*

Geognostic Situation.

It is found imbedded in sandy loam in alluvial soil; and it is said also in a kind of sandstone-conglomerate and claystone.

Geographic Situation.

Europe.—It occurs at Loch Neagh in Ireland: at Chemnitz and Hilbersdorf in Upper Saxony. In the year 1752, the whole under part of the trunk of a tree with branches and roots, in the state of woodstone, was found near Chemnitz. In the Electoral Cabinet at Dresden there is a specimen of woodstone from Chemnitz: it is a portion of the trunk of a tree, and measures five feet in length, and as many in diameter. It occurs in Bohemia; Franconia; Silesia; Swabia; Bavaria; Austria; Hungary; Transylvania; and France.

Asia.—Kamtschatka; where whole trees and branches are found in the state of woodstone: also near Irkuzk, and Catharinenburg.

Use.

It receives a good polish, and hence is sometimes cut as an ornamental stone.

Observations.

1. As woodstone exhibits characters different from all other minerals, it is very properly arranged in the system as a distinct substance.

2. We must be careful not to confound together all the varieties of petrified wood that occur in nature; for wood is sometimes petrified with hornstone, forming Woodstone; sometimes with opal, forming Wood-opal; at other times with common quartz or calcareous earth.

Tenth Subspecies.

Flinty-Slate.

THIS subspecies is divided into two kinds, viz. Common Flinty-Slate, and Lydian-Stone.

First

First Kind.

Common Flinty Slate.

Gemeiner Kieselchiefer, *Werner.*

Id. Wid. s. 380.—Siliceous Schistus, *Kirw.* vol. i. p. 306.—Kieselschiefer, *Estner,* b. ii. s. 343. *Id. Emm.* b. i. s. 178.—Schisto silicea, *Nap.* p. 244.—Schiste silicieux commun, *Broch.* t. i. p. 283.—Gemeiner Kieselschiefer, *Reuss,* b. ii. s. 332. *Id Lud.* b. i. s. 84. *Id. Mohs,* b. i. s. 259. *Id. Bert.* s. 168. *Id. Suck.* 1r th. s. 361.—Jaspe schisteux, *Brong.* t. i. p. 327.—Gemeiner Kieselschiefer, *Steffens,* b. i. s. 175. *Id. Hoff.* b. ii. s. 75. *Id. Lenz,* b. i. s. 373. *Id. Oken,* b. i. s. 297. *Id. Haus.* Handb. b. ii. s. 400.—Indurated Slate, *Aikin,* p. 244.

External Characters

Its principal colour is grey, and most frequently ash-grey. It passes on the one side into smoke-grey and greyish-black, on the other into pearl-grey, from which it passes into flesh-red, and into a colour intermediate between brownish-red and cherry-red.

The colours sometimes occur in flamed and striped, also in spotted and clouded delineations.

It is often traversed by quartz veins.

It occurs massive, in mountain masses, and in blunt-edged pieces, which are pebbles.

It sometimes occurs in lamellar concretions.

Internally it is faintly glimmering, almost dull.

The fracture in the great is slaty, and in the small splintery.

The fragments are indeterminate angular, and more or less sharp-edged, and sometimes tabular.

It is more or less translucent, and passes into translucent on the edges.

It is hard.

It is uncommonly difficultly frangible.

Specific gravity, 2.613, 2.628, 2.644, *Hoffman.*—2.641, *Kirwan.*

Chemical Characters.

It is to be regretted that this interesting substance has not been hitherto chemically examined.

Geognostic Situation.

It occurs in beds and imbedded masses in clay-slate and grey-wacke; and in roundish and angular masses in sandstone.

Geographic Situation.

It occurs in different parts of the great tract of clay-slate and grey-wacke, which extends from St Abb's Head to Port Patrick; also in the Pentland Hills near Edinburgh.

It is also found in Norway, Saxony, Bohemia, Silesia, France, and other countries.

Observations.

1. It is distinguished from *Splintery Hornstone*, with which it has been confounded, by its colours being in general darker, its glimmering internal lustre, its slaty fracture, its lamellar concretions, and its geognostic relations. Colour, lustre, translucency, and more difficult frangibility, distinguish it from *Lydian-stone.*

2. In early writings it is named Horn-Slate, (Hornschiefer); under which denomination mineralogists included a variety

variety of slaty rocks, as Porphyry-slate, and Greenstone. Werner first accurately described it, and gave it its present name and place in the system.

3. It is very nearly allied to the *horn-rock* of some mineralogists, which is an intimate mixture of quartz and felspar.

Second Kind.

Lydian-Stone *.

Lidischerstein, *Werner.*

Lapis Lydius, (s. Heraclius,) *Plin.* Hist. Nat. xxxiii. 8.—Lapis Lydius, *Wall.* t. i. p. 353.—L. Stein, *Wid.* p. 360.—Basanite, *Kirw.* vol. i. p. 307.—Lidischerstein, *Estner,* b. ii. s. 346. *Id. Emm.* b. i. s. 181.—Schisto silicea, *Nap.* p. 244.—Lydienne, *Lam.* t. ii. p. 384.—La pierre de Lydie, *Broch.* t. i. p. 286.—Lydischerstein, *Reuss,* b. ii. s. 337. *Id. Lud.* b. i. s. 85. *Id. Mohs,* b. i. s. 262. *Id. Bert.* s. 168. *Id. Suck.* 1r th. s. 363. —Jaspisartiger Kieselschiefer, *Hab.* s. 13.—Jaspe schisteux, *Brong.* t. i. p. 328.—Lydischerstein, *Steffens,* b. i. s. 176. *Id. Hoff.* b. ii. s. 79.—Lydit, *Lenz,* b. i. s. 374. *Id. Oken,* b. i. s. 297.—Jaspisartiger Kieselschiefer, *Haus.* b. ii. s. 400.—Lydian-stone, *Aikin,* p. 244.

External Characters.

Its colour is greyish-black, which passes into velvet-black.

It occurs massive, and also in trapezoidal-shaped rolled pieces, which have smooth and glistening surfaces.

It

* So named from Lydia in Asia Minor, where it was first observed. It is described in Pliny and Theophrastus by its present name.

It is, like the preceding kind, traversed by quartz veins.

Internally it is glimmering.

The fracture is generally even, and approaches sometimes to flat conchoidal.

The fragments are indeterminate angular, more or less sharp-edged, and sometimes approach to the cubical shape.

It is opaque.

It is hard, but not in so high a degree as flint.

It is rather difficultly frangible.

Specific gravity, 2.596, *Kirwan.*—2.629, *Karsten.*—2.585, *Hoffmann.*

Geognostic Situation.

It occurs very frequently along with common flinty-slate in beds in clay-slate; but it has not been found in any of the older primitive rocks. It occurs in masses of various sizes, imbedded in grey-wacke, and in beds that alternate with strata of that rock. A rock very nearly allied to it occurs in beds in the oldest coal formation, viz. that associated with the old red sandstone, and in some newer coal formations.

Geographic Situation.

It is found near Prague and Carlsbad in Bohemia; at Hainchen near Freyberg in Saxony; in the Hartz; and in the Moorfoot and Pentland Hills, near Edinburgh.

Use.

This mineral is sometimes used as a touchstone, for ascertaining the purity of gold and silver. When we wish to determine the relative purity of different kinds of gold and silver alloys, we draw the alloy across the surface of the

the stone, and compare the colour of its trace with that of the pure metals, or of known compounds of these metals, and we thus obtain by simple ocular inspection a pretty correct knowledge of the purity of the alloy.

A good touchstone should be harder than the metals or metallic compounds to be examined: if softer, the powder of the stone mixes with the trace of the metal, and obscures it. It must also possess a certain degree of roughness on its surface, in order that the metal may leave a sufficiently distinct trace or streak; it must not, however, be too rough, otherwise the particles of the metal will be hid amongst inequalities, and no distinct or continuous trace will be formed.

Lastly, a good touchstone must have a black colour, as this tint shews the colour of the streak better than any other.

Those varieties of Lydian-Stone which are neither too hard nor too soft, and which have a kind of velvety feel, and are not traversed by quartz veins, are those which are preferred for touchstones.

They are cut into tables by means of pumice; then ground with sandstone, and, lastly, rubbed with charcoal-powder or ivory-black.

Observations.

1. Compact varieties of Clay-slate and of Basalt are sometimes used as touchstones.

2. According to Humboldt, it contains a small portion of carbon.

Eleventh

Eleventh Subspecies.

Flint.

Feurstein, *Werner.*

Silex igniarius, *Wall.* t. i. p. 275.—Feurstein, *Wid.* p. 308.—Flint, *Kirw.* vol i. p. 301.—Feurstein, *Estner,* b. ii. s. 360. *Id. Emm.* b. i. s. 143.—Pietra focacia, *Nap.* p. 180.—Silex, ou Pierre à fusil, *Lam.* t. i. p. 137. *Id. Broch.* t. i. p. 268.—Quarz-agathe pyromaque, *Haüy,* t. ii. p. 427.—Feurstein, *Reuss,* b. ii. s. 295. *Id. Lud.* b. i. s. 79. *Id. Suck.* 1r th. s. 343. *Id. Bert.* s. 260. *Id. Mohs,* b. i. s. 264. *Id. Hab.* s. 9. Silex pyromaque, *Brong.* t. i. p. 313.—Quartz-agathe pyromaque, *Lucas,* p. 33. *Id. Brard,* p. 96.—Black Flint, *Kid,* vol. i. p. 211.—Feurstein, *Steffens,* b. i. s. 163. *Id. Hoff.* b. ii. s. 83. *Id. Lenz,* b. i. s. 377. *Id. Oken,* b. i. s. 265. *Id. Haus.* b. ii. s. 404.—Flint, *Aikin,* p. 182.

External Characters.

Its most common colour is grey, of which the following varieties occur: ash-grey, yellowish-grey, and smoke-grey. From smoke-grey it passes on the one side through ash-grey, into greyish-black; on the other, into yellowish-grey, and into a colour intermediate between ochre and wax-yellow; further, into yellowish-brown, reddish-brown, and into a colour intermediate between blood-red and brownish-red.

It sometimes presents zoned, striped, clouded, spotted, and flamed colour delineations.

Besides massive, in regular plates, in angular grains and pieces; it occurs also in globular and elliptical rolled pieces, in the form of sand, and tuberose and perforated.

It

It sometimes, although rarely, occurs in supposititious crystals. These are:

1. Acute double six-sided pyramid.
2. Flat single or double three-sided pyramid.
3. Six-sided prism, very flatly acuminated by three planes, which are set on the alternate lateral planes.
4. Table.

These crystals are internally hollow: the pyramidal and prismatic forms originate from calcareous spar; the tabular from heavy spar.

It occurs in extraneous external shapes, viz. in the form of echinites, corallites, madreporites, fungites, belemnites, mytilites, &c.: of these, the echinites are the most frequent, and the mytilites the rarest.

It sometimes occurs in lamellar concretions, which are either straight or concentrically curved.

The external surface of the angular pieces is smooth and glistening, that of the other forms is sometimes rough, sometimes uneven.

Internally its lustre is glimmering.

The fracture is perfect and large, and rather flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent; the blackish varieties are seldom more than translucent on the edges.

It is hard; rather harder than quartz.

It is easily frangible.

Specific gravity, 2.594, *Blumenbach.*—2.581, *Geller.*—2.581, *Brisson.*—2.594, 2.592, *Hoffmann.*—2.580, 2.630, *Kirwan.*

Chemical

Chemical Characters.

Before the blowpipe it is infusible without addition; but whitens and becomes opaque.

Constituent Parts.

Silica,	-	98.0	98.
Lime,	-	0.50	0.50
Alumina,	-	0.25	0.25
Oxide of Iron,		0.25	0.25
Loss,	-	1.00	1.
		100	100
		Klaproth, Beit. b. i. s. 46.	*Vauquelin*, Journ. de Mines, n. xxxiii. p. 702.

Physical Characters.

When two pieces of flint are rubbed together in the dark, they phosphorise very much, and emit a peculiar smell.

Geognostic Situation.

1. It occurs in primitive, transition, secondary, and alluvial rocks. In primitive and transition rocks, it occurs in metalliferous and agate veins. The metalliferous veins contain in some instances ores of silver or of cobalt, in others ores of iron; and the agate veins are composed of flint, calcedony, jasper, amethyst and quartz. In secondary countries, where this mineral occurs in greatest abundance, it is found in sandstone, limestone, chalk, and amygdaloid. The sandstone is that variety known under the name of *Puddingstone;* the limestone is one of the newer secondary rocks, in

in which the flint appears in beds, imbedded masses, and veins: in chalk it occurs in great abundance in beds, also imbedded in angular and tuberose-shaped masses, and in various extraneous shapes: and in amygdaloid it forms one of the constituent parts of agate, or occurs in veins. In alluvial country, it appears in the form of rolled masses, or gravel, and sometimes as coarse sand.

2. The imbedded masses of flint are frequently hollow, and the walls of the cavities are lined with crystals of quartz, and sometimes with crystals of sulphur.

3. The beds of flint, and also the tuberose and other shaped masses of this mineral, found in chalk, appear to have been formed at the same time with the chalk. But Werner is of opinion, that the tuberose, and many other forms, have been formed by infiltration: he conjectures, that during the deposition of chalk, air was evolved, which, in endeavouring to escape, formed irregular cavities, that were afterwards filled up, by infiltration, with flint.

4. It is often covered with a whitish crust, which is usually produced by weathering; but in other instances, appears to be an original formation.

Geographic Situation.

Europe.—In Scotland it occurs imbedded in secondary limestone in the island of Mull, and near Kirkaldy in Fifeshire; and in veins and agates in primitive and secondary rocks in various parts of the country. In England, it abounds in alluvial districts in the form of gravel; or is imbedded in chalk, or secondary limestone, and forms a constituent part of veins that traverse both primitive and secondary rocks.

In Ireland it occurs in considerable quantity in secondary limestone.

On

On the Continent of Europe it is not unfrequent; thus it occurs imbedded in chalk in the islands of Rugen and Zeeland; in secondary limestone in Swabia, Bavaria, Saxony, Prussia, Franconia, Austria, Galicia, France, Spain, and Switzerland.

Asia.—In the Uralian mountains it occurs in beds in secondary limestone; also in veins that traverse both primitive and secondary rocks. It has been found on the shores of the lake Baikal; and on the banks of the river Tura, also in Siberia; and in different parts of China.

America.—It occurs in North America, either imbedded in rocks, or in rolled pieces.

Uses.

The principal use of this mineral is for gun-flints, for which purpose it is excellently fitted, on account of its hardness, the abundance of sparks it affords with steel, and the sharp fragments it gives in breaking *. The most celebrated manufactories of gun-flints are those in England, Muesnes near Berry in France, in Gallicia, and of Avio in the Tyrol. The operation of making them is so simple and easy, that a good workman will make 1500 flints in a day. The whole art consists in striking the stone repeatedly with a kind of mallet, and breaking off at each stroke a fragment, sharp at one end, and thicker at the other. These fragments are afterwards shaped at pleasure, by laying the line at which it is wished they should break, upon a sharp iron instrument, and then giving it repeatedly smart blows with a mallet. During the whole operation, the workman holds the stone in his left hand, or merely supports it on his knee. All the varieties of flint

* Flint was first used as for muskets in the year 1670.

flint are not equally well fitted for gun-flints; the best are the yellowish-grey; the dark smoke and ash grey varieties are also used, but they are neither so easily split, nor do they afford such thin fragments as the other, and, owing to their greater hardness, they wear the lock sooner. In Prussia, an attempt was made to substitute a kind of porcelain for flint, and such flints were for some time used by the Prussian soldiers. In ancient times, flint was fashioned into cutting instruments; and it is conjectured that the stone knives used by the Hebrews for circumcision were of this mineral; and hence probably also originated the word Silex, which is derived from *scindere*. It also forms a principal ingredient in that species of pottery named *Flint-ware;* it is used as a mill-stone, particularly in smalt works; sometimes it is employed as a building-stone; and by chemists for mortars.

Observations.

1. Flint is distinguished from *Common Calcedony*, by its colour suite, glimmering lustre, perfect conchoidal fracture, inferior translucency, and inferior hardness.

2. It passes into Hornstone, Carnelian, Calcedony, and even into a kind of Flinty-slate.

3. It occurs frequently in extraneous external shapes, a character which distinguishes it from *Hornstone.*

4. Hacket has endeavoured to shew that it originates from chalk, and is daily forming.

5. Flint, when dug out of its repository, is very generally enveloped in a thin white opaque crust: if this crust be removed, and the flint exposed to the influence of the weather, it will, in the course of time, become opaque, and of a whitish colour.

Twelfth

Twelfth Subspecies.

Calcedony *.

Kalzedon, *Werner.*

This subspecies is divided into four kinds, viz. Common Calcedony, Chrysoprase, Plasma, and Carnelian.

First Kind.

Common Calcedony.

Gemeiner Kalzedon, *Werner.*

Achates chalcedonius, *Wall.* t. i. p. 287.—Calcedoine, *Romé de Lisle,* t. ii. p. 145.—Gemeiner Chalzedon, *Wid.* p. 317.—Common Chalcedony, *Kirw.* vol. i. p. 298.—Chalcedon, *Estner,* b. ii. s. 368. *Id. Emm.* b. i. s. 151.—Calcedonia, *Nap.* p. 183.—La Calcedoine, *Lam.* t. ii. p. 142. *Id. Broch.* p. 268.—Quartz-agathe calcedoine, *Haüy,* t. ii. p. 425.—Gemeiner Chalcedon, *Reuss,* b. ii. p. 271. *Id. Lud. Suck. Bert. Id. Mohs,* b. i. s. 273. *Id. Karst.* Tabel. s. 24. *Id. Leonhard,* Tabel. s. 10.—Quartz-agathe calcedoine, *Lucas,* p. 33.—Silex calcedoine, *Brong.* t. i. p. 298.—Quartz agathe calcedoine, *Brard,* p. 96.—Calcedony, *Kid,* vol. i. p. 217.—Calcedoine, *Haüy,* Tabl. p. 26.—Gemeiner Kalcedon, *Steffens,* b. i. s. 153. *Id. Hoff.* b. ii. s. 108. *Id. Lenz,* b. i. s. 385.—Chalcedon, *Oken,* b. i. s. 266.—Chalcedony, *Aikin,* p. 179.

External Characters.

Its most common colour is grey, of which the following varieties

* Calcedony, in antient times, was collected principally in the district of Calcedonia in Asia Minor, and hence its name.

varieties occur; smoke-grey, bluish-grey, pearl-grey, greenish-grey, and yellowish-grey. The bluish-grey passes into milk-white *, and smalt-blue; the pearl-grey, into pale violet-blue and plum-blue; the greenish-grey into a colour which is intermediate between grass and apple green; the yellowish-grey passes into honey-yellow †, wax-yellow, and ochre-yellow: from this into yellowish-brown, blackish-brown, and brownish-black ‡.

The two last-mentioned colours are very dark, and when held between the eye and the light appear blood-red.

The colours occur in clouded, striped ||, dendritic and moss-like delineations.

Those varieties, in which there is an alternation of white, black, and dark-brown layers are named *onyx*; those with white and grey layers, *calcedonyx*. The dendritic varieties, which have a white or grey basis, with black, brown, or green arborisations, are named *Mocha-stones* *.

The bluish-grey varieties, in concentric lamellar concretions, when cut across into thin tables, and held between the eye and the light, exhibit an iridescent appearance, and hence have been named *rainbow calcedony*. When cut parallel to the concretions, they exhibit a clouded delineation.

It

* Leucachates of Pliny.

† Cerachates of Pliny.

‡ The green and blue varieties are the rarest. M. De Dree mentions an *azure-blue* variety, under the name of *sapphirine*, and which is much prized on account of its beauty and rarity. It is found in Transylvania, and at Nertschinski in Siberia.

|| The variety with green stripes, named *Memphites*.

§ Mocha-stone, also named *Dendritic calcedony*.

It occurs massive, in blunt-edged pieces, smooth rolled pieces, plates, crusts, balls, (which sometimes contain water, forming what are called *enhydrites*, and more rarely, as at Irkutsk, mineral oil), reniform, botryoidal, coralloidal, stalactitical, cellular, with impressions (generally from cubes of fluor-spar), and crystallized.

The following are its crystallizations:

True Crystals.

1. Rhomboid, in which the sides are either drusy or granulated, with a glimmering lustre. They occur in druses.

Supposititious Crystals.

1. Rhomboid, from calcareous-spar.

It sometimes occurs also in extraneous external shapes, in the form of ammonites, turbinites, echinites, madrepores, and of petrified wood.

It occurs in lamellar distinct concretions, varying in thickness, and which are sometimes reniformly curved, sometimes globular and concentrically curved; and very rarely it is disposed in fibrous concretions, which are again collected into coarse, long, angulo-granular concretions.

Internally it is dull; the splintery varieties exhibit a faint degree of lustre.

The fracture is even, which sometimes passes into imperfect and flat conchoidal, and splintery.

The fragments are indeterminate angular, and rather very sharp-edged.

It

It is generally semitransparent; but the black and white varieties are only translucent.

It is hard; rather harder than flint.

It is brittle.

It is easily frangible.

Specific gravity, 2.600 to 2.655, *Kirwan.*—2.615, *Blumenbach.*—2.618, 2.643, *Karsten.*—2.583, 2.586, *Hoffman.*—2.664, *Brisson.*

Chemical Characters.

Infusible before the blowpipe without addition.

Constituent Parts.

Silica,	-	-	99
Loss,	-	-	1
			100 *Tromsdorf**.

Geognostic Situation.

It occurs in primitive, secondary and alluvial rocks, in balls, kidneys, angular pieces, short and thick beds, veins, and rolled pieces. The balls and kidneys occur most frequently in secondary amygdaloid, and contain, besides the calcedony, also flint, &c. and in their interior exhibit beautiful reniform, botryoidal, stalactitical, and other particular external shapes. The angular pieces are most frequent in secondary amygdaloid; they occur also in primitive porphyry. The beds occur in primitive porphyry, but more abundantly, in

* In the early analyses of Bergman, Gerhard and Lampadius, alumina, in the proportion of from 12 to 16 *per cent.* is stated as occurring in calcedony; and Guyton and Bindheim mention lime as one of its constituent parts.

secondary trap rocks, as in amygdaloid, basalt, and greenstone. The veins are of two kinds: agate veins, which occur in primitive, and secondary rocks; and metalliferous veins, that occur principally in primitive rocks. The agate veins contain, besides the calcedony, also flint, hornstone, opal, and amethyst. The metalliferous veins are of three formations: In the first, the calcedony is associated with silver and lead ores, and brown-spar, as in the Saxon Erzgebirge; in Lower Hungary, and Transylvania: In the second, with brown and black ironstone, sparry ironstone, hornstone, and other fossils, as in the Saxon Erzgebirge; in Voightland; at Huttenberg, in Carinthia, &c.: And in the third, along with ores of copper, as in the Trevascus mine, in Cornwall. The calcedony in these veins exhibits many different external forms, as stalactitical, botryoidal, coralloidal, reniform, &c. In alluvial country, it is found only in rolled pieces.

Geographic Situation.

Europe.—This mineral occurs more or less frequently in the secondary trap rocks of Scotland. Thus, it forms cotemporaneous veins in greenstone rocks in Fifeshire; and occurs in balls, kidneys, and veins, either singly or along with other minerals forming agate, in the trap rocks of the Pentland Hills, near Edinburgh, those in West Lothian, Mid Lothian, East Lothian, Dumfriesshire, Lanarkshire, Dumbartonshire, Stirlingshire, Perthshire, Angusshire, and other districts in the mainland of Scotland. The trap rocks of Mull, Rume, Canna, Eigg and Skye, afford calcedony; and small portions of it occur in the trap rocks of Shetland. The most singular varieties of English calcedony are those found in Trevascus mine, in Cornwall. It abounds in the amygdaloidal rocks of the island of Iceland

land and the Faroe islands. It is a rare mineral in the Scandinavian peninsula; and occurs more or less frequently in the Hartz; in the Electorate of Saxony; Silesia; Bohemia; Franconia; Suabia; Gallicia; France; Switzerland; Italy; Austria; Hungary; and Transylvania.

Asia.—It occurs in rolled pieces in the island of Ceylon; in the trap rocks of Dauria; in Calmuck Tartary; in the Altain and Uralian mountains; and on the shores of the sea of Ochotsk.

Africa.—It occurs in rolled pieces on the banks of the river Nile. The ancients are said to have procured their finest calcedonies from mountains in the neighbourhood of Thebes.

America.—It occurs in Greenland; in different parts of the United States, in porphyry and amygdaloid; in Mexico; and at Panama, in New Granada, in South America.

Uses.

As it is hard, susceptible of a fine polish, and exhibits beautiful colours, and considerable transparency, it is employed as an article of jewellery. It is cut into ring and seal stones, necklaces, ear-drops, small vases, cups, and snuff-boxes. The finer varieties, particularly those named Onyx, were much prized by the ancients, and were by them cut into cameas.

The Camea is a kind of engraving in relief, in which the figure is of a different colour from the ground. When the colours are good, and distinctly separated from each other, and the layers equal and parallel, the onyx is much prized. Many fine engraved cameas of this kind are preserved in collections. The National Museum in Paris, and the magnificent collection of M. De Dree, also in Paris, are rich in cameas.

The concentrically striped onyxes, which are very rare, were much prized by the ancients, and they cut upon them very beautiful figures in demi-relief*. One of the most beautiful works cut in this variety of calcedony, is the celebrated *Mantuan Vase*, which was seized by the Germans at the storming of Mantua, and ever since has been preserved in the Ducal Collection in Brunswick. Several beautiful plates of onyx are preserved in the Electoral Cabinet in Dresden: there is one valued at 44,000 dollars.

The dendritic calcedonies, or mocha-stones, are much prized as ornamental stones. The arborizations, as already mentioned, are black, red, brown, or green. The black are the most common, and most distinct: the red, on the contrary, are rarer, and are less distinct, and are named *corallines*, from the resemblance of the dendritic delineations to coral; and the green are rare, and much esteemed. These arborizations appear in some cases to be owing to iron, in others to manganese, iron, and mineral oil. Dutens,

* Some antiquarians are of opinion, that the *vasa murrhina* of Pliny were of onyx; but Dr Clarke, in the following passage, advances another hypothesis "The porcelain of China," he observes, "brought overland on the backs of camels, is exposed for sale in Grand Cairo, Smyrna, and Constantinople. We saw some porcelain dishes for containing pilau, that had been thus conveyed, and they were a yard in diameter. The same trade with China existed in the time of the Romans; and at the introduction of the porcelain vessels into Rome, they were bought at enormous prices, and were esteemed by the Romans of the Augustan age as articles of the highest luxury and magnificence. These were the *vasa murrhina* of Pliny, as may be proved from Belon, who says, that the Greeks called them in his time "La mirrhe de Smirna," from *murex*, a shell called by the French *Porcelain shell;* the fine vitrified superficies of porcelain resembling in its lustre and polish the surface of the Murex."—*Clarke's Travels.*

tens *, Von Moll, Daubenton, and lately Lenz, Blumenbach, and Dr MacCulloch, maintain that many of them are of a true vegetable nature. Dutens says, that if the plants contained in calcedony are extracted, and the fragments thrown on burning charcoal, a bituminous smell is exhaled; and Von Moll maintains, that calcedony sometimes contains brown and green moss.

Lenz affirms, that the calcedony found in the amygdaloid of Deuxponts contains musci of different kinds, such as lichen rangiferinus, confervæ, byssi, and brya. And Blumenbach says, in a letter to Baron Von Moll, that though he had hitherto disbelieved the occurrence of vegetable bodies in the dendritic variety of calcedony named *mocha-stone*, he must now admit that it does sometimes contain plants, apparently of the nature of conferva. He observed these in specimens from Iceland and Catherinenburg. The same celebrated naturalist maintains, that he found, in the interior of an agate, the fructification of an unknown plant, somewhat resembling the *Sparganium erectum*. Dr MacCulloch, after examining several hundred specimens of mocha-stone, is of opinion that they contain cryptogamous plants †. This opinion, however, still remains very improbable.

Observations.

1. Its dull and even fracture distinguish it from *Flint*; and the same characters distinguish it from *Carnelian*.

2. It passes into Opal and Flint; probably also into Hyalite.

3. It

* Vid. Traité des Pierres Precieuses, p, 70, 71.

† Vid. Geological Transactions, for Dr MacCulloch's observations on this subject.

8. It was first accurately described by Werner.

4. The dendritic variety is supposed to have been originally brought from Arabia, by the way of Mocha; and hence the name *Mocha-stone* given to it by jewellers.

TABULAR VIEW of the names given to different varieties of COMMON CALCEDONY.

1. *Leucachates* of Pliny, milk-white calcedony.
2. *Cerachates* of Pliny, honey-yellow calcedony.
3. *Sapphirine*; azure-blue calcedony.
4. *Onyx*; calcedony, in which there is an alternation of white, black, and dark-brown layers.
5. *Calcedonyx*. In this variety there are but two shades of colour, viz. white and grey, which are also disposed in layers.
6. *Mocha-stone*, or *Dendritic Calcedony*. In this variety beautiful arborizations are distributed through a white or grey ground.
7. *Memphites*; grey calcedony with green stripes.
8. *St Stephen's stone*; calcedony with small red points of carnelian or jasper. It ought rather to be placed with agate, but the common arrangement is here followed. It was formerly much esteemed.

Second

Second Kind.

Chrysoprase *.

Krisopras, *Werner.*

Achates-prasius, *Wall.* t. i. p. 292.—Chrysoprase, *Romé de Lisle,* t. ii. p. 167.—Krisopras, *Wern.* Cronst. p. 99. *Id. Wid.* p. 356. —Chrysoprasium, *Kirw.* vol. i. p. 284.—Crysopras, *Estner,* b. ii. s. 349. *Id. Emm.* b. i. s. 174.—Crisoprasio, *Nap.* p. 195. *Id. Lam.* t. ii. p. 177.—La Chrysoprase, *Broch.* t. ii. p. 280.—Quartz-agathe prase, *Haüy,* t. ii. p. 426.—Crysoprase, *Reuss,* b. ii. s. 270. *Id. Lud. Suck. Bert. Id. Mohs,* b. i. s. 304. *Id. Hab. Id. Karst.* Tabel. *Id. Leonhard,* Tabel.—Silex Chrysoprase, *Brong.* t. i. p. 298.—Quartz-agathe prase, *Lucas,* p. 33. *Id. Brard,* p. 96.—Chrysoprase, *Kid,* vol. i. p. 204.—Quartz-agathe prase, *Haüy,* Tabl. p. 26.—Chrysopras, *Hoff.* b. ii. s. 98. *Id. Steffens,* b. i. s. 157. *Id. Lenz,* b. i. s. 395. *Id. Oken,* b. i. s. 272. *Id. Aikin,* p. 180.

External Characters.

Its characteristic colour is apple-green, of all degrees of intensity; it passes into pale grass-green, pistachio-green, and greenish-grey. It is sometimes spotted yellowish-brown.

It occurs generally massive, and sometimes in plates.

Internally

* The name *Chrysoprase* (*χρυσοπρασος, Chrysoprasus*) is derived from the Greek, and was applied to a mineral having a yellowish-green colour. We are ignorant of the stone which the antients described under this name. Lehman was the first who applied it to the green stone of Kosemutz.—Vid. Histoire de l'Academie Royale des Sciences et Belles Lettres, année 1755; Berlin, 1757, p. 202.—Vid. also Meinecke's Monograph, intituled, Ueber den Crysoprase; Erlangen, 1805.

Internally it is dull, seldom glimmering.

Its characteristic fracture is even ; some varieties run into small and fine splintery ; others, very rarely, into flat conchoidal.

The fragments are indeterminate angular, and more or less sharp-edged.

It is intermediate between translucent and semi-transparent, but always approaches more to the first.

It is rather softer than calcedony or flint.

It is rather difficultly frangible.

Specific gravity, 2.600, *De La Metherie.*—2.714, *Karsten.*—2.608, *Hoffmann.*—3.250 ? *Klaproth.*

Chemical Characters.

Before the blowpipe it loses its colour and transparency, and is infusible without addition.

Constituent Parts.

Silica, - -	96.16
Lime, - -	0.83
Magnesia, - -	0.08
Alumina, - -	00.8
Oxide of Iron, -	0.08
Oxide of Nickel, -	1.00
	100

Klaproth, Beit, t. ii. p. 133.

Geognostic Situation.

It occurs in plates and cotemporaneous veins, along with quartz, hornstone, common calcedony, semi-opal, asbestus, indurated talc, lithomarge, green-earth, and steatite, in primitive serpentine.

Geographic

Geographic Situation.

It has hitherto been found only in the Principality of Munsterberg, in Lower Silesia, in the vicinity of the towns of Glassendorf, Grochau, and Kosemitz.

Uses.

This gem is much prized by jewellers. The colour, when deep and pure, is very agreeable to the eye, and when contrasted with brilliants and pearls, particularly by candle light, is very beautiful. It is generally cut into a convex form, or what jewellers call *en cabochon.* It is sometimes cut into ring-stones, necklaces, bracelets, ear-drops and brooches, and, when set, green taffeta is used as a foil. In ornamental dress, it is found to harmonize with diamonds and pearls. Ring-stones of chrysoprase, when semi-transparent, and of a pure apple-green colour, will sell at from ten to twenty guineas. Its colour fades when kept long in a warm and dry place, or when much exposed to the air: on this account it is recommended to keep it in moist cotton. As the colouring substance of this mineral is nickel, it is difficult to explain the change of colour just mentioned. It requires considerable attention in cutting, as it is very apt to fly in pieces; and lapidaries find that great care also must be used in polishing it, for, if the wheel is driven too fast, and the gem is overheated, it becomes whitish and muddy.

The larger and impure masses are cut into snuff-boxes, seal-stones, and similar articles. Very beautiful plates of chrysoprase are to be seen in the Cathedral Church in Prague.

Observations.

Observations.

1. Its distinguishing characters are its apple-green colour, even and dull fracture, semi-transparency, and hardness. Colour, and inferior hardness distinguish it from *Common Calcedony;* and the dull even fracture, with greater hardness, and weight, are the characters by which it is distinguished from *Opal.* Some observers have confounded it with *Prase,* from which it is readily distinguished by colour, the want of lustre, even fracture, greater transparency, hardness, and weight.

2. It passes into Opal and Splintery Hornstone.

Third Kind.

Plasma *.

Plasma, *Werner.*

Id. Emm. b. iii. s. 322. *Id. Broch.* t. i. p. 278. *Id. Reuss,* b. ii. s. 286. *Id. Lud. Suck. Bert.* *Id. Mohs,* b. i. s. 308. *Id. Karst.* Tabel. *Id. Leonhard,* Tabel. *Id. Hab.* *Id. Kid,* vol. i. p. 205. *Id. Steffens,* b. i. s. 159. *Id. Lenz,* b. i. s. 395.—Quartz-agathe calcedoine vert obscur, *Lucas,* t. ii. p. 110.—Plasma, *Hoff.* b. ii. s. 103.

External Characters.

Its most common colour is a variety intermediate between grass-green and leek-green, and sometimes approaching to pale mountain-green. It frequently occurs greenish-white and ochre-yellow: the latter colour is in dots; the first in spots, or clouded.

It

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* This mineral has been known under its present name in Italy for some hundred years. It is conjectured to be a corruption of *Prasius* or *Prasina,* the names given by Italian mineralogists to green-coloured minerals, such as prase and chrysoprase.

It occurs in angular pieces.

Internally its lustre is glistening, inclining to glimmering.

The fracture is imperfect, and rather flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent, inclining to semi-transparent.

It is hard.

It is brittle.

It is rather easily frangible.

Specific gravity, 2.553, *Klaproth.*—2.445? *Karsten.*

Chemical Characters.

It is infusible before the blowpipe, but loses its colour.

Constituent Parts.

Silica,	-	-	96.75
Alumina,	-	-	0.25
Iron,	-	-	0.50
Loss,	-	-	2.50
			100

Klaproth, Beit. b. iv. s. 326.

Geognostic and Geographic Situations.

It occurs in beds, associated with common calcedony. Most of the specimens in cabinets, have been collected among the ruins of Rome. It occurs also at Prussa, at the foot of Mount Olympus, in Asia Minor, where it is associated with the green calcedony of Klaproth, which is only a variety of plasma; and it has been lately found at Guadalupe, about a league from Mexico, where it occurs in beds, along with calcedony.

Use.

Uses.

It was considered by the Romans as a gem, and was cut into ornaments; and frequently figures were engraved upon it.

Observations.

1. It is distinguished from *Heliotrope* by colour, inferior lustre, and weight, and also by its greater transparency: it is distinguished from *Chrysoprase* by colour, greater lustre, perfect conchoidal fracture, and greater weight; and its fracture distinguishes it from *Common Calcedony*.

2. It has been known for several centuries in Italy under the name *Plasma*, but was first introduced into the system by Werner.

3. It is the *Prime d'Emeraude* of some authors; and would appear to have been described by Pliny as a variety of his *smaragdus*.

Fourth Kind.

Carnelian *.

Carneol, *Werner*.

Sarda, *Plin.* Hist. Nat. xxxvii. 7.—Achates carneolus, *Wall.* t. i. p. 185.—Cornaline, *Romé de Lisle,* t. ii. p. 146.—Blutrothe, Kalzedon, *Wid.* p. 318.—Carnelian, *Kirw.* vol. i. p. 300.—Karniol, *Emm.* b. i. s. 157.—Carniola, *Nap.* p. 185.—Agathe Cornaline, *Lam.* t. ii. p. 147.—La Cornaline, *Broch.* vol. i. p. 272.—Quartz-agathe cornaline, *Haüy,* t. ii. p. 425.—Karneol,

* The name *Carnelian* does not occur either in Theophrastus or Pliny, that mineral being described by these naturalists as a red variety of sarda. Carnelian, therefore, is of more modern date, and is supposed to be derived from the Latin words *caro* or *carneus,* which may have been given to it on account of its flesh-red colour.

neol, *Reuss,* b. ii. s. 282. *Id. Suck. Lud. Bert.* *Id. Mohs,* b. i. s. 298. *Id. Karst.* Tabel. *Id. Leonhard,* Tabel.—Silex cornaline, *Brong.* t. i. p. 296.—Quartz-agathe cornaline, *Lucas,* p. 33. *Id. Brard,* p. 96. *Id. Haüy,* Tabl. p. 26.—Karneol, *Steffens,* b. i. s. 160. *Id. Hoff.* b. ii. s. 118. *Id. Lenz,* b. i. s. 391. *Id. Oken,* b. i. s. 266. *Id. Haus.* Handb. b. ii. s. 406. —Carnelian, *Aikin,* p. 180.

External Characters.

Its principal colour is blood-red, of all degrees of intensity : the dark varieties sometimes incline to reddish-brown; but the paler varieties pass into flesh-red, and reddish-white, and also into a colour intermediate between ochre and wax yellow. It also occurs sometimes milk-white, and olive-green. It generally has but one colour ; sometimes, however, it exhibits concentrically striped delineations, or fortification or red dendritic delineations.

It occurs sometimes in rolled pieces, which appear to have been original balls ; sometimes in thin layers in agate; very seldom kidney-shaped. The surface of the rolled pieces is rough, and reddish-brown.

It occurs in fibrous concretions, which are straight, scopiform, closely aggregated, and collected into long and wedge-shaped prismatic and lamellar concretions.

The fracture is perfect conchoidal, or splintery in the reniform varieties.

The lustre is glistening, sometimes passing into shining, and is vitreous.

The fragments are indeterminate angular, and sometimes splintery.

It is generally semi-transparent ; seldom translucent.

It is hard, but in a lower degree than common calcedony and flint.

Specific gravity, 2.594, 2.630, *Brisson.*

Chemical

Chemical Characters.

It is infusible without addition.

Constituent Parts.

Silica, - -	94
Alumina, - -	3.50
Iron, - -	0.75
	100 *Bindheim.*

Geognostic and Geographic Situations.

It frequently occurs as a constituent part of agate, and in general has the same geognostic situation as common calcedony. The secondary trap rocks so abundant in Scotland, often contain carnelian, either alone, or in agate. The most beautiful carnelians, viz. those having an uniform blood-red colour, are found in rolled pieces, and are brought to this country from Arabia, India, Surinam, Siberia, and Sardinia: less beautiful varieties are found in Bohemia, Saxony, and the Palatinate. The fibrous varieties are found in Hungary.

Uses.

It is cut into seal-stones, ring-stones, bracelets, necklaces, brooches, and crosses; and figures are often engraved on it. Artists distinguish three principal kinds of carnelian: the one named *common carnelian*, varies in colour from white, through yellow to red; the second, named *sardé* (sardoine), displays on its surface an agreeable and rich reddish-brown colour, but appears of a deep blood-red colour when held between the eye and the light; the third, named *sardonyx*, is composed of layers of white and red

red carnelian. In the most esteemed carnelians of the east, the colours are of a uniform tint throughout the mass, without any undulations, and are free from that muddiness to which the European varieties of this stone are so liable. The most highly prized varieties are the white and red striped, or sardonyx, and the blood-red; the next in estimation are the pale-red; and the least valuable are the yellow, white, and brown. As it is a softer stone than common calcedony, it is more easily cut, and splinters much less when cutting and polishing; and hence, independent of colour, it has always been preferred by artists to the common calcedony. The finest varieties of carnelian are named by French artists those of the *old rock* (vieille roche), because they are no longer to be found so perfect in colour and transparency. The finest pieces of common carnelian are brought from Arabia, and from Cambay and Surat, in India *. The *sardé*, which is very rare at present, and bears a much higher price than the common carnelian, is procured from the shores of the Red Sea. Formerly carnelians used to be imported from Japan into Holland, and from thence were

* The carnelians of Cambay are procured from the neighbourhood of Broach, by sinking pits during the dry season, in the channels of torrents. The nodules which are thus found, are intermixed with other rolled pebbles, and weigh from a few ounces to two or three pounds. Their colour, when recent, is dark olive-green, inclining to grey. The preparation which they undergo, is, first, exposure to the sun for several weeks, and then calcination. The latter process is performed by packing the stones in earthen-pots, and covering them with a layer five or six inches thick of dried goats dung. Fire is then applied to the mass; and in twelve hours, the pots are sufficiently cool to be removed. The stones which they contain are now examined, and are found to be some of them red, and others nearly white; the difference in their respective tints depending in part on the original quality of colouring matter, and in part, perhaps on the difference in the heat to which they have been exposed. The annual value of Carnelian exported from India, amounts to £ 11,600.

were carried to Oberstein on the Rhine, in order to be exchanged for the agates of that country, which were exported to China.

The carnelian was much esteemed by the ancients. Many fine antique engraved carnelians are preserved in collections; and these have been described by Count Caylus, De Dree, and others. The sardonyx was cut into cameas, and afforded by far the most beautiful articles of this kind. The finest antique camea at present known, is in the French Imperial Museum at Paris: it is cut in a sardonyx, is of an oval shape, and is eleven inches by nine in breadth: it represents the *Apotheosis of Augustus.*

Observations.

1. It is distinguished from *Common Calcedony* by its glistening lustre, and conchoidal fracture. The milk-white variety, which approaches to common calcedony, may be distinguished from it, by its conchoidal fracture, and greater transparency.

2. It bears the same relation to Common Calcedony that Conchoidal Hornstone does to Splintery Hornstone.

3. It passes into Hornstone.

4. It was first accurately described by Werner, and united with the sardonyx of the ancients. Werner divided it into two kinds, Conchoidal and Fibrous.

5. Carnelian is named *sarda* by the ancients, according to some, from the city of Sardis in Lydia, in the vicinity of which this stone was found; according to others, from Sardinia, where it was also found; or according to others, from the Greek word σαρδος, which was given to it by reason of its predominating flesh-red colour. Lastly, as already remarked, some derive *carnelian* from the Latin words *caro* or *carneus,* which may have been given to it, owing to its flesh-red colour.

Thirteenth

Thirteenth Subspecies.

Heliotrope *.

Heliotrop, *Werner.*

Heliotropium, *Plin.* Hist. Nat. xxxvii. 10. p. 60.—Jaspis variegata, Heliotropius, *Wall.* t. i. p. 315.—Heliotrop, *Wid.* s. 316.—Heliotropium, *Kirw.* vol. i. p. 314. *Id. Estner,* b. i. s. 389. *Id. Emm.* b. i. s. 171.—Eliotropio, *Nap.* p. 193.—Jaspe sanguin, *Lam.* t. ii. p. 166.—L'Heliotrope, *Broch.* t. i. p. 276.—Quartz-jaspe sanguin, *Haüy,* t. ii. p. 436.—Heliotrop, *Reuss,* b. ii. s. 319. *Id. Lud. Suck. Bert. Id. Mohs,* b. i. s. 309. *Id. Karsten,* Tabel. *Id. Leonhard,* Tabel. *Id. Hab.*—Silex Heliotrope, *Brong.* t. i. p. 297.—Quartz-jaspe sanguin, *Lucas,* p. 37. *Id. Brard,* p. 101.—Bloodstone, *Kid,* vol. i. p. 210.—Quartz-agathe ponctué, *Haüy,* Tabl. p. 27.—Heliotrop, *Steffens,* b. i. s. 162. *Id. Hoff.* b. i. s. 105. *Id. Lenz,* b. i. s. 423. *Id. Oken,* b. i. s. 271. *Id. Haus.* Handb. b. ii. s. 407. *Id. Aikin,* p. 181.

External Characters.

The principal colour is intermediate between celandine-green and leek-green; sometimes passes into mountain-green, and even into grass and pistachio green. All these colours are dark. Sometimes it is marked with olive-green spots and stripes. The blood and scarlet red and the ochre-yellow dots and spots, are owing to disseminated jasper.

 It

* The name *Heliotrope* is of Greek extraction, from ἕλιος, *the sun,* and τρoπειν, *to turn.* According to Pliny, it received this name, because it was used for solar observations.

It occurs massive, in angular pieces and rolled pieces.

The internal lustre is glistening, and resinous.

The fracture is large and flat, but sometimes imperfect conchoidal.

The fragments are angular, and very sharp-edged.

It is generally translucent on the edges; some varieties are translucent.

It is easily frangible.

It is hard; but softer than calcedony.

It is rather heavy.

Specific gravity, 2.623, *Karsten.*—2.700, *Kirwan.*—2.614, *Hoffmann.*—2.633, *Blumenbach.*

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

Silica,	84.00
Alumina,	7.50
Iron,	5.00

Tromsdorf.

Geognostic Situation.

It is found in rocks belonging to the secondary trap-formation, and probably occurs in the same kind of repository as calcedony.

Geographic Situation.

The ancients procured this mineral from Æthiopia. At present, the most highly esteemed varieties are brought from Bucharia, Great Tartary, and Siberia. It occurs also in Iceland; and it is said also in Transylvania, Sardinia,

dinia, and Bohemia. In Scotland, a variety of mineral nearly resembling heliotrope, occurs in the island of Rume.

Uses.

This mineral was well known to the ancients, who have left us accurate descriptions of it. Figures were seldom cut upon Heliotrope until after the commencement of the Christian era, when representations of religious subjects were often engraved upon it. There is a fine engraved stone of this kind in the National Library in Paris, representing the head of *Christ flagellé*, so cut that the red spots are made to represent drops of blood. It is also cut into seals, snuff-boxes, and other ornamental articles. The varieties having the greatest degree of transparency, and most numerous red spots, are the most highly prized: these are found in Bucharia. The Siberian varieties are destitute of red spots.

Observations.

1. It is distinguished from *Common Calcedony* by its colour, fracture, lustre, and transparency.

2. It is Calcedony, intimately combined with Green Earth.

3. Its fracture and transparency shew that it is a species intermediate between Calcedony and Jasper.

Fourteenth Subspecies.

Jasper *.

This subspecies is divided into five kinds, viz. Egyptian Jasper, Striped Jasper, Porcelain-Jasper, Common Jasper, and Agate-Jasper.

First Kind.

Egyptian Jasper.

This kind is subdivided into Red Egyptian Jasper, and Brown Egyptian Jasper.

1. Red Egyptian Jasper.

Rother Egyptischer Jaspis, *Werner.*

Rother Egyptisher Jaspis, *Hoff.* b. ii. s. 162.—Rother Kugel Jaspis, *Steffens,* b. i. s. 181.—Rother Egyptisher Jaspis, *Lenz,* b. i. s. 416.

External Characters.

Its colour is intermediate between flesh-red and blood-red; also ochre-yellow, yellowish-brown, and yellowish-grey. These colours form ring-shaped delineations.

It is found in roundish blunt edged rolled pieces.

The external surface is rough; also uneven and dull.

Internally it is dull, or very faintly glimmering.

The fracture is large, and rather flat conchoidal.

It

* Etymologists are in doubt as to the origin of the word *Jasper*. Some, as Isiodorus, derive it from the Greek word ἴας, which signifies green, a frequent colour of this mineral. But whatever may have been its original signification, we know that it is of high antiquity, because it occurs in the Hebrew and Greek languages. We are also ignorant of the particular stone denominated Jasper by the ancients.

It breaks into indeterminate angular and sharp-edged fragments.

It is very feebly translucent on the edges.

It is hard.

It is rather easily frangible.

Specific gravity, 2.632, *Hoffmann.*

Geognostic and Geographic Situations.

It is found imbedded in red clay-ironstone in Baden.

Use.

It is used for ornamental purposes.

Observations.

It sometimes passes into Flint, but is distinguished from that mineral by its opacity, and inferior hardness.

2. Brown Egyptian Jasper.

Brauner Egyptischer Jaspis, *Werner.*

Silex Ægyptiacus, *Wall.* t. i. p. 276.—Egyptian Pebble, *Kirw.* vol. i. p. 312.—Egyptisher Jaspis, *Emm.* b. i. s. 234.—Caillou d'Egypte, *La Meth.* t. ii. p. 166.—Le Jaspe Egyptien, *Broch.* t. i. p. 332.—Egyptisher Jaspis, *Reuss,* b. ii. s. 302. *Id. Lud.* b. i. s. 93. *Id. Suck.* 1r th. s. 353. *Id. Bert.* s. 227. *Id. Mohs,* b. i. s. 314. *Id. Leonhard,* Tabel. s. 11.—Jaspe Egyptien, *Brong.* t. i. p. 325.—Egyptischer Jaspis, *Karst.* Tabel. s. 38.—Egyptian Jasper, *Kid,* vol. i. p. 208.—Quartz-agathe opaque, *Haüy,* Tabl. p. 27.—Brauner Kugel Jaspis, *Steffens,* b. i. s. 180.—Brauner egyptisher Jaspis, *Hoff.* b. ii. s. 164. *Id. Lenz,* b. i. s. 414.—Egyptian Jasper, *Aikin,* p. 183.

External

External Characters.

Its colours are chesnut-brown, yellowish-brown, isabella-yellow, and yellowish-grey. The yellowish-grey, or isabella-yellow, generally form the interior or centre of the pebble; and the brown colours are disposed in concentric stripes, alternating with black stripes. In the brown colour, there sometimes occur black spots, and similar coloured dendritic delineations.

It occurs in roundish, blunt edged, and spheroidal masses.

The surface is uneven or rough.

Externally it is glimmering, very seldom feebly glistening; internally it is partly glistening, partly glimmering; but the grey is dull.

The fracture is flat and perfect conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is very feebly translucent on the edges, or almost opaque.

It is as hard as hornstone.

Specific gravity, 2.564, *Brisson.*—2.601, 2.624, *Hoffmann.*

Chemical Character.

It is infusible without addition before the blowpipe.

Geognostic Situation.

The geognostic situation of this mineral is still imperfectly known. Cordier informs us, that it is found imbedded in a conglomerate rock, which, in his opinion, extends in great beds throughout Egypt to the deserts of Africa; while

while Mohs, from the resemblance of its colour-delineations to those of agate, supposes that it has been formed by infiltration, in the manner of agate, and therefore, that Egyptian jasper will be found to occur in amygdaloid. In whatever original situation it occurs, it is well known, from the observations of travellers, to occur loose in the sands of Egypt.

Geographic Situation.

It has been hitherto found only in Egypt.

Uses.

As the colours of this mineral are agreeable to the eye, beautifully disposed, and as it receives a good polish, it is prized by jewellers as an ornamental stone, and is cut into various ornamental articles.

Observations.

Colour, colour-delineation, external shape, and low degree of lustre, are the most distinguishing characters of this mineral.

Second Kind.

Striped Jasper.

Band Jaspis, *Werner.*

Striped Jasper, *Kirw.* vol. i. p. 312.—Band Jaspis, *Emm.* b. i. s. 237.—Jaspe rubane, *Lam.* p. 165.—Le Jaspe rubane, *Broch.* t. i. p. 334.—Band Jaspis, *Reuss,* b. ii. s. 305. *Id. Lud.* b. i. s. 94. *Id. Suck.* 1r th. s. 355. *Id. Bert.* s. 228. *Id. Mohs,*
b. i.

b. i. s. 116. *Id. Hab.* s. 13. *Id. Leonhard,* Tabel. s. 11.——Jaspe Rubanne, *Brong.* t. i. p. 324.—Band Jaspis, *Karsten,* Tabel. s. 38.—Riband Jasper, *Kid,* vol. i. p. 207.—Quartz-jaspe Onyx, *Haüy,* Tabl. p. 28.—Band Jaspis, *Steffens,* b. i. s. 182. *Id. Hoff.* b. ii. s. 166. *Id. Lenz,* b. i. s. 417. *Id. Oken,* b. i. s. 298.—Striped Jasper, *Aikin,* p. 44.

External Characters.

Its colours are grey, green, yellow, and red, and seldom blue. Of grey, it presents the following varieties, pearl-grey, greenish-grey, and yellowish-grey: Of yellow, cream-yellow, which passes into straw-yellow: Of green, mountain-green, which passes into leek-green and greenish-grey: Of red, cherry-red, brownish-red, and flesh-red; the cherry-red passes into plum-blue.

There are always several colours together, and these are arranged in striped and flamed, and sometimes in spotted delineations.

It occurs massive, in whole beds.

Internally it is dull, when an admixture of foreign ingredients does not give it a feeble glimmering lustre.

The fracture is large and flat conchoidal, which approaches sometimes to fine earthy, sometimes to even. In the large it sometimes inclines to slaty, and the laminæ are in the direction of the striped delineations.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque, or very feebly translucent on the edges.

It is hard, but rather in a lower degree than the Egyptian jasper.

It is rather easily frangible.

Specific

Specific gravity, 2.441, *Haberle.*—2.472, 2,537, 2.553, *Hoffmann.*—2.491, *Karsten.*

Geognostic and Geographic Situations.

It occurs in secondary clay-porphyry in the Pentland Hills near Edinburgh; in a similar situation at Gnadenstein and Wolftitz, near Froburg in Saxony. In neither of these countries do we observe the leek-green and brownish-red striped varieties: these latter occur only in the beautiful striped jasper which is found at Orsk, in the district of Orenburg in Siberia. According to Hausmann, it occurs in the Hartz, along with common flinty-slate and Lydian stone, in clay-slate mountains.

Use.

This mineral receives an excellent polish, and hence is used like agate for ornamental purposes.

Observations.

1. The distinguishing characters of this mineral, are its colour-delineations, its want of lustre, and its very flat conchoidal fracture, which sometimes inclines to earthy, and even to slaty. Its geognostic situation also distinguishes it from all the other subspecies of this species.

2. It is allied to Conchoidal Hornstone and Claystone, and passes into both of these minerals. These transitions are to be observed in the Pentland Hills. It is distinguished from *Conchoidal Hornstone* by its colour, colour-delineations, want of lustre, its more perfect flat conchoidal fracture, and its opacity: from *Claystone* it is distinguished by its greater hardness.

Third

Third Kind.

Porcelain-Jasper.

Porzellan Jaspis, *Werner.*

Id. Wid. p. 314.—Porcellanite, *Kirw.* vol. i. p. 313.—Porzellan-Jaspis, *Estner,* b. ii. s. 613. *Id. Emm.* b. i. s. 240.—Diaspro porcellanico, *Nap.* p. 192.—Jaspe porcelaine, *Lam.* t. ii. p. 166. *Id. Broch.* t. i. p. 166.—Thermantide porcellanite, *Haüy,* t. iv. p. 510.—Porzellan Jaspis, *Reuss,* b. ii. s. 307. *Id. Lud.* b. i. s. 94. *Id. Suck.* 1r th. s. 351. *Id. Bert.* s. 226. *Id. Mohs,* b. i. s. 321. *Id. Karsten,* Tabel. s. 38. *Id. Leonhard,* s. 12. *Id. Steffens,* b. i. s. 184. *Id. Hoff.* b. ii. s. 168. *Id. Lenz,* b. i. s. 418. *Id. Oken,* b. i. s. 298. *Id. Haus.* b. ii. s. 398.—Porcellanite, *Aikin,* p. 241.

External Characters.

Its colours are grey, blue, yellow, and seldom black and red. Of grey, it presents the following varieties; smoke, bluish, yellowish, and pearl grey: from pearl-grey it passes into lilac-blue and lavender-blue: also into brick-red, which inclines to yellow: from yellowish-grey it passes into straw-yellow, and ochre-yellow: from smoke-grey into greyish-black, and ash-grey.

It generally exhibits but one colour, and is sometimes marked with dotted, flamed, striped, and clouded delineations.

The grey varieties are generally brick-red in the rifts. It often presents brick-red vegetable impressions; and this is most frequently the case with the lavender-blue varieties.

It occurs most commonly massive, and in angular pieces; and is frequently cracked in all directions.

Internally

Internally it is glistening, sometimes approaching to shining, sometimes to glimmering, and even to dull; and the lustre is vitreo-resinous.

The fracture is imperfect conchoidal, and sometimes large and flat, and occasionally small conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is opaque.

It is hard in a low degree.

It is easily frangible.

Specific gravity, 2.330, *Kirwan.*—2.430, *Karsten.*—2.431, 2.432, 2.461, 2.577, 2.595, 2.645, *Hoffmann.*

Chemical Characters.

The lavender-blue variety, when exposed to a heat of 151° of Wedgwood, according to Kirwan, melts into a spongy yellowish-grey semi-transparent mass. Other varieties, according to Link, melt before the blowpipe into a white glass.

Constituent Parts.

Silica, -	60.75
Alumina, -	27.25
Magnesia, -	3.00
Oxide of Iron, -	2.50
Potash, - -	3.66

According to *Rose.*

Geognostic Situation.

It is always found along with burnt-clay and earth-slags, in places where pseudo-volcanoes have formerly burnt, or where

where beds of coal are now in a state of inflammation. Hence it follows, that it is a pseudo-volcanic production; and, according to Werner, it is slate-clay converted into a kind of porcelain by the action of the heat of the volcano. As the coal wastes, hollows are formed in the bed, and the superincumbent porcelain-jasper breaks in pieces, and falls into them: hence it never occurs in regular beds, but in irregular broken masses, intermixed with burnt-clay, earth-slags, and similar substances.

Geognostic Situations.

It is found on the coast of Fifeshire; at Madeley, in Shropshire; and near Dudley in Warwickshire. It occurs in Bohemia, principally in the plain betwixt the Erzgebirge and the Mittelgebirge, where immense beds of coal appear. It also appears at Planitz, near Zwickau in Saxony, and in the neighbourhood of Zittau in Upper Lusatia. Likewise at Erterode, at the Meisner, in the Habichtswald; at Dutweiler, in the department of Saare; and also in Iceland.

Fourth Kind.

Common Jasper.

Gemeiner Jaspis, *Werner.*

Jaspis, *Cronst.* § 64, 65. p. 76.—Jaspis, *Wall.* p. 311. & 318.—Gemeiner Jaspis, *Wid.* s. 311.—Common Jasper, *Kirw.* vol. i. p. 310.—Gemeiner Jaspis, *Emm.* b. ii. s. 243.—Diaspro commune, *Nap.* p. 189.—Jaspe, *Lam.* p. 164.—Le Jaspe commune, *Broch.* t. i. p. 338.—Quarz-jaspe, *Haüy,* t. ii. p. 435. —Gemeiner Jaspis, *Reuss,* b. ii. s. 311. *Id. Lud.* b. i. s. 95. *Id.*

Id. Suck. 1r th. s. 348. *Id. Bert.* s. 228. *Id. Mohs,* b. i. s. 317. *Id. Hab.* s. 11.—Quartz-jaspe, *Lucas,* p. 37.—Jaspe commun, *Brong.* t. i. p. 324.—Quartz-jaspe, *Brard,* p. 101.—Gemeiner Jaspis, *Leonhard,* Tabel. s. 12. *Id. Karst.* Tabel. s. 38.—Jasper, *Kid,* vol. i. p. 206.—Quarz-jaspe, *Haüy,* Tabl. p. 28. —Gemeiner Jaspis, *Steffens,* b. i. s. 185. *Id. Hoff.* b. ii. s. 172. *Id. Lenz,* b. i. s. 420. *Id. Oken,* b. i. s. 298.

External Characters.

The most common colours are red and brown; seldom yellow and black. It occurs brownish-red, cherry-red, blood-red, cochineal-red, scarlet-red, ochre-yellow, yellowish-brown, chesnut-brown, liver-brown, blackish-brown, and pitch-black.

It has generally only one colour; sometimes, however, it occurs with spotted, clouded, flamed, or striped delineations.

It occurs generally massive, sometimes also disseminated, in blunt-cornered rolled pieces, mixed with calcedony in a moss-like manner, and rarely reticulated.

Internally it varies, according to the fracture, from shining to dull; and the lustre is resino-vitreous.

The fracture of some varieties is more or less perfect and flat conchoidal, and these have a shining or glistening lustre: in others it is even, with a glimmering lustre, or fine earthy and dull.

The fragments are indeterminate angular, and more or less sharp-edged.

It is opaque, or very faintly translucent on the edges.

It is hard in a low degree.

It is rather easily frangible.

Specific gravity, 2.554, 2.671, *Haberle.*—2.580, 2.700, *Kirwan.*—2.298, 2.314, 2.349, 2.573, 2.665, *Hoffmann.*

Chemical

Chemical Characters.

It is infusible without addition before the blowpipe.

It retains its colour for a considerable time, and at length becomes white.

Geognostic Situation.

It occurs principally in veins, as a constituent part of agates, or in imbedded cotemporaneous masses in primitive, transition, and secondary rocks. The veins in which it occurs are either entirely filled with jasper, or they contain also ores of different kinds, as of iron, lead, or silver. It is found more abundantly in ironstone veins than in those of lead and silver; and the iron ores with which it is associated, are red and brown ironstone, accompanied with quartz and iron-flint. The lead ores are lead-glance; and the argentiferous minerals are native silver, and vitreous silver-ore. The most beautiful varieties, and the largest masses, occur in veins entirely filled with jasper, or a mixture of jasper and agate.

Geographic Situation.

Europe.—It occurs in the Pentland Hills, and Moorfoot Hills, near Edinburgh; and in different places along the course of the rivers Tweed and Clyde, where it is contained in clay-slate and greywacke rocks. It occurs in trap rocks and transition rocks in Ayrshire and Dumfriesshire. To the north of the Frith of Forth it is not unfrequent, both in the form of veins and imbedded portions. In the fine display of rocks described by Colonel Imrie, as occurring in the course of the North Esk river in the Mearns, there are cotemporaneous masses and veins of jasper in transition rocks. It occurs also in the Shetland Islands, and

and in several of the Hebrides. On the Continent of Europe it has been observed in Sweden, Russia, Germany, Hungary, Transylvania, France, Italy, Spain, Portugal; and in the islands of the Mediterranean, particularly Sicily.

Asia.—It is found in great abundance in Siberia.

Uses.

When it occurs in sufficiently large masses, and receives a good polish, it is cut into various ornamental articles, as vases, snuff-boxes, ringstones, &c. The finest varieties are used for engraving on: many beautiful antique engraved stones of common jasper are preserved in collections.

Observations.

1. Colour, lustre, fracture, and geognostic situation combined, distinguish this kind of jasper from the others.

2. It passes into Iron-flint and into Clay-Ironstone, and is nearly allied to Hornstone and Claystone.

3. The *Sinopel* of some mineralogists is a variety of common jasper.

Fifth Kind.

Agate Jasper.

Agat-Jaspis, *Werner.*

Id. Broch. t. ii. p. 141.—Agath-Jaspis, *Reuss,* b. ii. s. 316. *Id. Lud.* b. i. s. 95. *Id. Mohs,* b. i. s. 322. *Id. Leonhard,* Tabel. s. 12. *Id. Karsten,* Tabel. s. 38. *Id. Steffens,* b. i. s. 187. *Id. Hoff.* b. ii. s. 175. *Id. Lenz,* b. i. s. 422. *Id. Oken,* b. i. s. 298.

External

External Characters.

Its colours are yellowish-white and reddish-white; the yellowish-white passes into cream and straw yellow, and approaches to ochre-yellow; the reddish-white passes into flesh-red and pale blood-red. Several colours generally occur together, and these are arranged either in clouded, flamed, or striped delineations; of these the striped are either disposed in a circular manner, or fortification-wise.

It occurs massive.

It frequently occurs in distinct concretions, which are either fortification-wise bent, or concentric lamellar.

Internally it is dull.

The fracture is small and flat conchoidal, approaching to even.

The fragments are indeterminate angular, and rather sharp-edged.

It is generally opaque, or slightly translucent on the edges.

It is hard in a low degree.

It sometimes adheres slightly to the tongue.

Chemical Character.

Before the blowpipe it is affected in the same manner as common jasper.

Geognostic Situation.

It occurs principally in layers, in agate-balls, in amygdaloid; likewise in agate balls and veins in porphyry.

Geographic Situation.

It occurs in the agates of the middle district of Scotland, in in Mid Lothian, West Lothian, and East Lothian; also in Saxony, Deuxponts, and Hungary.

Observations.

It is distinguished from the other kinds of Jasper, by its colour-delineations, fracture, hardness, weight, and geognostic situation.

Agate *.

AGATE is not, as some mineralogists maintain, a simple mineral, but is composed of various species of the quartz family, intimately joined together, and the whole mass is so compact and hard, that it receives a high polish. From its compound nature, it ought rather to be considered in the geognostic part of this work; yet as Werner and other mineralogists describe it along with the quartz genus, we shall not deviate from their plan.

Agate is principally composed of calcedony, with flint, hornstone, carnelian, jasper, cacholong, amethyst, and quartz. Of these minerals sometimes only two, in other instances more than three occur in the same agate; and these are either massive, disseminated, or in layers. Agates are by Werner divided into different kinds, according to their colour-delineations; and he enumerates the following:— 1. *Ribbon* or *Striped Agate*. 2. *Brecciated Agate*. 3. *Fortification-Agate*. 4. *Tubular Agate*. 5. *Landscape-Agate*. 6. *Moss-Agate*. 7. *Jasper-Agate*.

* The name *Agate*, is derived from the river Achates in Sicily, where it is said this mineral was first found.

1. *Ribbon or Striped Agate.*

It is composed of layers of calcedony, flint, and amethyst, and also of hornstone, jasper, and quartz, which alternate with each other, vary in breadth, and although sometimes curved, sometimes straight, yet are always parallel. When this agate is cut at right angles to the layers, the *common striped agate* is formed: when the section is made across a reniform elevation, we obtain the *zoned agate;* and when the section is oblique, the *serpentine agate* is formed.

This agate occurs principally in veins. A magnificent vein of this kind occurs at Cunnersdorf and Schlottwitz in Saxony, and another at the Halsbach, near Freyberg, and both are situated in gneiss. Agate veins of this kind occur also in porphyry, and these are of great size, as at Wiederau, near Rochlitz in Saxony; or in numerous small veins, traversing the porphyry in all directions, as at Rothlof, near Chemnitz, also in Saxony.

2. *Brecciated Agate.*

This beautiful agate is composed of fragments of another species, which is usually striped agate, generally connected together by a basis of amethyst. This agate occurs in the middle of the great vein of striped agate at Cunnersdorf.

According to some mineralogists, Ribbon-agate is supposed to have been formed from different solutions which have been successively decomposed in a previously existing rent or fissure. The brecciated agate, which is found in the middle of the vein of ribbon-agate, is conjectured to have owed its origin to a rent or rents taking place in that agate; and the fragments thus formed being afterwards connected together, by a new solution poured into the fissure or fissures. This opinion, however plausible, is certainly liable to numerous objections.

3. *Fortification-*

3. *Fortification-Agate.*

This agate is composed of layers of calcedony, flint, and jasper, which have generally in the middle a nucleus of massive amethyst. These layers are thin and parallel, and are fortification-wise bent. It generally occurs in irregular balls, which are contained in amygdaloid. When these balls are cut across, their surface sometimes very much resembles a fortification. The largest agates of this description occur at Oberstein on the Rhine; and many beautiful varieties are met with in the amygdaloid rocks which abound so much in Scotland.

4. *Tubular-Agate.*

When the central spaces in stalactitic calcedony are filled with agate, the compound is named Tubular Agate. It is a rare variety.

5. *Landscape-Agate.*

In this the substances are so arranged, that the whole may be likened to a landscape. It also is a rare variety.

6. *Moss-Agate.*

In this beautiful kind of agate, jasper of various colours, as brown, yellow, and red, appears as it were floating in a basis of calcedony. The jasper resembles moss, and when its arborizations are distinct, it has a very beautiful appearance. All the parts here are evidently of cotemporaneous formation.

7. *Jasper-Agate.*

Jasper-agate is a mixture of calcedony, or hornstone, and jasper. The jasper is of a red, yellow, or brown colour, aud is the predominating ingredient in the agate. It occurs in veins, which sometimes contain ores of different kinds, as ores of silver and iron.

The following are less important kinds of agate.

1. *Spotted-Agate.*

In this beautiful agate, spots of red, yellow, or brown jasper, are dispersed through a calcedonic base. The St Stephen stone, already described under the article Calcedony, may be considered as a spotted agate.

2. *Clouded-Agate.*

It is so named from its clouded appearance: the clouded delineations are of jasper.

3. *Star-Agate.*

This is an agate with stellular markings.

4. *Petrifaction-Agate.*

This agate contains petrifactions of marine animal substances, as shells of the turbinites and tubulites tribes.

Geognostic Situation.

Agates, as already mentioned, occur in veins in gneiss, and in porphyry, and in balls in amygdaloid, greenstone, and porphyry; and probably these, as well as all the other repositories of this singular compound mineral, are of contemporaneous formation with the rocks in which they are contained.

Geographic Situation.

Very beautiful varieties of the different kinds of agate occur in the porphyry, amygdaloid, and greenstone rocks of Scotland.

Scotland. On the Continent there is a great depository of agate at Oberstein on the Rhine: it also occurs in Saxony, Silesia, Bohemia, and Italy; also in the island of Sicily. It likewise abounds in Siberia, East Indies, and China.

Uses.

Agate is sometimes cut into snuff-boxes, and ring-stones: the larger masses are hollowed into mortars, or cut into elegant vases. It was much prized by the ancients, who executed several fine works in it. In the Electoral Cabinet at Dresden, and the Ducal Cabinet in Brunswick, there are beautiful vases of agate. At Oberstein on the Rhine, the amygdaloid rocks are regularly quarried for the agates they contain, and these are cut and polished, and exported to other countries. The cutting, polishing, and selling of the agates (Scotch) of the amygdaloid of this country, is now carried on to a very considerable extent, and is to many a lucrative employment.

TABULAR

TABULAR VIEW

OF THE

PELLUCID GEMS,

*Arranged according to Colour, with some of their more Distinctive Characters *.*

	Spec. Grav.	Hardness.	Refraction.
I. WHITE and GREY GEMS.			
a. Diamond,	3.5	Scratches all other minerals.	Simple.
b. Sapphire,	4.0	Scratches topaz.	Feeble double refraction.
c. Topaz of Brazil,	3.55	Scratches rock-crystal.	Double refraction, stronger than sapphire.
d. Rock-crystal,	2.65	Scratches felspar.	Same as the preceding.
II. RED GEMS.			
a. Oriental ruby,	4.2	Scratches topaz.	Feeble double refraction.
b. Spinel ruby,	3.7	Scratches topaz, but in a lower degree than oriental ruby.	Simple.

* This Table is in imitation of that given by Haüy, in his Treatise on Gems.

	Spec. Grav.	Hardness.	Refraction.
c. Brazilian ruby, or red topaz,	3.5	Scratches rock-crystal, but does not affect spinel.	Double in a moderate degree.
d. Precious garnet, columbine-red colour.	4.0	Scratches rock-crystal in a moderate degree.	Simple.
e. Pyrope, blood-red colour,	3.7	Scratches rock-crystal more readily than precious garnet.	Simple.
f. Tourmaline,	3.0	Scratches rock-crystal but feebly.	Double in a moderate degree.
III. Blue Gems.			
a. Oriental sapphire,	4.2	Scratches topaz.	Feeble double refraction.
b. Beryl, or Aqua-marine,	2.7	Scratches rock-crystal feebly, but not topaz.	Feeble double refraction.
c. North American tourmaline,	3.0	Scratches rock-crystal feebly.	Double refraction.
d. Water Sapphire or Dichroite. When viewed in one direction, violet-blue, in another brownish-yellow.	2.7	Same as preceding.	Feeble double refraction.
IV. Green Gems.			
a. Oriental emerald or green Sapphire,	4.2	Scratches topaz, and spinel ruby.	Feeble double refraction.
b. Peruvian emerald, or true emerald,	2.8	Scratches rock-crystal, but not topaz.	Feeble double refraction.

	Spec, Grav.	Hardness.	Refraction.
c. Brazilian or Columbian emerald, a variety of tourmaline.	3.0	Scratches rock-crystal feebly.	Double refraction.
d. Chrysoprase,	2.6	Scratches glass and felspar.	
V. BLUISH-GREEN GEMS.			
a. Oriental aqua-marine, a variety of sapphire,	4.0	Scratches topaz.	Feeble double refraction.
b. Siberian beryl,	2.6	Scratches rock-crystal.	Feeble double refraction.
VI. YELLOW GEMS.			
a. Oriental topaz, a variety of sapphire,	4.	Scratches topaz.	Feeble double refraction.
b. Brazilian topaz,	3.5	Scratches rock-crystal, but not so deeply as spinel.	Feeble double refraction.
c. Yellow zircon or jargoon,	4.4	Scratches rock-crystal, but not topaz.	Strong double refraction.
VII. YELLOWISH GREEN and GREENISH-YELLOW GEMS.			
a. Oriental peridote, a variety of sapphire,	4.	Scratches topaz.	Feeble double refraction.

	Spec. Grav.	Hardness.	Refraction.
b. Chrysoberyl, or Oriental chrysolite,	3.8	Nearly as hard as sapphire.	Refracts double in a middling degree.
c. Beryl, or aqua-marine,	2.6	Scratches quartz but feebly.	Feeble double refraction.
d. Jargoon of Ceylon, or yellowish-green zircon,	4.4	Scratches rock-crystal more easily than bery.l	Very perfect double refraction.
e. Chrysolite,	3.4	Scratches felspar. but not rock-crystal.	Refracts double in a high degree, but not so powerfully as zircon.
f. Yellowish-green tourmaline, or peridote of Ceylon,	3.0	Scratches rock-crystal feebly.	Double refraction.
VIII. Violet Gems.			
a. Oriental amethyst, a variety of sapphire,	4.0	Scratches topaz.	Feeble double refraction.
b. Amethyst,	2.7	Scratches felspar.	Refracts double in a middling degree.
IX. Hyacinth-Red Gems.			
a. Cinnamon-stone,	3.6	Scratches rock-crystal feebly.	Simple.
b. Hyacinth-garnet, or vermeille,	4.0	Scratches rock-crystal in a middling degree.	Simple.

	Spec. Grav.	Hardness.	Refraction.
c. Hyacinth,	4.4	Scratches rock-crystal in a middling degree.	Perfect double refraction.
d. Hyacinthine tourmaline.	3.0	Scratches rock-crystal feebly.	Double refraction.
X. GEMS which are OPALESCENT, or display a fine play of colour.			
a. Asterias, or star-stone, a variety of sapphire.	4.0	Scratches topaz.	
1. Ruby asterias, red ground.			
2. Sapphire asterias, blue ground.			
3. Topaz asterias, yellow ground.	3.5	Scratches rock-crystal.	
b. Opal, *	2.1	Scratches white glass feebly,	
c. Oriental girasol, or girasol corundum, with a milky ground, from which there shoots bluish and yellowish pencils of light,	4.0	Scratches topaz,	
d. Moonstone, argentine, or fish-eye stone, is a variety of felspar,	2.6	Scratches felspar, but not rock-crystal.	
e. Sunstone, or Oriental aventurine,	2.6		
f. Labrador-stone,	3.0		

* The three last-mentioned minerals belong to the order of Spar, and are placed here merely on account of their opalescent properties.

2. Indivisible Quartz.

Untheilbarer Quartz, *Mohs.*

This species contains nine subspecies, viz. 1. Float-stone, 2. Quartzy Sinter, 3. Hyalite, 4. Opal, 5. Menilite, 6. Obsidian, 7. Pitchstone, 8. Pearlstone, 9. Pumice-stone.

First Subspecies.

Float-stone, or Spongiform Quartz.

Schwimmstein, *Werner.*

Quartz nectique, *Haüy.*

Schwimstein, *Hoff.* b. ii. s. 75.—Schwimkiesel, *Haus.* Handb. b. ii. s. 416.—Spongiform Quartz, *Aikin,* p. 177.

External Characters.

Its colours are yellowish white, yellowish-grey, and sometimes reddish-white.

It occurs in porous, massive, and tuberose forms.

Internally it is dull.

The fracture is coarse earthy.

Its fragments are indeterminate angular, and blunt-edged.

It is feebly translucent on the edges.

It is soft, but its particles are as hard as quartz.

It is rather brittle.

It is easily frangible.

It feels meagre and rough, and emits a grating noise when we draw our finger across it.

Specific gravity 0.448, *Karsten.*—0.512, *Tralles.*

Constituent

Constituent Parts.

Silica, -	91.0	94.0	98.0
Water, -	6.0	5.0	
Ferruginous alumina,	0.25	0.5	
Carbonate of Lime,	2.00		2.0
Trace of Magnesia.			
	99.25	99.5	100

Bucholz in Leonhard's Tasch. b. vi. s. 5. 8. *Vauquelin.*

Geognostic and Geographic Situations.

It occurs incrusting flint, or in imbedded masses in a secondary limestone, at St Ouen, near Paris. It is said to occur also in the Lausberg, near Achen, and in Pary's mine, Anglesey.

Observations.

This mineral is characterised by colour, tuberose external shape, porous internal structure, dull, earthy fracture, slight translucency, softness, and specific gravity.

Second Subspecies.

Quartzy or Siliceous Sinter.

Kieselsinter, *Werner.*

This subspecies is divided into three kinds, viz. Common Sinter, Opaline Sinter, and Pearly Sinter.

First

First Kind.

Common Quartzy or Siliceous Sinter.

Gemeiner Kieselsinter, *Karsten.*

Kiesel-sinter, *Klaproth & Karsten,* Beit. b. ii. s. 109. *Id. Reuss,* b. ii. s. 241. & 245.—Kieseltuff, *Mohs,* b. i. s. 245. *Id. Leonhard,* Tabel. s. 8.—Gemeiner Kieselsinter, *Karsten,* Tabel. s. 24.—Quartz-agathe concretionné thermogene, *Haüy,* Tabl. p. 27.—Quartz-hyaline concretionné, *Brong.* t. i. p. 274.—Gemeiner Kieselsinter, *Steffens,* b. i. s. 128. *Id. Lenz,* b. i. s. 360. *Id. Haus.* Handb. b. ii. s. 391.

External Characters.

Its colours are greyish-white and reddish-white, with light-red and hair-brown spots and stripes; also smoke-grey and yellowish-grey.

It occurs massive, stalactitic, coralloidal, fine fructicose, fine botryoidal, porous; and occasionally contains stems of plants.

It occurs in distinct concretions, which are fine granular, fibrous, and thin and curved lamellar.

Externally it is dull; internally, when it is porous, dull, in other forms glistening and pearly.

The fracture is flat-conchoidal, also coarse-grained uneven.

The fragments are indeterminate angular, and rather blunt-edged.

It is more or less translucent on the edges.

It is semihard.

It is very brittle.

Specific gravity, 1.807, *Klaproth.*—1.816, *Karsten.*

Chemical

Chemical Characters.

It is infusible without addition before the blowpipe.

Constituent Parts.

Silica,	-	98.0
Alumina,	-	1.5
Iron,	- -	0.5
		100

Klaproth, Beit. b. ii. s. 109.

Geognostic and Geographic Situations.

It occurs abundantly around the hot springs in Iceland. It is deposited from the water of these springs, in which it appears to have been held in a state of solution, partly by the alkali the water contains, partly by its high temperature, which is 212° at the surface, but may be greater in the interior of the earth, where the water appears to be subjected to a considerable degree of compression.

Second Kind.

Opaline Siliceous Sinter.

Opalartiger Kieselsinter, *Hausmann.*

Opalartiger Kieselsinter, *Weber's* Naturkunde, b. ii. s. 111. *Id. Steffens,* b. i. s. 130.

External Characters.

Its colours are yellowish-white and milk-white, with brownish, blackish, or bluish spots; and on the fracture-surface veined and dendritic delineations.

It

It is massive.

The fracture is imperfect conchoidal, sometimes passing into even.

Sometimes it occurs in distinct concretions, which are lamellar or granular.

The lustre is glistening.

The fragments are angular and sharp-edged.

It is translucent on the edges.

It is semihard; brittle.

Easily frangible.

Adheres to the tongue.

Chemical Characters and Constituent Parts.

The same as in the first subspecies.

Geographic Situation.

It occurs at the Hot Springs in Iceland.

Observations.

It bears a striking resemblance to Opal.

Third Kind.

Pearl-Sinter, or Fiorite.

Fiorite, *Thomson.*

Id. Santi, Viaggio al Montamiata, 1795, breve notizia di un viaggatore sulle incrostazioni silicee ternale d'Italia, &c. 1794. *Id.*

Id. Thompson, Bibl. Britan. t. i. Janv. 1790.—Quartz-hyalin concretionné, *Haüy,* t. ii. p. 416.—Perlsinter, *Mohs,* b. i. s. 247. Quartz-hyalin concretionné, *Brong.* t. i. p. 274. *Id. Lucas,* p. 32. *Id. Brard,* p. 92. *Id. Haüy,* Tabl. p. 25.—Perlsinter, *Steffens,* b. i. s. 131. *Id. Lenz,* b. i. s. 361. *Id. Oken,* b. i. s. 278.

External Characters.

Its colours are milk-white, yellowish-white, greyish-white; also pearl-grey and yellowish-grey.

It occurs coralloidal, stalactitic, tubular, cylindrical, fructicose, botryoidal, reniform, and small globular.

Externally it is sometimes smooth and shining, with a pearly lustre, sometimes rough and dull: internally it is dull, glistening, or shining, with a lustre intermediate between resinous and pearly.

It occurs in thin concentric lamellar distinct concretions, which are curved in the direction of the external surface, and incrust massive pearl-sinter, which is in round granular distinct concretions.

The fracture is fine grained uneven; also flat conchoidal, and fine splintery.

The fragments are angular, and not particularly sharp-edged.

It is translucent, often only translucent on the edges; and sometimes is semi-transparent in thin pieces.

It scratches glass, but is not so hard as quartz.

It is brittle, and easily frangible.

Specific gravity 1.917, *Santi.*

Chemical Characters.

It is infusible before the blowpipe without addition.

Constituent

Constituent Parts.

Silica,	-	-	94
Alumina,	-	-	2
Lime,	-	-	4
			100
			Santi.

Geognostic and Geographic Situations.

It was discovered by Santi, on Montamiata *, and has been found on volcanic tuff and pumice in the Vicentine, at Solfatara, in Ischia, and at St Michael †.

Observations.

According to Dr Thompson it is a volcanic production. The silica, he supposes, was held in solution by means of soda, aided by the high temperature of the vapours which exhale from the bosom of the earth in volcanic countries by natural apertures, named *fumaroli.*

* In the second edition of this work, I mentioned Dr Thompson as the discoverer of Pearl-sinter; but I am told that it was first noticed by Santi, an Italian naturalist.

† Heuland.

Third Subspecies.

Hyalite.

Hyalith, *Werner.*

Hyalite, *Kirw.* vol. i. p. 296. *Id. Broch.* t. i. p. 272. *Id. Reuss,* b. ii. s. 246.—Quartz concretionné, *Haüy,* Tabl. p. 25.—Hyalith, *Steffens,* b. i. s. 132. *Id. Hoff.* b. ii. s. 131. *Id. Lenz,* b. i. s. 365. *Id. Oken,* b. i. s. 273.—Glasopal, *Haus.* Handb. b. ii. s. 424.—Hyalite, *Aikin,* p. 178.

External Characters.

Its colours are yellowish and greyish white; also yellowish-grey and light ash-grey, and mountain-green *.

It is generally small reniform, small botryoidal, and sometimes stalactitic, and in crusts.

Externally it is smooth and shining; internally it is shining, and splendent; and the lustre vitreous, slightly inclining to resinous.

The fracture is small, and rather flat conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is translucent, approaching to semitransparent.

It is intermediate between hard and semihard.

Specific gravity, 2.476, *Karsten.*—2.140, *Kopp.*

Chemical Characters.

It is infusible before the blowpipe without addition.

Constituent

* This variety is found at Chemnitz in Hungary.

Constituent Parts.

Silica, - -	92.0	
Water, - -	6.33	
Trace of Alumina.		
	98.33	*Bucholz.*

Geognostic and Geographic Situation.

It has been hitherto found principally near Frankfort on the Mayne, where it occurs in fissures in vesicular basalt and basaltic greenstone; it also occurs at Chemnitz in Hungary.

Uses.

It is sometimes cut into ringstones, which externally are not unlike those of Topaz, but are easily distinguished from that mineral, partly by inferior hardness, partly by the delicate rents observable in its interior.

Observations.

1. It is distinguished from *Calcedony* by its colour-suite, its small reniform and botryoidal shapes, its lustre, conchoidal fracture, transparency, and inferior hardness: it is more nearly allied to *Opal*, but is distinguished from it by external aspect, greater transparency and hardness.

2. It is nearly allied to Pearl-Sinter.

Fourth Subspecies.

Opal.

Opal, *Werner.*

This subspecies is divided into seven kinds, viz. Precious Opal, Common Opal, Fire Opal, Mother-of-Pearl Opal or Cacholong, Semi-Opal, Jasper-Opal, and Wood Opal.

First Kind.

Precious Opal.

Edler Opal, *Werner.*

Opalus; Paederos; *Plinius,* l. xxxvii. 6.—Achates opalus, (in part), *Wall.* t. i. p. 280. *Id. Wid.* p. 325.—Opal, *Kirw.* vol. i. p. 289.—Edler Opal, *Emm.* b. i. s. 341.—Opalo, *Nap.* p. 197. —Opale, *Lam.* t. ii. p. 154.—L'Opale noble, *Broch.* t. i. p. 341. Quartz-resinite opalin, *Haüy,* t. ii. p. 434.—Edler Opal, *Reuss,* b. ii. s. 249. *Id. Lud. Id. Suck. Id. Bert. Id. Mohs,* b. i. s. 341. *Id. Karst.* Tabel. *Id. Leonhard,* Tabel. *Id. Hab.*—Silex opale, *Brong.* t. i. s. 300.—Quartz-resinite opalin, *Lucas,* p. 36. *Id. Brard,* p. 100.—Opal, *Kid,* vol. i. p. 227.—Quartz-resinite opalin, *Haüy,* Tabl. p. 27.—Edler Opal, *Steffens,* b. i. s. 135. *Id. Hoff.* b. ii. s. 136. *Id. Lenz,* b. i. s. 397. *Id. Oken,* b. i. s. 275. *Id. Haus.* Handb. b. ii. s. 422.

External Characters.

The most common colour of precious opal is milk-white, inclining to blue, which, when held between the eye and the light, appears pale wine-yellow; and it is sometimes yellowish-white. It almost always displays a beautiful play of colour, in which the tints are blue, green, yellow, and

and red. Generally several of these colours occur in one piece; but in some comparatively rare varieties, one tint predominates over the others. The rarest and most beautiful of these colours is the red *.

It occurs massive, disseminated, in plates, and in strings or small veins.

Internally its lustre is generally splendent, seldom passing into shining, and is vitreous.

The fracture is perfect conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is translucent, and then it exhibits a red and green play of colours; or it passes from translucent into semitransparent, when it exhibits a most beautiful yellow colour; or it is semitransparent, approaching to transparent, when the principal colour is azure-blue.

It is semihard in a high degree.

It is brittle.

It is uncommonly easily frangible.

Some varieties adhere more or less to the tongue.

Specific gravity, 2.114, *Blumenbach.*—2.073, *Karsten.*—2.110, *Brisson.*

Chemical Characters.

Before the blowpipe it becomes opaque, and milk-white, but is infusible.

Constituent

* The play of colours is caused by numerous minute rents that traverse this mineral: thin layers of air are contained in them, and these have the property of reflecting the prismatic colours. It is a phenomenon analogous to the coloured rings observed by Newton.

Constituent Parts.

Silica, - -	90
Water, -	10
	100

Opal of Czscherwenitza, according to *Klaproth.*

Geognostic Situation.

It occurs in small veins in clay-porphyry, generally accompanied with semi-opal; also in amygdaloid.

Geographic Situation.

It is found most abundantly in clay-porphyry at Czscherwenitza, near Kaschau in Upper Hungary, where the famous opal-mines that afford all the opal of commerce are situated; sparingly in secondary amygdaloid in the Faroe Islands; and in trap rocks in the north of Ireland, at Sandy Brae. Formerly small portions of it were found in the mines near Freyberg in Saxony. De Dree mentions that it occurs also in South America *.

Uses.

Few gems are more beautiful than the opal. The elegant play of the richest, purest, and most beautiful colours, have procured for it a high rank among the precious stones. Notwithstanding its beauty, it is but indifferently suited to the purposes of jewellery, on account of its softness, great frangibility,

* It is mentioned in one of the public journals, that two mines of precious opal have been lately discovered in the district of Gracios di Dios, sixty Spanish miles in the interior of Honduras.

frangibility, and its often splitting on a change of temperature. Jewels of opal must therefore be very carefully kept, because from their softness they easily scratch, and exposure to alternation of temperature, occasions them to split, by which their beauty is very much diminished. It is worked into ringstones, necklaces, ear-drops, and other ornaments. It is cut into a convex form, or *en cabochon*, with the view of showing its colours to the greatest advantage; but its softness prevents its being facetted, or if facets are cut on it, these must be very flat. The cutting is executed on a leaden wheel with water; and then it is polished with tin ashes, in a piece of chamois-leather, by which operation it receives its perfect lustre. When deficient in colour, jewellers are in the practice of setting it in a foil of the desired colour; but if it possesses a beautiful play of colour, it appears to the greatest advantage when set in a black case. At present, the opal is held in great estimation in all countries, but particularly in Hungary, Moldavia and Wallachia, where it forms the chief ornaments in the dress of the oldest and most wealthy families. It is exported to Turkey, and from thence it is frequently imported into Holland, where it is falsely denominated *oriental opal.* It is so highly esteemed by the Turks, that a fine opal of moderate size has sometimes been sold at the price of a diamond. It was much prized by the ancients. Pliny (the only one of the ancient writers who mentions the opal) describes it as uniting the beauties of the carbuncle, amethyst, and emerald; and the Greeks expressed their admiration of this lovely gem, by naming it *paederos.* Nonius, a Roman Senator, possessed an opal of extraordinary beauty, valued at L. 160,000; rather than part with which to Mark Antony, he chose to suffer exile. He fled to Egypt,

Egypt with his opal, where it was supposed he secreted it. It is not, after this, mentioned by any ancient writer; and the only other notice published in regard to it, is a story by a French interpreter Roboly, who pretended that he had discovered it amidst the ruins of Alexandria.

It does not appear that the opal was ever much used for engraving on, and very few engraved stones of this mineral are preserved in collections. The opal is frequently minutely disseminated through porphyry; and pieces of this kind, when cut and polished, are worked into snuff-boxes, and other similar articles.

Observations.

1. The peculiar play of colour distinguishes this mineral from all others. In all other characters it nearly agrees with Common Opal, differing principally in its higher degree of lustre and transparency.

2. This is one of the few minerals whose name has remained unaltered from the earliest times; but its origin or derivation is imperfectly known. Some derive it from the Greek word οψ or οπος, which signifies *vision*, because it was supposed to possess the power of strengthening the eye. The precious opal was the only kind known to the ancients.

3. The finer varieties are named *oriental opal*. Tavernier, however, informs us, that no precious opal is found in the East, and that those which are sold as oriental are brought from Hungary.

4. Those varieties of precious opal which adhere to the tongue, are only translucent, and scarcely exhibit any of the play of colour which so remarkably distinguishes the common varieties; but when immersed in water, they become

come more transparent, and acquire a very beautiful play of colour. This property of becoming transparent on immersion in water, occurs also in some varieties of common and semi-opal, and these have been described under various names, as *Oculus mundi*, and *Hydrophane*, or *Changeable Opal* *. They are much prized by collectors on account of their rarity, and the property just mentioned. In order to preserve their beauty, we must be careful never to immerse them but in pure water, and to take them out again as soon as they have acquired their full transparency. If we neglect these precautions, the pores will soon become filled with earthy particles deposited from the water, and the hydrophane will cease to exhibit this curious property, and will always remain more or less opaque. When changeable opals are well dried, and immersed in melted wax or spermaceti, they absorb a portion of it, and become transparent, but on cooling become opaque again. For some time these prepared opals were imposed on the public as rare and singular minerals, and sold at a very high price, under the name *Pyrophane*.

5. In the Imperial Cabinet at Vienna, there are two pieces of opal from the mines in Hungary, which deserve to be mentioned here. The one is about five inches long and two and a half in diameter, and exhibits a very rich and splendent play of colours; the other, which is of the size and shape of a hen's egg, is also extremely beautiful.

Second

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* These hydrophanes were known to the ancients under the name *Pantarbas*. Neuheuser, in his treatise intituled *Coronæ gemma nobilissimæ*, published in the sixteenth century, mentions the hydrophane, under the name *Verkehrstein* or *Wunderstein*.

Second Kind.

Common Opal.

Gemeiner Opal, *Werner.*

Id. Wid. p. 325.—Semi-opal, *Kirw.* vol. i. p. 290.—Gemeiner Opal, *Emm.* b. i. s. 251.—Opalo, *Nap.* p. 197.—Girasol & Hydrophane, *Lam.* p. 156.—L'Opal commune, *Broch.* t. i. p. 344.—Gemeiner Opal, *Reuss,* b. ii. s. 253. *Id. Lud. Id. Suck. Id. Bert. Id. Mohs,* b. i. s. 344. *Id. Karsten,* Tabel. *Id. Leonhard,* Tabel.—Silex opale, *Brong.* t. i. p. 300.—Quartz-resinite commun, *Haüy,* Tabl. p. 28.—Gemeiner Opal, *Steffens,* b. i. s. 137. *Id. Lenz,* b. i. s. 400. *Id. Oken,* b. i. s. 275. *Id. Haus.* Handb. b. ii. s. 422. *Id. Hoff.* b. ii. s. 144.—Common Opal, *Aikin,* p. 178.

External Characters.

The principal colour of Common Opal is milk-white; but it occurs also greyish, yellowish, and greenish white. The milk-white passes into bluish-grey: and the greyish-white into smoke-grey: the yellowish-white into yellowish-grey, wax-yellow, honey-yellow, ochre-yellow, hyacinth-red, and an intermediate colour between flesh-red and brick-red: the greenish-white passes into apple-green, pistachio-green, and mountain-green. It never exhibits more than one colour. The milk-white variety, when turned round in the sun's rays, reflects a reddish colour. It is named *Girasol* *.

It occurs massive, disseminated, in sharp angular pieces, and very rarely vesicular.

Internally

* *Girasol* is derived from the Latin, *gyro,* to turn, and *sol,* the sun.

Internally its lustre is generally splendent, sometimes passing into shining; and is vitreous.

The fracture is perfect conchoidal.

The fragments are indeterminate angular and sharp-edged.

It is most commonly semitransparent; sometimes it approaches to translucent, but seldom to transparent.

It scratches glass.

It is brittle.

It is uncommonly easily frangible.

It sometimes adheres to the tongue.

Specific gravity, 2.015, *Klaproth.*—2.144, *Kirwan.*—2,064, *Haberle.*

Chemical Characters.

Before the blowpipe it is infusible without addition.

Constituent Parts.

	Opal of Kosemutz.	Of Telkobanya.
Silica, -	98.75	93.50
Alumina, -	0.1	
Oxide of Iron, -	0.1	1.0
Water, -	-	5.0
	98.95	99.50

According to *Klaproth*, t. ii. p. 164. & 169.

Geognostic Situation.

It occurs in veins along with precious opal in clay-porphyry, and in short beds in primitive serpentine. It is also found in secondary amygdaloid, associated with calcedony, either in vesicular cavities, in cotemporaneous veins, or in short and thick beds. It also occurs in metalliferous veins,

veins, along with galena and blende, as in Saxony, Island of Elba, and in Bohemia; or in red ironstone veins in Saxony. These veins traverse granite, gneiss, mica-slate, clay-slate or porphyry.

Geographic Situation.

It is found in metalliferous veins in Cornwall, in Iceland, the Faroe Islands, North of Ireland; in the Electorate of Saxony, as at Freyberg, Hubertsberg, Eibenstock, Johann-georgenstadt, and Schneeberg; in Bohemia, as at Bleistadt, Fribus, Heinrichsgrün; Brittanny in France; Silesia; Poland; Salzburg; at Florence in Italy; and Telkobanya in Hungary.

Uses.

It is cut for ornamental purposes: thus, the green-coloured Silesian variety is sometimes fashioned into ring-stones; and the yellow variety, which was formerly named *wax-opal* and *pitch-opal*, is also cut and polished by jewellers.

Observations.

This mineral is characterised by its peculiar milk-white colour, strong lustre, perfect conchoidal fracture, considerable transparency, and its low degree of hardness and weight.

Third

Third Kind.

Fire Opal.

Feur Opal, *Karsten.*

Feur Opal, *Karsten & Klaproth,* Beit. iv. s. 156. *Id. Karsten,* p. 26. *Id. Steffens,* b. i. s. 138. *Id. Lenz,* b. i. s. 402. *Id. Oken,* b. i. s. 275. *Id. Haus.* Handb. b. ii. s. 423.

External Characters.

Its principal colour is hyacinth-red, which passes through honey-yellow into wine-yellow; and upon lighter places shews a carmine-red and apple-green iridescence. In its interior, dendritic delineations are sometimes to be observed.

Internally it is splendent, and the lustre is vitreous.

It occurs in distinct concretions, which are partly thick and curved lamellar, partly large and coarse granular.

The fracture is perfect conchoidal.

The fragments are indeterminate angular and sharp-edged, or tabular.

It is completely transparent.

It is hard.

It is uncommonly easily frangible.

Specific gravity 2.120, *Klaproth.*

Chemical Characters.

When exposed to heat, its colour changes into pale flesh-red; it becomes translucent, and traversed with numerous fissures.

Constituent

Constituent Parts.

Silica, -	92.00
Water, - -	7.75
Iron, - -	0.25
	100.00

Klaproth.

Geognostic and Geographic Situations.

It has hitherto been found only in America, at Zimapan in Mexico, where it was first observed by Sonnenschmid and Humboldt. It occurs in a particular variety of hornstone-porphyry, which contains, besides the fire-opal, also imbedded lavender-blue grains the size of a pea, of a substance not unlike porcelain-jasper. In the middle of each grain of this blue substance, there is a whitish siliceous mineral, from which the blue mineral diverges in all directions in a stellular manner *.

Fourth Kind.

Mother-of-Pearl Opal, or Cacholong.

Perlmutter Opal, *Karsten.*

Achates opalinus, tenax, fractura inæqualis, Cachalonius, *Wall.* gen. 20. sp. 126. p. 285.—Calcedoine altérée, ou Cacholong, *Romé de Lisle.*—Calcedoine blanche opaque, *De Born.*—Cachelonio, *Nap.*—Silex cacholong, *Brong.* t. i. p. 302.—Cacholong, *Kid,* vol. i. p. 225.—Quartz-agathe cacholong, *Haüy,* Tabl. p. 27.—Perlmutter opal, *Steffens,* b. i. s. 139. *Id. Lenz,* b. i. s. 404.—Kacholong, *Oken,* b. ii. s. 274.

External

* Mr Heuland informs me he has specimens of this beautiful mineral from Guadalupe in Mexico, in cacholong.

External Characters.

Its colours are milk-white, yellowish-white, and greyish-white; sometimes dendritic.

It occurs massive, disseminated, in blunt angular pieces, in crusts, and sometimes reniform.

Externally it is dull; internally it alternates from dull to glistening and shining, and is pearly.

It sometimes occurs in coarse granular distinct concretions.

The fracture is flat conchoïdal, but becomes earthy by the action of the atmosphere.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is opaque.

It is somewhat harder than common opal.

It is brittle, and easily frangible.

Specific gravity, 2.209, *Karsten.*—2.272 Feroe, *Kopp.*

Chemical Characters.

It is infusible before the blowpipe.

Geognostic and Geographic Situations.

It occurs, along with calcedony, in trap rocks in the island of Iceland; in the Faroe Islands; also in Greenland: and in Bucharia. At Huttenberg in Carinthia, it occurs along with compact and fibrous brown ironstone. It is also mentioned as a production of the Island of Elba, and of Estremadura in Spain.

Uses.

When cut, it is generally *en cabochon;* but it is seldom used for engraving upon, on account of its brittleness. The

The Valentine III. in the Royal Library at Paris, is engraved upon cacholong. Italian artists sometimes use it for mosaic work, and Wallerius says the Calmuc Tartars fashion it into vessels of various kinds, and into idols.

Observations.

1. Some mineralogists consider it as a variety of Calcedony; but it is distinguished from that mineral by lustre, fracture, hardness, and specific gravity.

2. The name *Cacholong*, is by some derived from a supposed river in Bucharia, named Cach, where the mineral is said to have been first found: but as there is no river of that name in Bucharia, other mineralogists have derived the name from *cholong*, that is, a stone, and *cach*, which in the language of that country signifies a pebble; while Blumenbach says, that cacholong is a Mongolian word signifying a beautiful stone.

Fifth Kind

Semi-Opal.

Halb-Opal, *Werner.*

Id. Wid. p. 325.—Semi-opal, and several of the Pitchstones of *Kirw.* vol. i. p. 290. 292.—Halb-Opal, *Emm.* b. i. s. 256. *Id. Estner*, b. ii. s. 429.—Semi-opalo, *Nap.* p. 201.—Pissite, *Lam.* t. ii. p. 160.—La Demi-opal, *Broch.* t. i. p. 347.—Quartz-resinite commun, *Haüy*, t. ii. p. 433.—Halb-Opal, *Reuss*, b. ii. s. 257. *Id. Lud.* b. i. s. 97. *Id. Suck.* 1r th. s. 311. *Id. Bert.* s. 266. *Id. Mohs*, b. i. s. 355. *Id. Hab.* s. 8.—Quartz-resinite commun, *Lucas*, p. 36.—Halb-Opal, *Leonhard*, Tabel. s. 13.—Silex Resinite, *Brong.* t. i. p. 303.—Halb-Opal, *Karsten*, Tabel, s. 26.—Semi-opal, *Kid*, vol. i. p. 231.—Quartz-resinite

resinite Hydrophane, *Haüy,* Tabl. p. 27.—Halbopal, *Steffens,* b. i. s. 141. *Id. Hoff.* b. ii. s. 149. *Id. Lenz,* b. i. s. 406. *Id. Oken,* b. i. s. 276. *Id. Haus.* b. ii. s. 424.—Semi-opal, *Aikin,* p. 179.

External Character.

Its most common colours are white, grey and brown. Of white, the varieties are yellowish-white, and greyish-white, seldom milk-white and greenish-white. It passes from ash-grey into greyish-black; from yellowish-grey into wax-yellow, into a colour intermediate between ochre and isabella yellow, into yellowish-brown, hair-brown, liver-brown, chesnut-brown, reddish-brown, and nearly into red; and, lastly, from greenish-grey into leek-green, olive-green, and oil-green.

Sometimes several colours occur together, and these are arranged in spotted, concentric striped, clouded, or flamed delineations; but it is most commonly uniform, or of one colour.

It occurs not only massive and disseminated, but also tuberose, small reniform, small botryoidal, and stalactitic.

Externally it is glistening; internally, generally glistening, sometimes approaching to shining, or passing into glimmering.

The fracture is large and flat conchoidal, but less perfect than that of common opal; and it sometimes inclines to small conchoidal.

The fragments are indeterminate angular and very sharp-edged.

It is more or less translucent, and sometimes passes to translucent on the edges.

It is semihard, approaching to hard.

It is rather easily frangible.

Specific gravity,—Yellowish and greenish-grey from Hungary, 2.000, *Hoff.* Yellowish-white from Steinheim, 2.001, *Hoff.* Blackish-brown from Steinheim, 2.059, *Hoff.* Milk-white from Freyberg, 2.167, *Hoff.* From Moravia, 2.167, *Klap.* 2.077, 2.187, *Karsten.*

Chemical Characters.

It is infusible before the blowpipe without addition; but with borax it melts, and without intumescing.

Constituent Parts.

Semi-opal from Neu Wieslitz, between Brünn and Kremsier in Moravia:

Silica, -	85.00
Alumina, -	3.00
Oxide of Iron, -	1.75
Carbon, -	5.00
Ammoniacal Water,	8.00
Bituminous Oil, -	0.33
	99.08

Klaproth, Beit. b. v. s. 31.

Geognostic Situation.

It occurs in angular pieces, beds, and veins, in porphyry and amygdaloid; also in metalliferous (most usually silver) veins that traverse granite and gneiss.

Geographic Situation.

It is found in Greenland, Iceland, Faroe Islands, Scotland, in the Isle of Rume, where it occurs in amygdaloid;

Electorate

Electorate of Saxony, Bohemia, Frankfort on the Mayne, Silesia, Lower Austria, Poland, Hungary, Transylvania, Isle of Elba, Piedmont, and Siberia.

Observations.

1. It is distinguished from *Common Opal* by the muddiness of its colours, its particular external shapes, its inferior lustre and transparency, its less perfect conchoidal fracture, and its greater hardness and weight.

2. It passes into Opal-Jasper, Calcedony, and Conchoidal Hornstone.

3. It has been arranged with Pitchstone by Dolomieu, Fichtel, and other mineralogists; but it is distinguished from that mineral by its vitreous lustre, greater transparency, inferior specific gravity, its want of distinct concretions, and its infusibility.

Sixth Kind.

Jasper-Opal, or Ferruginous Opal.

Opal-Jaspis, *Werner.*

Jaspe-Opale, *Broch.* t. ii. p. 498.—Opal-Jaspis, *Reuss,* b. ii. s. 317. *Id. Lud.* b. i. s. 95. *Id. Mohs,* b. i. s. 324. *Id. Leonhard,* Tabel. s. 12.—Jasp-Opal, *Karsten,* Tabel. s. 26.—Jasopal, *Steffens,* b. i. s. 143.—Opal Jaspis, *Hoff.* b. ii. s. 177.—*Id. Lenz,* b. ii. s. 411.—Jasp-opal, *Oken,* b. i. s. 277.—Eisenopal, *Haus.* b. ii. s. 428.—Ferruginous Opal, *Aikin,* p. 179.

External Characters.

Its colours are scarlet-red, light blood-red, brownish-red, ochre-yellow, isabella-yellow, yellowish-grey, and ash-grey.

The isabella-yellow passes into yellowish-white; and the blood-red into reddish-brown.

The colour is either uniform, or distributed in spotted, veined, and clouded delineations.

It occurs massive.

Internally its lustre is shining, approaching to splendent, and is intermediate between vitreous and resinous.

The fracture is perfect conchoidal, and sometimes rather flat conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

It is opaque, and sometimes feebly translucent on the edges.

It is intermediate between hard and semihard.

It is easily frangible.

Specific gravity,—

Yellow and red striped from Constantinople,	1.863.	*Hoff.*
Red from Lauenhayn, - - -	2.053,	*Hoff.*
Brownish-red from Telkobanya, -	2.061,	*Hoff.*
Reddish-brown from Telkobanya,	2.072, 2.081,	*Hoff.*

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

Silica, - -	43.5
Oxide of Iron, -	47.0
Water, - -	7.5
	98.0

Klaproth, Beit. b. ii. s. 164.

Geognostic

Geognostic and Geographic Situation.

It is found in large and small pieces in porphyry, near Telkobanya, and Tokay in Hungary; in the Mittel-gebirge in Bohemia *; near Constantinople; in the Kolyvanian mountains in Siberia; and in veins in the Saxon Erzegebirge.

Observations.

It used to be arranged as a subspecies of Jasper; but its perfect conchoidal fracture, high lustre, great brittleness, and inferior weight, sufficiently distinguish it from the different subspecies of *Jasper.*

Seventh Kind.

Wood-Opal.

Holz-Opal, *Werner.*

Id. Wid. p. 325.—Ligniform Opal, *Kirw.* vol. i. p. 295.—Holz-opal, *Emm.* b. i. s. 260.—Semi-opalo, *Nap.* p. 201.—Xilopale, *Lam.* t. ii. p. 102.—Opal ligniforme, *Broch.* t. i. p. 350.—Holz-Opal, *Reuss,* b. ii. s. 267. *Id. Lud.* b. i. s. 98. *Id. Suck.* 1r th. s. 317. *Id. Bert.* s. 267. *Id. Mohs,* b. i. s. 340. *Id. Leonhard,* Tabel. s. 13. *Id. Karst.* Tabel. s. 26.—Quartz-resinite xyloïde, *Haüy,* Tabl. p. 28.—Holz-opal, *Steffens,* b. i. s. 144. *Id. Hoff.* b. ii. s. 153. *Id. Lenz,* b. i. s. 413. *Id. Oken,* b. i. s. 276.—Wood Opal, *Aikin,* p. 179.

External Characters.

It occurs most commonly white, grey, or brown, and sometimes also black. The white varieties are milk-white, yellowish-

* Heuland.

yellowish-white, and greyish-white: the greyish-white passes into ash-grey, pearl-grey, smoke-grey, and yellowish-grey; which latter passes into ochre-yellow, yellowish-brown, wood-brown, hair-brown; and the greyish-white passes into greyish-black.

The colour is sometimes simple, sometimes in flamed and striped delineations, which are conformable with the original texture of the wood.

It occurs in pieces which have the shape of branches and stems.

Internally its lustre is shining, which sometimes passes on the one hand into splendent, and on the other into glistening, and even into glimmering.

The cross fracture is large and flat conchoidal; the longitudinal fracture is sometimes modified by the remaining fibrous woody texture.

The fragments are sometimes indeterminately angular and sharp-edged, sometimes long splintery.

It is more or less translucent; sometimes only translucent on the edges.

It is semihard in a high degree.

It is easily frangible.

Specific gravity, 2.080, 2.100, *Kirwan*.—2.048, 2.059, *Hoff.*; also 2.189, *Hoff.*

Geognostic and Geographic Situations.

It is found in alluvial land at Zastravia in Hungary; and is said to occur in secondary trap rocks in Transylvania. It has also been found in the neighbourhood of Fain, near Telkobanya in Upper Hungary. Many years ago the trunk of a tree penetrated with opal was found in Hungary, ry, which was so heavy that eight oxen were required to draw it.

Observations.

1. Its woody texture distinguishes it from the other subspecies of *Opal:* and it is distinguished from *Woodstone* by its lighter colours, higher lustre, perfect conchoidal fracture, greater transparency, and inferior hardness and weight.

2. It is wood penetrated with opal, and is intermediate between Common Opal and Semi-Opal.

Uses.

It is cut into plates, and is then used for snuff-boxes, and other ornamental articles.

Fifth Subspecies.

Menilite.

This subspecies is divided into two kinds, viz. Brown Menilite, and Grey Menilite.

First Kind.

Brown Menilite.

Brauner Menilite, *Hoffmann.*

Leberopal, *Reuss,* b. ii. s. 265.—Menilite, *Lud.* b. ii. s. 141.—Leberopal, *Suck.* 1r th. s. 316.—Knollenstein, *Mohs,* b. i. s. 343.—Leberopal, *Hab.* s. 9.—Menilite, *Leonhard,* Tabel. s. 13.—Leberopal, *Karst.* Tabel. s. 26.—Silex Menilite, *Brong.* t. i. p. 312.—Menilite, *Kid,* vol. i. p. 232.—Quartz-resinite subluisant brunatre, *Haüy,* Tabl. p. 28.—Menilith, *Steffens,* b. i.

b. i. s. 145.—Brauner Menilite, *Hoff.* b. ii. s. 156.—Leberopal, *Lenz,* b. i. s. 410.—Kalkopal, or Knollenstein, *Oken,* b. i. s. 276.

External Characters.

Its colour is chesnut-brown, which inclines to liver-brown. On the surface, it has sometimes a bluish colour.

It occurs always tuberose, seldom larger than a fist, often smaller.

The external surface is rough and dull; internally it is faintly glistening, and the lustre is intermediate between resinous and vitreous.

It sometimes has a tendency to lamellar distinct concretions.

The fracture is very flat conchoidal.

The fragments are indeterminate angular and very sharp-edged.

It is translucent on the edges.

It scratches glass.

It is easily frangible.

Specific gravity, 2.185, *Klaproth.*—2.168, *Brisson.*—2.176, *Haberle.*—2.161, 2.169, *Hoffmann.*

Chemical Characters.

It is infusible before the blowpipe without addition.

Constituent Parts.

Silica, - - -	85.5
Alumina, - - -	1.0
Lime, - - -	0.5
Oxide of Iron, - -	0.5
Water, and Carbonaceous Matter,	11.0
	98.5

Klaproth, Beit. b. ii. s. 169.

Geognostic

Geognostic and Geographic Situations.

It has hitherto been found only at Menil Montant, near Paris, where it occurs imbedded in adhesive-slate, in the same manner as flint is in chalk. It is worthy of remark, that the direction of the thin lamellar concretions of the menilite correspond with that of the slaty structure of the adhesive-slate in which it is imbedded. This fact shews that the menilite and slate are of cotemporaneous formation.

Observations.

1. This subspecies is distinguished from the following, or the *Grey Menilite*, by its brown colour, its internal lustre, its more perfect conchoidal fracture, its translucency on the edges, its inferior weight, and geognostic situation.

2. It is nearly allied to semi-opal; but it is distinguished from it by colour, shape, feebler lustre, inferior translucency, greater weight, and geognostic situation.

3. It was at one time arranged along with Pitchstone, under the name *Blue Pitchstone:* more lately it has been described as a member of the Opal species, under the title *Liver Opal*, (Leberopal).

Second Kind.

Grey Menilite.

Grauer Menilite, *Hoffmann.*

External Characters.

Its colour is yellowish-grey, which sometimes inclines to wood-brown.

It

It occurs tuberose, but more compressed than in the brown subspecies, and the external surface is smoother.

Internally it is glimmering or dull.

The fracture is very flat conchoidal, and is sometimes almost even.

The fragments are indeterminate angular and sharp-edged.

It is very feebly translucent on the edges, and sometimes quite opaque.

It is semihard in a high degree.

It is easily frangible.

Specific gravity 2.286, 2.375, *Hoff.*

Geognostic and Geographic Situations.

It occurs at Argenteuil near Paris, imbedded in a clayey marl: also in gypsum which alternates with this marl. It has also been found at St Ouen, near Paris; and, according to Haüy, on the Maase.

Sixth Subspecies.

Obsidian.

This Subspecies is divided into two Kinds, viz. Translucent Obsidian and Transparent Obsidian.

First Kind.

Translucent Obsidian.

Durchscheinender Obsidian, *Hoffman.*

Lapis Obsidianus? *Plin.* Hist. Nat. xxxvi. 26. s. 67.—Achates islandicus, *Wall.* t. ii. p. 378.—Pumex vitreus solidus, Syst. Nat.

Nat. xii. 3. p. 182. n. 7.—Verre de volcan en masses irreguliers, Pierre obsidienne, Pierre de gallinace, & Agathe noir d'Islande, *Romé de Lisle,* t. ii. p. 635.—Verre ou Laitier de volcan, *Faujas,* des Volcans, p. 308.—Obsidian, *Wid.* s. 348. *Id. Kirw.* vol. i. p. 265.—Obsidian, *Nap.* p. 205.—*Retzius,* De lapide Obsidiano, Lund. Goth. 1799, 4to.—Lave vitreuse obsidienne, *Haüy,* t. iv. p. 494.—Obsidian, *Reuss,* b. ii. s. 355. *Id. Lud.* b. i. s. 85. *Id. Suck.* 1r th. s. 371. *Id. Bert.* s. 270. *Id. Mohs,* b. i. s. 349. *Id. Hab.* s. 15.—Lave vitreuse obsidienne, *Lucas,* p. 231.—Obsidienne, *Brong.* t. i. p. 355.—Lave verre noire, *Brard,* p. 447.—Obsidian gemeiner, *Leonhard,* Tabel. s. 14.—Obsidian, *Karsten,* Tabel. s. 36.—Obsidian, *Kid,* Appendix, p. 38. *Id. Steffens,* b. i. s. 371.—Durchscheinender Obsidian, *Hoff.* b. ii. s. 191.—Gemeiner Obsidian, *Lenz,* b. i. s. 432.—Obsidian, or Lava-glass, *Oken,* b. i. s. 305.—Gemeiner Obsidian, *Haus.* Handb. b. ii. s. 432.

External Characters.

Its most frequent colour is velvet-black, which sometimes passes on the one side into greyish-black, ash-grey, and smoke-grey, and on the other into pitch-black. Some varieties are olive-green, and exhibit a beautiful silvery, or golden opalescence. The colour is generally uniform, seldom spotted or striped.

It occurs massive, in blunt-cornered pieces, and sometimes in original grains, which are angular or roundish.

The external surface of the blunt-cornered pieces is rough; that of the grains sometimes rough, sometimes smooth.

Internally it is specular splendent, seldom shining, and the lustre is vitreous.

The fracture is perfect, large, and rather flat conchoidal.

It breaks into angular and very sharp-edged fragments, which sometimes incline to the tabular form.

It

It alternates from translucent to translucent on the edges.

It is hard.

It is very brittle.

It is easily frangible.

The streak is grey.

Specific gravity, Peruvian, 2.348, *Brisson.*—Icelandic, 2.382, 2.397, *Hoff.*—Hungarian, 2.374, 2.358, *Hoff.*

Chemical Characters.

The black obsidian of Iceland, according to Da Camara, on charcoal, before the blowpipe, melts into a pale ash-grey, imperfect vesicular glass. The obsidian of the Island of Candia, before the blowpipe, was changed into a white, light, and uncommonly porous mass. That of Spanish America, before the blowpipe, lost its black colour, became white, spongy, and fibrous, and increased to seven or eight times its original bulk: hence, it is conjectured that some gaseous substance escapes; and Von Humboldt is inclined to believe, that the gas evolved during the fusion of obsidian in the interior of the earth, may give rise to the earthquakes that agitate the Cordilleras.

Constituent Parts.

Obsidian of Iceland.	
Silica,	74
Alumina,	2
Oxide of Iron,	14
	90
Loss,	10
	100
	Abilgard.

Obsidian of the Serro de las Novajas.	
Silica,	78.0
Alumina,	10.0
Lime,	1.0
Natron,	1.6
Potash,	6.0
Oxide of Iron,	1.0
	97.6
	Vaquelin.

Abilgaard

Abilgaard is of opinion, that the loss in his analysis was owing to the escape of either potash or soda.

	American.	American.	American.
Silica, - - -	72.0	72.0	71.0
Alumina, - -	12.5	14.2	13.4
Natron and Potash, -	10.0	3.3	5.0
Lime, - - -	0.0	1.2	1.6
Oxide of Iron & Manganese,	2.0	3.0	4.0
	96.5	93.7	95.0
	Collet-Descotils.	*Drappier.*	*Drappier.*

Geognostic Situation.

This mineral occurs in beds, and imbedded masses and veins, in porphyry, and in various secondary trap rocks. Sometimes it contains grains and crystals of felspar, when it forms obsidian porphyry.

Geographic Situation.

Europe.—This singular mineral is found in different parts of Europe. The island of Iceland, so remarkable on account of its volcanoes and hot springs, contains beds of this kind of obsidian. According to Shumacher, a bed of obsidian two feet thick, occurs in the Bordafiord Syssel in Iceland; and Sir George Mackenzie, during his journey through that remote and desolate country, observed a great mass of obsidian, which appeared to him to be part of a stream that had flowed from a volcano. It is also found in the mountains of Tokay in Hungary, imbedded in pearlstone-porphyry; and in the same geognostic situation in Spain. It occurs in several of the islands in the Mediterranean, as Milo, Candia, and the Lipari Islands *.

Africa.

* Vid. Account of the Obsidian of Lipari, by Spallanzani in his Travels, and Colonel Imrie, in the 2d volume of the Memoirs of the Wernerian Society.

Africa.—According to Cordier and Humboldt, it occurs at the summit of the Peak of Teneriff; and Dr Forster observed it in great quantity in the Isle of Ascension. It is said also to occur in the Island of Madagascar.

Asia.—Siberia; and near the town Goda, twenty wersts from Teflis in Georgia.

America.—Humboldt and Sonnenschmidt found beds and mountain-masses of obsidian at great heights, both in Peru and Mexico.

Polynesia.—Dr Forster found obsidian in several of the islands in the South Sea, as Easter Island, and Roggewein's Island.

Uses.

Although it can be cut and polished, yet its brittleness and frangibility are so great, that it is very apt to fly in pieces during the working: hence it is but seldom used by jewellers. Danish lapidaries cut the obsidian of Iceland into snuff-boxes, ring-stones, and ear-drops. The beautiful olive-green opalescent variety from Mexico, is cut and polished, and used for ring-stones or brooches. It has very much the appearance of cat's-eye, and has been passed for such by jewellers. According to Pliny, the ancients are said to have formed obsidian into mirrors, and into ornamental articles. In New Spain and Peru, the natives cut it into mirrors; and formerly they used to manufacture it into knives, and other cutting instruments. Hernandez saw more than 100 of these knives made in an hour. Crtez, in his letter to the Emperor Charles V. relates that he saw at Tenochtitlan, razors made of obsidian; and Von Humboldt examined the mines which afforded the obsidian for these purposes on the Serro de las Novajas, or the *Mountain of Knives*. The natives of Easter and Ascension islands use

use it in place of cutting instruments; also for pointing their lances and spears, and for striking fire with.

Observations.

1. It was first introduced into the oryctognostic system by Werner. Its name is of great antiquity, being derived from a Roman named Obsidius, who first brought it from Ethiopia to Rome. Pliny speaks of it in the following lines: "In genere vitri et obsidiana numerantur, ad similitudinem lapidis quem in Æthiopia invenit Obsidius, nigerrimi coloris, aliquando et translucidi, crassiori visu, atque in speculis parietum pro imagine umbras reddente," &c.

2. It passes into Pitchstone, Pearlstone, and Pumice.

3. The resemblance of this mineral to glass, and its frequent occurrence in the neighbourhood of volcanoes, has induced some mineralogists to consider it as of volcanic origin, while others, from its alternation with porphyry rocks, maintain that it is of Neptunian formation. Werner, Hoffmann, Steffens, and Mohs, are of opinion that it is an aquatic production; whereas Faujas St Fond, Von Buch, Cordier, and Haüy, maintain its volcanic origin.

Second Kind.

Transparent Obsidian.

Durchsichtiger Obsidian, *Hoffmanu.*

Marekanit, *Karst.* Tabel. s. 36.—Obsidienne de Marikan, *Brong.* t. i. p. 432.—Edler Obsidian, *Haus.* s. 87.—Durchsichtiger Obsidian, *Hoff.* b. ii. s. 200.—Marekanit, *Lenz,* b. i. s. 435. *Id. Oken,* b. i. s. 305.—Edler Obsidian, *Haus.* Handb. b. ii. s. 432.

External

External Characters.

The colours are duck-blue, greyish-white, and clove-brown.

The blue occurs only massive; the white and brown in large and small grains.

The surface of the grains is smooth.

Internally it is splendent.

The fracture is perfect conchoidal.

It breaks into intermediate angular and sharp-edged fragments.

It is perfectly transparent.

It is hard.

It is brittle.

It is very easily frangible.

Specific gravity, 2.333, 2.360, *Lowitz.*—2.365, *Blumenbach.*—2.366, *Hoff.*—2.365, *Klaproth.*

Chemical Characters.

According to Link, it melts more easily than the translucent obsidian, and into a white muddy glass.

Constituent Parts.

Silica, - -	81.00
Alumina, . -	9.50
Lime, - -	0.33
Oxide of Iron, - -	0.60
Potash, - -	2.70
Natron, - -	4.50
Water, - -	0.50
	99.13 *Klaproth.*

Geognostic

Geognostic Situation.

It occurs imbedded in pearlstone-porphyry.

Geographic Situation.

The white and brown varieties are found at Marekan, near Ochotsk in Siberia; the brown variety at Cape de Gate in Spain; and the blue variety in the Serro de las Novajas in Mexico.

Observations.

This kind is characterized by its colour and transparency.

Seventh Subspecies.

Pitchstone.

Pechstein, *Werner.*

Id. Wid. s. 332.—Pitchstone, *Kirw.* vol. i. p. 292.—Pechstein, *Estner,* b. ii. s. 435. *Id. Emm.* b. i. s. 262.—Pietra picea, *Nap.* p. 203.—Pissite, var. h. *Lam.* t. ii. p. 162.—La Pierre de Poix, *Broch.* t. i. p. 353.—Petrosilex resiniforme, *Haüy,* t. iv. p. 386.—Pechstein, *Reuss,* b. ii. s. 345. *Id. Lud.* b. i. s. 98. *Id. Suck.* 1r th. s. 321. *Id. Bert.* s. 225. *Id. Hab.* s. 15.—Resinite, *Brong.* t. i. p. 345.—Pechstein, *Haus.* s. 87. *Id. Leonhard,* Tabel. s. 13. *Id. Karst.* Tabel. s. 36. *Id. Kid,* vol. i. p. 231.—Pechstein, *Steffens,* b. i. s. 375. *Id. Hoff.* b. ii. s. 202. *Id. Lenz,* b. i. s. 436. *Id. Oken,* b. i. s. 304.—Pitchstone, *Aikin,* p. 203.

External Characters.

The principal colour is green, from which it passes on the one side into black, grey, and blue, and on the other, through several varieties of green, into brown, yellow, and red; yellow and blue are the rarest colours. The green colours are blackish-green, mountain-green, leek-green, olive-green, and oil-green. From blackish-green it passes into greenish-black, bluish-black, greyish-black, ash-grey, smoke-grey, and a colour intermediate between indigo and Berlin blue: from olive-green and oil-green into liver-brown, reddish-brown, and pale blood-red. The yellowish-grey sometimes approaches to ochre-yellow. These colours are seldom bright, most generally dull and deep. The colour is in general uniform, seldom in veined, clouded, and spotted delineations.

It occurs massive, sometimes in distinct concretions, which are coarse, seldom large and flat granular; sometimes thick and wedge-shaped prismatic; and rarely thick and straight lamellar. The surface of the distinct concretions is generally smooth and shining, and sometimes rather curved.

Internally it is shining, sometimes passing into glistening, even inclining to glimmering. The red has the feeblest, the bluish and the green the strongest lustre; and the lustre is vitreo-resinous.

It is feebly transparent on the edges.

The fracture is imperfect conchoidal *, and is sometimes large and flat, sometimes small conchoidal: from the latter it passes into coarse-grained uneven, which sometimes approaches to coarse splintery. The conchoidal has the strongest, the splintery the weakest, lustre.

It breaks into angular and sharp-edged fragments.

It is semi-hard in a high degree.

It

* Some varieties of the Arran pitchstone have a perfect and large conchoidal fracture: this, with their lamellar concretions, distinguishes them from the more common varieties of this mineral.

It is rather easily frangible.

Specific gravity, 2.196 to 2.389, *Hoff.*—2.314 to 2.319, *Brisson.*

Chemical Characters.

Before the blowpipe it is fusible without addition. The black variety of Arran at 21° of Wedgwood's pyrometer, intumesced a little, its colour was slightly altered, the surface glazed, and internally porous; at 31°, intumesced considerably and softened; at 65°, the intumescence was more considerable; at 100°, it was still vesicular, but more compact. The blackish-green variety of Arran becomes black, is much rent, and internally porous at 23°; at 55° formed a porous enamel; at 70° it became perfectly white, and still porous. The pitchstones of Meissen in Saxony, according to Mr Kirwan, appear to be more infusible than those of Arran. He found some to melt at 130° Wedgwood; others at 152° to 165°; and a red variety remained nearly unaltered at 160°.

Constituent Parts.

Pitchstone of Meissen.	
Silica, - -	73.00
Alumina, - -	14.50
Lime, - -	1.00
Oxide of Iron, -	1.00
Oxide of Manganese,	0.10
Natron, - -	1.75
Water, - -	8.50
	99.85

Klap. Beit. b. iii. s. 257.

Geognostic Situation.

It occurs in veins that traverse granite; in beds and veins in porphyry, and in the old red sandstone formation; and in veins and imbedded portions in secondary trap rocks.

Geographic Situation.

Europe.—Pitchstone occurs in considerable abundance in different parts in Scotland *. In the Island of Arran it traverses granite in the form of veins; in the red sandstone of that island it appears in beds, and veins of very considerable magnitude; and in small veins in the trap rocks of the Isle of Lamlash. In the islands of Mull, Canna, and Skye, it occurs either imbedded, or in the form of veins in secondary trap and porphyry rocks. Near Eskdalemuir, in the mountainous parts of Dumfriesshire, it rests upon transition rocks, and is associated with secondary trap rocks. I am told that it occurs in trap rocks in Ardnamurchan in Argyleshire. Dr MacCulloch found it in granite near the summit of Cairngorm; I found it at Cumberhead in Lanarkshire; and my friend Dr Murray, several years ago, observed black pitchstone amongst trap rocks on the summits of the Cheviot Hills.

In Ireland, it occurs in a vein traversing granite, in the Townland of Newry †, where it was first observed by Mr Joy of Dublin.

It occurs in the Island of Iceland in secondary trap rocks ‡.

This

* Vid. Jameson's Mineralogical Travels; and Mineralogical Description of Dumfriesshire.

† Fitton's Mineralogy of Dublin, p. 53.

‡ Sir George Mackenzie's Travels in Iceland.

This mineral has never been found in the Scandinavian Peninsula. It occurs in the Electorate of Saxony, near Meissen, along with porphyry and sienite, which rest upon gneiss; in a similar formation at Braunsdorf, Spechtshausen and Mohorn, between Dresden and Freyberg, near Dittersdorf, and at Planitz, near Zwickaw. The blue variety of pitchstone occurs near Vicenza in Italy, and probably in secondary trap rocks *. Pitchstone occurs in porphyry between Schemnitz and Kremnitz, and also near Tokay in Hungary; and in several of the islands in the Mediterranean, it appears to be associated with porphyry.

Asia.—It occurs at Kolyvan in Siberia, and near Mursink, in the Uralian mountains.

America.—In Mexico, according to Sonnendsmidt, it occurs in great abundance, associated with clay-porphyry †.

In South America it occurs at Pasto, Popayan, and Quito, along with clay-porphyry.

Observations.

1. It has been confounded with *Semi-Opal*: but it is distinguished from it by the following characters: its colour-suite is more extensive, and the colours are duller and more muddy than those of semi-opal: its lustre is vitreo-resinous; but that of semi-opal is vitreous: its fracture is imperfect conchoidal; that of semi-opal perfect conchoidal: it is rather heavier than semi-opal, and is differently affected by the blowpipe.

2. It

* In the Isle of Eigg, there is a blue variety of pitchstone, occurring in secondary trap, which resembles that of Vicenza.

† It is said to occur in serpentine at the Bare Hills, seven miles from Baltimore in Maryland.—Cleaveland's Mineralogy, p. 251.

2. It is named *Pitchstone*, from the striking resemblance which some of its varieties have to pitch.

3. It was first discovered, about seventy years ago, by a mineralogist of Dresden, named Schulz; but it was first established as a distinct species by Werner.

4. It appears to pass on the one hand into Obsidian, and on the other into Pearlstone.

Eighth Subspecies.

Pearlstone.

Perlstein, *Werner.*

Le Perlstein, *Broch.* t. i. p. 352.—Lave vitreuse perlée, *Haüy,* t. iv. p. 495.—Perlstein, *Reuss,* b. ii. s. 349. *Id. Lud.* b. i. s. 99. *Id. Suck.* 1r th. s. 367. *Id. Bert.* s. 224. *Id. Mohs,* b. i. s. 353.—Lave vitreuse perlé, *Lucas,* p. 231.—Obsidienne perlé, *Brong.* t. i. p. 340.—Perlstein, *Haus.* s. 88.—Pearlstein, *Leonhard,* Tabel. s. 14. *Id. Karsten,* Tabel. s. 36.—Pearlstone, *Kid,* Appendix, p. 38.—Perlstein, *Steffens,* b. i. s. 378. *Id. Hoff.* b. ii. s. 208. *Id. Lenz,* b. i. s. 443. *Id. Oken,* b. i. s. 306. *Id. Haus.* Handb. b. ii. s. 432.—Pearlstone, *Aikin,* p. 203.

External Characters.

Its colour is generally grey, sometimes also black and red. The varieties of grey are smoke, bluish, ash, yellowish, and pearl grey: from dark ash-grey it passes into greyish-black: from yellowish-grey into a kind of straw-yellow: from pearl-grey into flesh and brick-red, and reddish-brown. The colours are sometimes disposed in striped and spotted delineations.

It occurs massive, vesicular; and the vesicles are sometimes round, and sometimes so much elongated, that the mass

mass appears fibrous; also in large and coarse angulo-granular distinct concretions, that include small and round granular concretions, which are again composed of very thin concentric lamellar concretions. The surface of the concretions, particularly in the large and coarse granular, is smooth, shining, and pearly, and has a striking resemblance to that of pearl. In the centre of these concretions, we frequently meet with roundish balls of obsidian.

Its lustre is shining and pearly.

Its fracture, on account of the thinness of the distinct concretions, is hardly observable, but appears to be small and imperfect conchoidal.

The fragments are indeterminate angular and blunt-edged.

It is translucent on the edges, sometimes even translucent.

It is uncommonly easily frangible.

It is soft, passing into very soft.

Specific gravity, Mexican, 2.254, *Vauquelin.*—Hungarian, 2.340, *Klaproth.*—Hungarian, 2.343, *Hoff.*

Chemical Characters.

Before the blowpipe it intumesces very much, and is converted into a white spumaceous glass.

Constituent Parts.

Pearlstone of Hungary.

Silica,	75.25
Alumina,	12.00
Oxide of Iron,	1.60
Potash,	4.50
Lime,	0.50
Water,	4.50
	98.35

Klaproth, Beit. b. iii. s. 326.

Pearlstone of Mexico.

Silica,	77.0
Alumina,	13.0
Oxide of Iron & Manganese,	2.0
Potash,	2.0
Lime,	1.5
Natron,	0.7
Water,	4.0
	100.2

Vauquelin.

Geognostic

Geognostic Situation.

It occurs in great beds in clay-porphyry, and both rocks contain imbedded cotemporaneous balls of hornstone. It is frequently intermixed with felspar, mica, and quartz, and thus acquires a porphyritic character. It has also been found in secondary trap rocks.

Geographic Situation.

Europe.—It occurs in large beds, in porphyry, near Tokay, Keresztur, and Telkobanya, in Hungary; also at Schemnitz, Glasshütte and Kremnitz, in the same country. It is said to occur at Carbonera, at Cape de Gate in Spain, where it is associated with obsidian. It occurs, along with porphyry, near Sandy Brae in Ireland; and in secondary trap rocks in the Island of Iceland *.

Asia.—Beautiful varieties of this mineral occur near Ochotsk.

America.—It occurs, along with porphyry, in Mexico.

Observations.

1. The distinct concretions distinguish this species from all the other members of the *Pitchstone* family: it is further characterized by its colour-suite, kind of lustre, great frangibility, and low degree of hardness.

2. Some mineralogists describe it as a variety of Obsidian; others as a Zeolite, under the title *Volcanic Zeolite;* but Werner, with more propriety, views it as a species distinct from either of these, and, from the resemblance of the most characteristic varieties to Pearl in colour, lustre, and form, names it *Pearlstone.*

Ninth

* Mackenzie's Travels in Iceland.

Ninth Subspecies.

Pumice.

Bimstein, *Werner.*

Pumex, *Plin.* Hist. Nat. xxx. 21.—Porus igneus, *Wall.* t. ii. p. 375.—Pumex vulcani, *Romé de Lisle,* t. ii. p. 629.—Bimstein, *Wid.* p. 350.—Pumice, *Kirw.* vol. i. p. 415.—Bimstein, *Emm.* b. i. s. 350.—Pumice, *Nap.* p. 208.—Pierre-ponce, *Lam.* t. ii. p. 473.—La Pierre-ponce, *Broch.* t. i. p. 443.—Lave vitreuse pumicée, *Haüy,* t. iv. p. 495.—Bimstein, *Reuss,* b. ii. s. 261. *Id. Lud.* b. i. s. 125. *Id. Suck.* 1r th. s. 374. *Id. Bert.* s. 204. *Id. Mohs,* b. i. s. 356. *Id. Hab.* s. 16.—Lave vitreuse pumicée, *Lucas,* p. 231.—Ponce, *Brong.* t. i. p. 332.—Bimstein, *Haus.* s. 88.—Verre fibreux, *Brard,* p. 448.—Bimstein, *Leonhard,* Tabel. s. 15.—Bimstein, *Karst.* Tabel. s. 36.—Pumice, *Kid,* App. p. 35.—Bimstein, *Steffens,* b. i. s. 379. *Id. Hoff.* b. ii. s. 213. *Id. Lenz,* b. i. s. 439. *Id. Haus.* Handb. b. ii. s. 435.—Pumice, *Aikin,* p. 204.

This Subspecies is now divided by Karsten and Werner into three kinds: these are, Glassy Pumice, Common Pumice, and Porphyritic Pumice.

First Kind.

Glassy Pumice.

Glasiger Bimstein, *Werner, Karsten, Hoffmann,* and *Hausmann.*

External Characters.

Its colour is smoke-grey, of different degrees of intensity

sity; also ash-grey, which sometimes inclines to greyish-white.

It occurs vesicular, and capillary in the vesicular cavities.

Internally the principal fracture is glistening and pearly, the cross fracture shining, and nearly vitreous.

The principal fracture is promiscuous fibrous; the cross fracture small and imperfect conchoidal, inclining to uneven.

The fragments are indeterminate angular, and blunt-edged.

It is sometimes translucent, sometimes only translucent on the edges.

It is intermediate between hard and semi-hard.

It is very brittle.

It is rather easily frangible.

It feels very rough, sharp, and meagre.

Specific gravity 0.378 to 1.444, *Hoffmann*.

Geognostic and Geographic Situations.

It occurs in beds, along with common pumice and obsidian, in the Lipari islands, and in the islands of Santorini and Milo, in the Grecian Archipelago.

Observations.

It is distinguished from *Common* and *Porphyritic Pumice*, by its darker colours, vitreous, shining and conchoidal cross fracture, greater translucency, and greater hardness.

Second

Second Kind.

Common Pumice.

Gemeiner Bimstein, *Werner*, *Karsten*, *Hoffmann*, and *Hausmann*.

External Characters.

Its colours are almost always white, and principally greyish and yellowish white, which sometimes approach to yellowish-grey, ash-grey, and smoke-grey.

It occurs vesicular, and the vesicles are much elongated. In the interior of the vesicles there are capillary fibres.

Internally it is sometimes glistening, sometimes glimmering, and the lustre is pearly.

The principal fracture is more or less perfect fibrous which is curved and parallel; the cross fracture is uneven.

It breaks into blunt-edged fragments, sometimes into splintery fragments.

It is only translucent on the edges.

It is semi-hard, but in a high degree.

It is very brittle.

It is rather easily frangible.

It feels meagre and rough.

Specific gravity, 0.914, *Brisson.*——0.752 and 0.770, *Hoffmann.*

Chemical Characters.

At a heat varying from 35° to 40° of Wedgwood, it is so much altered, that its fibrous fracture is no longer distinguishable: at 60°, it melts into a grey-coloured slag.

Constituent

Constituent Parts.

Silica, - -	77.50
Alumina, - -	17.50
Natron and Potash, - -	3.00
Iron, mixed with Manganese, -	1.75
	99.75

Klaproth, Beit. b. iii. s. 265.

Geognostic Situation.

It occurs in beds, along with glassy pumice and obsidian. In the Island of Lipari, according to Spallanzani, there is a whole hill, named Campo Bianco, in which the pumice is distinctly stratified; and in the same island, it also occurs in globular distinct concretions. It occurs in beds between Andernach and Coblentz; and a remarkable bed of this mineral is contained in alluvial land, near Neuwied.

Geographic Situation.

Europe.—It occurs in the Island of Iceland, along with obsidian *; abounds in the Lipari Islands; is found in the Islands of Santorini and Milo, in the Grecian Archipelago; and, as already mentioned, occurs on the banks of the Rhine.

Africa.—Island of Teneriff.

Asia.—Ternate, and the other Molucca Islands.

America.—In Mexico.

Uses.

* Mackenzie's Travels in Iceland.

Uses.

Common pumice is used for polishing glass, soft stones, and metals; also by parchment-makers, curriers, and hat-makers; and hence it forms a considerable article of trade, and is exported from the Lipari Islands in great quantities to the different countries of Europe. It forms a pernicious ingredient in some teeth-powders: sailors in the Mediterranean use it for shaving; and in the East it is an indispensable article in every bath, for the purpose of removing hairs from the body. On account of its porosity, it is used in Teneriff as a filtering-stone. In Italy it is ground down, and used in place of sand in the making of mortar.

Observations.

It is distinguished from *Glassy Pumice* by its lighter colours, the nature of its lustre, its more perfect fibrous fracture, its lower translucency, and inferior hardness.

Third Kind.

Porphyrytic Pumice.

Porphyrartiger Bimstein, *Werner*, *Karsten*, and *Hoffmann*.

External Characters.

Its colours are greyish-white, and light ash-grey, and very seldom pale blackish-brown.

It occurs massive, in mountain masses; and internally it is minutely porous.

Internally it is glistening or glimmering, and the lustre is pearly.

The

The fracture is very imperfect curved and parallel fibrous, which sometimes passes into compact, or into splintery and uneven.

The fragments are indeterminate angular and rather blunt-edged.

It is feebly translucent on the edges.

It is semi-hard.

It is very brittle.

It is rather easily frangible; and

Is light.

Specific gravity 1.661, *Hoffmann*.

Geognostic and Geographic Situations.

Porphyritic pumice contains crystals of felspar, quartz, and mica, thus forming a kind of porphyry, which is contained in clay porphyry, and is generally associated with claystone, obsidian, pearlstone, and pitchstone-porphyry. It occurs in Hungary at Tokay, Keresztur, and Telkobanya; also in the continuation of this tract at Schemnitz, Glashütte, and Kremnitz. It appears also to be associated with porphyry on the northern acclivity of the Carpathians, as at the Green Lake, above Kasemark. It is said to occur also near Rio Mayo, in the Province of Quito.

Genus XIV.—BORACITE.

This Genus contains but one Species, viz. Hexahedral Boracite.

1. Hexahedral

1. Hexahedral Boracite.

Boracite, *Werner.*

Hexaedrischer Boracit, *Mohs.*

Boracit, *Wid.* s. 533. *Id. Kirw.* vol. i. p. 172. *Id. Estner,* b. ii. s. 1061. *Id. Emm.* b. i. s. 509. *Id. Nap.* p. 370. *Id. Broch.* t. i. p. 589. *Id. Haüy,* t. ii. p. 337. *Id. Reuss,* b. ii. 2. s. 372. *Id. Lud.* b. i. s. 160. *Id. Suck.* 1r th. s. 578. *Id. Bert.* s. 137. *Id. Mohs,* b. ii. s. 232.—Magnesie boratée, *Lucas,* p. 20.—Borazit, *Leonhard,* Tabel. s. 41.—Magnesie boratée, *Brong.* t. i. p. 167. *Id. Brard,* p. 68.—Boracit, *Karsten,* Tabel. s. 48. *Id. Haus.* s. 120. *Id. Kid,* vol. i. p. 118.—Magnesie boratée, *Haüy,* Tabl. p. 16.—Borazit, *Lenz,* b. ii. s. 855. *Id. Oken,* b. i. s. 399. *Id. Haus.* b. iii. s. 821. *Id. Hoff.* b. iii. s. 138. *Id. Aikin,* p. 173.

External Characters.

Its colours are greyish and yellowish white, which passes into yellowish-grey, ash-grey, smoke-grey, and pale greenish-grey.

It has been hitherto found only regularly crystallized, and in the following figures:

1. Cube, either perfect or variously truncated on the edges and angles.
2. Tetrahedron, truncated on all the edges, and acuminated on all the angles with three planes, which are set on the lateral planes.
3. Rhomboidal or garnet dodecahedron.

The crystals are singly imbedded, generally small and very small, and seldom middle-sized.

The surface is generally smooth, seldom rough, and hence it is splendent or shining externally.

Internally

Internally it is shining and adamantine.

Sometimes an imperfect fourfold cleavage is to be seen, parallel with the sides of an octahedron.—*Mohs.*

The fracture is imperfect and small conchoidal, sometimes passing into small-grained uneven.

The fragments are indeterminate angular and sharp-edged.

It is translucent, and rarely transparent.

It is as hard as quartz.

It is rather brittle.

It is easily frangible.

Specific gravity, 2.911, *Karsten.*—2.8, 3.0, *Mohs.*

Physical Characters.

It is pyro-electric on all the angles, those that are diagonally opposite, being one positive, and the other negative. This electricity is uncommonly easily excited, even more so than in tourmaline, or indeed in any other mineral with which we are acquainted.

Chemical Characters.

Fusible with ebullition into a yellowish enamel.

Constituent Parts.

	From Luneburg.	From Segeberg.	From Luneburg.
Lime,	11.00		
Magnesia,	13.50	36.3	16.6
Alumina,	1.00		
Silica,	2.00		
Oxide of Iron,	0.75		
Boracic Acid,	68.00	63.7	83.4
	96.25	100	100.0
	Westrumb.	*Pfaff.*	*Vauquelin.*

Vauquelin

Vauquelin found no lime in the transparent crystals, but only magnesia: hence he is of opinion, that boracite is a simple borate of magnesia. Nearly the same result was obtained by Pfaff, in his analysis of the boracite of the Segeberg.

Geognostic and Geographic Situations.

This curious mineral has been hitherto found only in the Kalkberg, at Luneberg in Hanover, where it occurs in a particular bed, along with imbedded quartz crystals; and in the same formation, in the Segeberg, near Kiel in Holstein.

Observations.

1. This species is well characterized by its crystallizations, kind of lustre, and electrical properties.

2. Lazius, who first attended to this mineral, named it *Cubic Quartz:* Westrumb found by chemical analysis that it contained boracic acid, and named it *Sedative Spar;* and Werner gave it its present denomination.

3. Fluor-spar is sometimes cut into the form of boracite crystals, and sold as such to the ignorant.

Order II.—SPAR.

Genus I.—PREHNITE.

Prehn Spath, *Mohs.*

This Genus contains one Species, viz. Prismatic Prehnite.

1. Prismatic Prehnite.

Prismatischer Prehn Spath, *Mohs.*

Prehnite, *Werner.*

Prehnit, *Wern.* Bergm. Journ. for 1790, b. i. s. 110. *Id. Wid.* s. 357. *Id. Emm.* b. i. s. 192.—Prenite, *Nap.* p. 235.—Prehnite, *Lam.* t. ii. p. 311. *Id. Broch.* t. i. p. 295. *Id. Haüy,* t. iii. p. 167. *Id. Reuss,* b. ii. s. 423. *Id. Lud.* b. i. s. 37. *Id. Suck.* 1r th. s. 414. *Id. Bert.* s. 182. *Id. Mohs,* b. i. s. 358. *Id. Lucas,* p. 69. *Id. Brong.* t. i. p. 376. *Id. Haus.* s. 95. *Id. Brard,* p. 171. *Id. Leonhard,* Tabel. s. 15. *Id. Karsten,* Tabel. s. 30. *Id. Kid,* vol. i. p. 250. *Id. Haüy,* Tabl. p. 50. *Id. Steffens,* b. i. s. 382. *Id. Hoff.* b. ii. s. 220. *Id. Lenz,* b. i. s. 444. *Id. Oken,* b. i. s. 356. *Id. Haus.* Handb. b. ii. s. 559. *Id. Aikin,* p. 216.

This Species is divided into two Subspecies, viz. Foliated Prehnite, and Fibrous Prehnite.

First

First Subspecies.

Foliated Prehnite.

Blättiger Prehnit, *Werner.*

External Characters.

The principal colour is apple-green, from which it passes on the one side to leek-green, mountain-green, greenish-grey, and greenish-white, and on the other into grass-green, yellowish-grey, and yellowish-white.

It occurs massive, and in distinct concretions, which are large, coarse, and fine angulo-granular, and also thick and wedge-shaped prismatic. It is sometimes crystallized.

Its primitive form is an oblique four-sided prism of 103° and 77°, which is often so short as to form an oblique four-sided table, as represented in Fig. 70. Pl. 4 *. The following are some of the secondary forms which the species assumes:

1. The oblique four-sided table is sometimes truncated either on all its terminal edges, or only on the acute edges. When the truncations on all the edges increase very much, there is formed
2. An irregular eight-sided table, (Fig. 71. Pl. 4. †.) When the truncations on the acute edges increase considerably, there is formed
3. An irregular six-sided table, (Fig. 72. Pl. 4.) ‡. When these truncating planes increase in magnitude,

* Prehnite rhomboïdale, Haüy.

† Prehnite octogonale, Haüy.

‡ Prehnite hexagonale, Haüy.

tude, and when the table at the same time becomes thicker, and the obtuse edges are slightly truncated, there is formed

4. A broad rectangular four-sided prism, rather flatly bevelled on the extremities, in which the bevelling planes are set on the smaller lateral planes, and the edge of the bevelment is slightly truncated.

The crystals are small and very small, seldom middle-sized.

They seldom occur single, being generally aggregated, in such a way as to be attached by their lateral planes; sometimes in tabular and manipular groupes, sometimes in cravat and ruff like groupes. All these groupes occur again in druses.

Externally the crystals are almost always shining.

Internally it is shining, or glistening, and is pearly.

The cleavage is imperfect, with folia in one direction parallel to the base of the prism.

The fracture is fine-grained uneven.

The fragments are intermediate angular, and not very sharp-edged.

It alternates from translucent, through semi-transparent into transparent.

Some varieties are as hard as felspar, others as hard as quartz.

It is rather easily frangible.

Specific gravity, 2.609, 2.696, *Haüy.*—2.924, *Hoffm.*—2.8, 3.0, *Mohs.*

Chemical Characters.

It intumesces before the blowpipe, and melts into a pale, green or yellow, or greenish-black frothy glass, but does not gelatinate with acids.

Physical

Physical Characters.

According to the observations of M. De Dree, it becomes electric by heating.

Constituent Parts.

Prehnite of the Cape.		Prehnite of Dauphiny.			
Silica, -	43.83	Silica, -	50.0	Silica, -	48
Alumina,	30.33	Alumina,	20.4	Alumina,	24
Lime, -	18.33	Magnesia,	0.5	Lime, -	23
Oxide of Iron,	5.66	Lime, -	23.3	Oxide of Iron,	4
Water, -	1.83	Oxide of Iron,	4.9		
		Water, -	0.9		99
	99.89				
			100		*Vauquelin.*
Klaproth, Beobacht. und Endeck der Naturf-Freunde zu Berlin; b. ii. s. 211.		*Hassenfratz*, Journal de Physique, 1780.			

Geognostic Situation.

Europe.—It was first found in France in the year 1782, by M. Schreiber, near to Rivoire in Oisans, in a steatitic rock, imbedded in massive hornblende. It is not disseminated through the mass of the rock, but traverses it in the form of cotemporaneous veins, that contain, besides this mineral, also axinite, octahedrite, chlorite, calcareous-spar, and other minerals. In the same country, at St Christophe, it occurs, along with axinite, in cotemporaneous veins that traverse granite. Veins containing foliated prehnite also occur in the Alps of Savoy; in the Saualpe in Carinthia; and at Ratschinkes in the district of Sterzing in the Tyrol. It is said to occur massive in amygdaloid, along with calcareous-spar and chlorite, in the Seiser Alp in the Tyrol; and along with foliated chlorite and

and adularia, in the valley of Fusch in Salzburg. The yellowish-white variety is found in a slaty rock, with acicular epidote, and delicate fibrous asbestus, in Mount Crelitz, near St Sauveur, in the valley of Bareges in the Department of the High Pyrenees *; in the Alp Novarda in Piedmont, where it is accompanied with epidote; also at Fahlun and Arendal in Scandinavia.

Africa.—Beautiful apple-green massive varieties of this mineral are found in mountains in the country of the Namaquas, in the interior of Southern Africa. These mountains are said to be granitic, and to contain, besides veins of prehnite, also much copper-ore.

America.—It occurs in Greenland, accompanied with calcareous-spar, in minute cotemporaneous veins in sienite.

Observations.

1. This mineral is characterised by its colour, crystallization, the peculiar grouping of its crystals, cleavage, lustre, transparency, hardness, and weight.

2. It bears some resemblance to Stilbite and Mesotype, in lustre, fracture, and in the changes it experiences by exposure to the heat of the blowpipe: but it is distinguished from them by its green colour, its crystallization, its greater hardness, and weight, as also by its chemical characters.

3. It has been confounded with Prase, Chrysolite, Chrysoprase, Emerald, and Felspar. It was Werner who in the year 1783 first established it as a particular species, and named it after its discoverer *Prehn*, at that time Governor of

* This variety, from its lightness, was for some time considered as a distinct species, under the name *Koupholite.*

of the Cape of Good Hope. He first brought it from the Cape to Europe.

4. The beautiful white-coloured vases sometimes imported from India, and which are said to be of *Jade*, a substance allied to felspar, are, in Count de Bournon's opinion, of the nature of prehnite.

Second Subspecies.

Fibrous Prehnite.

Fasriger Prehnit, *Werner.*

External Characters.

Its colours are siskin-green, oil-green, asparagus-green, mountain-green, and greenish-white.

It occurs massive, reniform, in straight scopiform and stellular fibrous, and radiated distinct concretions, which are collected into large and coarse angulo-granular concretions; also crystallized in acicular four-sided prisms.

Internally it is glistening, and the lustre is pearly.

It breaks into indeterminate angular and rather sharp-edged fragments; sometimes into splintery and wedge-shaped fragments.

It is translucent.

It is as hard as the foliated subspecies.

It is easily frangible.

Specific gravity, 2.889, *Haüy.*—2.856, *Hoffmann.*

Chemical Character.

Before the blowpipe it melts into a vesicular enamel.

Physical

Physical Character.

It becomes electric by heating.

Constituent Parts.

Silica, - -	42.50
Alumina, - -	28.50
Lime, -	20.40
Natron and Potash,	0.75
Oxide of Iron, -	3.00
Water, - -	2.00
	97.15

Laugier, Annales du Museum, t. xv. p. 205.

Geognostic Situation.

This subspecies appears to be confined to secondary mountains; at least it has hitherto been found only in secondary trap rocks, as basalt, amygdaloid, basaltic-greenstone, and common greenstone. It occurs either in cotemporaneous veins, or in amygdaloidal, and other shaped cavities in these trap rocks.

Geographic Situation.

Europe.—In Scotland, it occurs in veins and cavities in trap-rocks near Beith in Ayrshire; Bishoptown in Renfrewshire; also at Hartfield, near Paisley; near Frisky Hall, in Cockney Burn, Old Kilpatrick, and Loch Humphrey in Dunbartonshire; in Salisbury Craig, the Castle Rock, and Arthur Seat near Edinburgh; in Berwickshire; and in the Islands of Mull and Raasay.

It occurs in small veins, along with zeolite and native copper, in amygdaloid, at Reichenbach, in the department of of Saar in France; also near Oberstein. At Fassa in the Tyrol, it occurs in amygdaloid along with zeolite.

America.—It is found in greenstone in Connecticut and Massachusets.

Observations.

1. It is distinguished from *Foliated Prehnite*, by its greenish-yellow colours, external shape, low degree of lustre, and distinct concretions; and we may add to these, its geognostic situation.

2. It resembles *Fibrous* and *Radiated Zeolites* in its concretions, lustre, and easy fusibility; but is distinguished from these minerals by its green colours, and its greater hardness and weight.

GENUS II. DATOLITE *.

Dattel Spath, *Mohs.*

Esmarkite, *Hausmann.*

THIS genus contains one species, viz. Prismatic Datolite.

1. Prismatic Datolite.

Prismatischer Datholit, *Mohs.*

This species is divided into two subspecies, viz. Common Datolite, and Botryoidal Datolite.

First

* The name *Datolite* refers to the granular concretions which this species exhibits in the massive varieties, and was given to it by its discoverer M. Esmark.

First Subspecies.

Common Datolite.

Datholit, *Werner.*

Chaux Datholite, *Brong.* t. ii. p. 397. *Id. Haus.* s. 123. *Id. Karst.* Tabel. s. 17.—Chaux boratée siliceuse, *Haüy,* Tabl. p. 17.—Datolith, *Lenz,* b. ii. s. 859. *Id. Haus.* Handb. b. iii. s. 865. *Id. Hoff.* b. iii. s. 148. *Id. Aikin,* p. 173.

External Characters.

Its colours are greyish-white, milk-white, greenish-white, greenish-grey, which latter inclines to celandine-green, and rarely to muddy honey-yellow.

It occurs in massive portions, which are divided into large coarse and small granular distinct concretions; and crystallized.

The primitive form is an oblique four-sided prism of 109° 28′, and 70° 32′. The principal secondary forms are the following:

1. Low oblique four-sided prism.
   - *a.* Perfect, but this is rarely the case.
   - *b.* The angles on the obtuse edges truncated.
   - *c.* The angles on the acute edges slightly truncated.
   - *d.* Truncated on all the angles.
   - *e.* Bevelled on the acute lateral edges.
   - *f.* Truncated on the acute lateral edges.

   When those truncations on the edges, and on the angles of the obtuse lateral edges increase in magnitude, there is formed,
2. A rectangular four-sided prism, flatly acuminated on the extremities, with four planes which are set on the lateral planes.

The

The crystals are small and very small, seldom middle-sized, and are aggregated in druses.

Externally it is shining.

Internally it is intermediate between shining and glistening, and the lustre is resinous.

The cleavage is parallel with the lateral planes of the prism, but very imperfect.

The fracture is intermediate between fine-grained uneven and imperfect conchoidal.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is translucent, and sometimes transparent.

It is as hard as appatite, sometimes even harder, but never so hard as felspar.

It is very brittle.

It is difficultly frangible.

Specific gravity, 2.980, *Klaproth.*—2.916, *Ullinger.*—2.878, *Hausmann.*

Chemical Characters.

When exposed to the flame of a candle, it becomes opaque, and may then be easily rubbed down between the fingers. Before the blowpipe, it intumesces into a milk-white coloured mass, and then melts into a globule of a pale rose-colour.

Constituent Parts.

Silica,	36.50	Silica,	37.66	Silica,	37.0
Lime,	35.50	Lime,	34.00	Lime,	28.0
Boracic Acid,	24.00	Boracic Acid,	21.67	Boracic Acid,	31.0
Water,	4.00	Water,	5.50	Alumina,	1.0
Trace of Iron and Manganese.		Loss,	1.17	Iron, Manganese, and Nickel,	1.5
			100.00	Water,	1.4
	100.00				100
Klaproth, Beit. b. iv. s. 359.		*Vauquelin*, in Lucas's Tab. Meth. ii. 71.		*Esmark.*	

Geognostic

Geognostic and Geographic Situations.

It is associated with large foliated granular calcareous-spar, more rarely with violet-blue fluor-spar, quartz, and sometimes with apple-green prehnite, in a bed of magnetic ironstone in gneiss, at the mine of Nodebroe, near Arendal in Norway. It is said also to occur in small veins in greenstone, in the Geisalp in Sonthofen; and in the Syseralp *.

Observations.

1. Datolite is characterised by colour, form, distinct concretions, resinous lustre, translucency, and hardness.

2. It resembles prehnite, but is distinguished from it by resinous lustre, compact fracture, inferior hardness, and not becoming electric by heating.

Second Subspecies.

Botryoidal Datolite or Botryolite.

Botryolith, *Hausmann.*

This subspecies is divided into two kinds, viz. Fibrous Botryolite, and Earthy Botryolite.

First Kind.

Fibrous Botryolite.

Fasriger Botryolith, *Hausmann.*

Fasriger Botryolith, *Haus.* s. 122.—Chaux boratée silice concretionnée-mameloné, *Haüy,* Tabl. p. 17.—Fasriger Botryolit, *Lenz,* b. ii. s. 858.—Botryolite, *Aikin,* p. 174.

External

* Mr Heuland informs me, that specimens from the Syser Alp are very rare, and to be found only in old collections.

External Characters.

Externally it is pearl-grey, and yellowish-grey; internally greyish, milk, and reddish white, which passes into pale rose-red. The colours are in concentric stripes.

It occurs reniform, botryoidal, small globular; in fibrous concretions which are scopiform and stellular; these concretions are again collected into small angulo-granular concretions, which are traversed by very thin curved lamellar concretions.

The surface is granulated or rough, and dull.

Internally it is glimmering and pearly.

The fracture is splintery.

It is translucent on the edges.

It is semihard, approaching to soft.

It is brittle.

Specific gravity 2.885, *Klaproth.*

Chemical Characters.

It intumesces and melts into a white glass before the blowpipe.

Constituent Parts.

Silica,	- -	36.00
Lime,	- -	39.50
Boracic Acid,	-	13.50
Oxide of Iron,	-	1.00
Water,	- -	6.50
		96.50

Klaproth, Beit. b. v. s. 125.

Geognostic

Geognostic and Geographic Situations.

It occurs in the Kjenlie mine, near Arendal in Norway, along with common quartz, schorl, calcareous-spar, and iron-pyrites, in a bed of magnetic ironstone, in gneiss.

Observations.

1. It is distinguished by its colours, botryoidal shape, concentric curved lamellar and delicate and stellular fibrous concretions, its pearly lustre, and specific gravity.

2. It was first described by Abildgaard of Copenhagen, under the name *Semi-globular Zeolite.* Its chemical properties were first noticed by Esmark, who, from the effects produced on it by the blowpipe, conjectured that it contained boracic acid. This conjecture was confirmed by the experiments of Gahn and Hausmann, who discovered, that, like datolite, it contained boracic acid, lime, and silica ; and Hausmann, on account of its botryoidal shape, gave it the name it now bears.

Second Kind.

Earthy Botryolite.

Erdiger Botryolith, *Hausmann.*

Erdiger Botryolith, *Haus.* s. 121. *Id. Lenz,* b. ii. s. 859.

External Characters.

Its colour is snow-white.
It is small botryoidal.
It is dull.
The fracture is earthy.

Geognostic and Geographic Situation.

It occurs along with the fibrous subspecies.

GENUS III.

Genus III.—ZEOLITE *.

Schaum Spath, *Mohs.*

This genus contains the following species, viz. 1. Dodecahedral Zeolite, 2. Hexahedral Zeolite, 3 Rhomboidal Zeolite, 4. Pyramidal Zeolite, 5. Di-prismatic Zeolite, 6. Prismatic Zeolite, 7. Prismatoidal Zeolite, 8. Axifrangible Zeolite †. * Wavellite.

1. Dodecahedral Zeolite, or Leucite ‡.

Dodecaedricher Schaum Spath, *Mohs.*

Leucit, *Werner.*

Grenat d'un blanc cristallin, et grenat dicolore, *Romé de Lisle,* p. 330.—Grenat d'un blanc mat à 24 facettes, *Born,* t. i. p. 436. —Leuzit, *Wid.* s. 229.—Vesuvian or White Garnet, *Kirw.* vol. i. p. 285.—Leuzit, *Estner,* b. ii. s. 188. *Id. Emm.* b. i. s. 348. *Id. Lam.* t. ii. p. 259. *Id. Broch.* t. i. p. 188.—Amphigene, *Haüy,* t. ii. p. 559.—Leucit, *Reuss,* b. ii. th. i. s. 396. *Id. Lud.* b. i. s. 63. *Id. Suck.* 1r th. s. 202. *Id. Bert.* s. 175. *Id. Mohs,* b. i. s. 74. *Id. Hab.* s. 21.—Amphigene, *Lucas,* s. 47. *Id. Brong.* t. i. p. 364. *Id. Brard,* p. 126. *Id. Kid,* vol. i.

* Zeolite (Prismatic and Prismatoidal Zeolite) was discovered by Cronstedt in the middle of the last century: he published an account of this curious mineral in the Memoirs of the Swedish Academy of Sciences for the year 1756. On account of its intumescing and foaming before the blowpipe, he named it *Zeolith*, from the Greek word *ζεω, to foam.* In the present arrangement, it is principally used as a generic name.

† Mohs names the eighth species *Axentheilender*, because its principal cleavage is perpendicular to the axis of the crystal; and this term is here translated *axifrangible*, until a more appropriate one shall occur.

‡ *Leucite*, from λευκος, *white*, and refers to its frequent white colour.

vol. i. p. 254. *Id. Haüy,* Tabl. p. 33.—Leucit, *Steffens,* b. i. s. 80. *Id. Hoff.* b. i. s. 482. *Id. Haus.* Handb. b. ii. s. 588. *Id. Aikin,* p. 195.

External Characters.

Its colour is generally white, and most frequently yellowish-white; sometimes also greyish-white, which passes into ash and smoke grey, and rarely reddish-white.

It seldom occurs massive, and in granular concretions, most frequently in roundish imbedded grains, and crystallized in acute double eight-sided pyramids, in which the lateral planes of the one are set on the lateral planes of the other, and the summits deeply and flatly acuminated by four planes, which are set on the alternate lateral edges *.

The crystals are all around crystallized; generally small, and seldom middle-sized.

The surface of the grains is rough, and dull, or feebly glimmering; that of the crystals is smooth, seldom slightly streaked, in the direction of the diagonal, and glistening. Internally the lustre is shining, approaching to glistening, and is vitreous, inclining to resinous.

Sometimes an imperfect cleavage is to be observed.

The fracture is imperfect and flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, semitransparent, and some varieties approach to transparent.

It refracts single.

It is harder than appatite, but not so hard as felspar.

It is brittle.

It

* Amphigene trapezoidal, Haüy.—Romé de Lisle, t. ii. p. 386. Pl. 4. fig. 110.

It is easily frangible.

Specific gravity, 2.463, *Brisson.*—2.464, *Kirwan.*—2.455 to 2.490, *Klaproth.*—2.461, *Karsten.*

Chemical Characters.

Before the blowpipe it is infusible without addition: with borax it forms a brownish transparent glass. According to Lampadius, when exposed to a stream of oxygen gas, it melts easily into a white transparent glass *.

Constituent Parts.

Mean of different analyses.

Silica, -	54	56
Alumina,	24	20
Potash,	21	20
Lime,		2
Loss, -	1	2
	100	100
	Klaproth.	*Vauquelin.*

Geognostic Situation.

It occurs principally in secondary trap rocks, and in lavas, and appears to be almost exclusively a production of Italy. It is imbedded in basalt and wacke, and other similar rocks, at Albano, and Frascati, near Rome, and in great abundance in the lavas around Naples. At Monte Somma it occurs included in a rock composed of black mica, felspar, (ice-spar), garnet, vesuvian, and calcareous spar, which is found in loose masses.

* Lampadius, Samml. prakt. Chem. Abhandl. b. ii. s. 62.

Geographic Situation.

Its Italian localities are Pompeij, Ponte Felice near Borghetto, Civita Castellana, Aqua Pendente, Somma, Frascati, and Vesuvius. The supposed leucites of the Pyrenees, Transylvania, Norway, and Peru, do not belong to this species.

Observations.

1. *Distinctive Characters.—a.* Between leucite and *garnet.* The colours of garnet are red or brown; those of leucite white or grey: garnet has a considerable variety of crystallizations; leucite but one form, technically denominated the *leucite figure:* garnet scratches quartz, leucite only apatite. The specific gravity of garnet extends from 3.5 to 4.2; but the specific gravity of leucite does not exceed 2.46. And, lastly, garnet is fusible before the blowpipe, leucite infusible.—*b.* Between leucite and *analcime.* Analcime has in general an uneven fracture, or distinct cleavage; leucite has a conchoidal fracture, and rarely a cleavage: analcime is softer than leucite; analcime occurs covering the walls of drusy cavities, leucite imbedded; and, lastly, analcime is fusible before the blowpipe, leucite is infusible.

2. It was named by Bergman, White Garnet. Werner named it Leucite, from its white colour; and it was he who first established it as a distinct species.

3. It sometimes weathers to a white earth, in the manner of felspar; a change which is probably owing to the abstraction of its alkali.

4. Von Buch is of opinion that this mineral is an ignigenous production; whereas Werner, Mohs, &c. view it as an aquatic production.

5. Karsten subdivided it into three subspecies, viz. Conchoidal, Uneven, and Earthy; but these appear to be but varieties produced by the action of volcanic fire.

2. Hexahedral

2. Hexahedral Zeolite, or Analcime *.

Hexaedrischer Schaum Spath, *Mohs.*

Analcime, *Haüy.*

Kubizit, *Werner.*

Analcime, *Haüy,* t. iii. p. 180. *Id. Mohs,* b. i. s. 385. *Id. Lucas,* p. 71. *Id. Brong.* t. i. p. 380. *Id. Haus.* s. 94. *Id. Brard,* p. 175. *Id. Leonhard,* Tabel. s. 17. *Id. Karsten,* Tabel. s. 30. *Id. Haüy,* Tabl. p. 51. *Id. Steffens,* b. i. s. 401.—Kubizit, *Hoff.* b. ii. s. 251.—Analcim, *Lenz,* b. i. s. 457.—Wurfeliger Cubicit, *Oken,* b. i. s. 349.—Blättricher Analzim, *Haus.* Handb. b. ii. s. 587.—Analcime, *Aikin,* p. 212.

External Characters.

Its colours are greyish and yellowish white, but seldom milk and reddish white, which latter passes into flesh-red.

It seldom occurs massive, and this variety is disposed in coarse and small angulo-granular concretions, which are in general very closely aggregated; generally crystallized, in the following figures:

1. Perfect cube, which is its primitive figure, fig. 78. Pl. 4. †.
2. The cube flatly and deeply acuminated on all the angles, with three planes, which are set on the lateral planes, fig. 79. Pl. 4. ‡. When the acuminating

* The name *Analcime* is derived from the Greek, and signifies a body without power, because this mineral is only feebly electric by friction.

† The primitive figure, according to Haüy, is the cube.

‡ Analcime tripointé, Haüy.

nating planes become larger, and at length all the planes of the primitive figure disappear, there is formed

3. An acute double eight-sided pyramid, deeply and somewhat flatly acuminated on both extremities, with four planes which are set on the alternate lateral edges, fig. 80. Pl. 4. *.

The crystals are small and very small, seldom middle-sized, and rarely large; and they rest on one another, or mutually penetrate each other.

The surface of the crystals is smooth, and splendent or shining.

Internally it is intermediate between shining and glistening, and the lustre is vitreous, inclining to pearly.

The cleavage is threefold, but imperfect; and the folia are parallel with the sides of the cube.

The fracture is small or fine-grained uneven, or conchoidal.

The fragments are generally indeterminate angular, seldom more or less cubical, owing to the imperfection of the cleavage.

It is translucent or semitransparent, and the crystals are transparent.

It is harder than apatite, but softer than felspar.

It is easily frangible.

Specific gravity, 2.244, *Vauquelin.*—2.2, 2.0, *Mohs.*

Chemical Characters.

It melts with intumescence, before the blowpipe, into a transparent glass.

Physical

* Analcime trapezoidal, Haüy.

Physical Character.

By friction, but not by heating, it becomes electric.

Constituent Parts.

Analcime of Montecchio-Maggiore.

Silica, - -	58.0
Alumina, -	18.0
Lime, - -	2.0
Natron, - -	10.0
Water, - -	8.5
	96.5

Vauquelin, Annal. du Mus. d'Hist. Nat. t. ix. p. 241.

Geognostic Situation.

It occurs in primitive and secondary rocks, but more abundantly in secondary than in primitive country. Thus, it sometimes appears along with magnetic ironstone in gneiss, where it is associated with garnet, augite, hornblende, epidote, prehnite, and calcareous-spar: in metalliferous veins that traverse clay-slate, where it is accompanied with galena, ores of silver and zinc, and calcareous-spar and quartz; very frequently in amygdaloid, and also in basalt and clinkstone porphyry, in which it occurs either in cotemporaneous veins, or in vesicular cavities.

Geographic Situation.

It occurs in the secondary greenstone of Salisbury Craigs, and in the porphyritic rock of the Calton Hill, near Edinburgh: in the greenstone it is contained in drusy cavities, where it is associated with calcareous-spar and prehnite;

ite; in the porphyry, it is in cavities, and is associated with calcareous-spar. Near the village of Old Kilpatrick in Dunbartonshire, where it also occurs in secondary trap-rocks, it is accompanied with prehnite, needle-zeolite, laumonite, and cross-stone; and prehnite and needle-zeolite occur along with analcime at Bishoptown, in the parish of Erskine in Renfrewshire, and near Beith in Ayrshire. The secondary trap of Perthshire, also of the islands of Mull, Staffa, Canna, and Skye, contain crystals of this mineral. In general, it occurs in this country more frequently in the leucitic, than in any other form.

It occurs not unfrequently in the trap-rocks of Iceland, and in those of the Faroe Islands, and Disco in Greenland; but it is a rare mineral in Norway, having hitherto been found only in metalliferous beds near Arendal; and its localities in the North of Germany, are at Andreasberg in the Hartz, where it occurs very rarely in metalliferous veins that traverse primitive clay-slate, and in Bohemia, where it is an inmate of basalt and porphyry-slate.

It occurs in secondary amygdaloid in the Seiser Alp in the Tyrol; in a similar rock at Montecchio-Maggiore, near Vicenza in Italy; in the Bannat of Temeswar.

This species was first discovered by Dolomieu, who found it in the amygdaloid rocks of Etna in Sicily; and a mineral named by the late Dr Thompson of Naples *Sarcolite*, and considered by Haüy as a variety of analcime, occurs in the rocks of Monte Somma, near Naples.

3. Rhomboidal

3. Rhomboidal Zeolite, or Chabasite *.

Rhomboedrischer Schaum Spath, *Mohs.*

Chabasie, *Haüy.*

Schabasit, *Werner.*

Chabasie, *Haüy,* t. iii. p. 176. *Id. Mohs,* b. i. s. 380. *Id. Lucas,* p. 70. *Id. Brong.* t. i. p. 382. *Id. Leonhard,* Tabel. s. 16.—Chabasin, *Karst.* Tabel. s. 80. *Id. Haus.* s. 95.—Chabasie, *Brard,* p. 174. *Id. Haüy,* Tabl. p. 50.—Chabasin, *Steffens,* b. i. s. 399.—Schabasit, *Hoff.* b. ii. s. 257.—Chabasie *Lenz,* b. i. s. 468.—Rhomboedrischer Cubicit, *Oken,* b. i. s. 349.—Chabasin, *Haus.* Handb. b. ii. s. 584.—Chabasie, *Aikin,* p. 210.

External Characters.

Its colour is greyish-white, approaching to yellowish-white.

It seldom occurs massive; almost always crystallized. Its primitive figure is a rhomboid of 93° 36′, and 86° 24′, represented in fig. 81. Pl. 4. The following are the most frequent secondary forms:

1. Truncated on the six obtuse lateral edges.
2. Truncated on the six obtuse lateral edges, and on the six obtuse angles, fig. 82. Pl. 4. †.
3. In which each of the original planes of the rhomboid is divided into two, fig. 83. Pl. 4. ‡.

The crystals are small, middle-sized, and very small, and superimposed and resting on each other.

The

* The name *Chabasie*, is from Chabazion, a stone described by Orpheus in his poems, but unknown to us at present.

† Chabasie tri-rhomboidal, Haüy.

‡ Chabasie disjointé, Haüy.

The lateral planes of the crystals are streaked in a peculiar manner: the streaks shoot from the shorter diagonal, (the dividing edge of the plane), and run parallel with the two adjoining lateral edges of the rhomb. The truncating planes are smooth.

Externally the crystals are splendent: internally glistening, and the lustre is vitreous.

The cleavage is three-fold, in the direction of the planes of the rhomboid.

The fracture is imperfect conchoidal, and also small-grained uneven.

The fragments are indeterminate angular.

It is translucent; the crystals sometimes pass into semi-transparent.

It is as hard as fluor-spar, and sometimes even harder, but never so hard as apatite.

It is easily frangible.

Specific gravity, 2.717, *Haüy*.—2.0, 2.1, *Mohs*.

Chemical Character.

Before the blowpipe it melts easily into a spongy white enamel.

Constituent Parts.

	Chabasite of the Faroe Islands.
Silica, - -	43.33
Alumina, - -	22.66
Lime, - -	3.34
Natron, with Potash, -	9.34
Water, - -	21.00
	99.67

Vauquelin, Annal. de Mus. d'Hist. Nat. t. ix. p. 333.

Geognostic

Geognostic Situation.

It occurs principally in secondary trap rocks; most frequently in cavities of amygdaloid, where it is often associated with agate, calcareous-spar, zeolite, and green-earth. It is said also to occur in a clayey rock, which contains mica and garnet, and in small veins in a rock composed of hornblende and felspar: but we are ignorant of the class to which these rocks belong.

Geographic Situation.

Europe.—The vesicular cavities of the trap-rocks of Mull and Skye afford crystals of chabasite: it occurs in similar rocks in the north of Ireland; and beautiful specimens are found in the amygdaloid of Iceland and of the Faroe Islands. The agate-balls imbedded in the amygdaloid of Oberstein on the Rhine, sometimes contain beautiful crystals of this mineral; and the clayey, and felspar and hornblende rocks already mentioned, which occur in the Seiser Alp in the Tyrol, afford fine crystals of chabasite. It is said to occur in the basalt of Saxony.

Africa.—It occurs in the trap-rocks of the Isle of Bourbon.

America.—In secondary trap rocks in North Greenland.

Observations.

1. The principal characters of this species are crystallization, streaking, kind of lustre, fracture, hardness, and weight.

2. It was formerly united with analcime, to which it is so very nearly allied, that it required the sagacity of Haüy and Werner to establish the marks of difference between them.

them. It is distinguished from *Analcime* by its crystallizations, and streaking.

3. In form it is nearly allied both to Calcareous-spar and Axinite: it is distinguished from *Calcareous-spar* by its form, fracture, and its remaining unaltered in acids; and its inferior hardness at once distinguishes it from *Axinite.*

4. Pyramidal Zeolite, or Cross-Stone.

Pyramidischer Schaum Spath, *Mohs.*

Kreutstein, *Werner.*

Harmotome, *Haüy.*

Hyacinth blanche cruciforme, *Romé de Lisle,* t. ii. p. 299.—Staurolite, *Kirw.* vol. i. p. 282. *Id. Estner,* b. ii. s. 499. *Id. Emm.* b. i. s. 209.—Ercinite, *Nap.* p. 239.—Andreolithe, *Lam.* t. ii. p. 285.—Harmotome, *Haüy,* t. iii. p. 191.—Pierre cruciforme, *Broch.* t. i. p. 311.—Kreutzstein, *Reuss,* b. ii. s. 430. *Id. Lud.* b. i. s. 90. *Id. Suck.* 1r th. s. 418. *Id. Bert.* s. 248. *Id. Mohs,* b. i. s. 382. *Id. Hab.* s. 24.—Harmotome, *Lucas,* p. 73.—Kreutzstein, *Leonhard,* Tabel. s. 17.—Harmotome, *Brong.* t. i. p. 385. *Id. Brard,* p. 178. *Id. Haus.* s. 95.—Kreutzstein, *Karst.* Tabel. s. 30.—Staurolite, *Kid,* vol. i. p. 251.—Harmotome, *Haüy,* Tabl. p. 51.—Kreutzstein, *Steffens,* b. i. s. 405. *Id. Hoff.* b. i. s. 261. *Id. Lenz,* b. i. s. 471. *Id. Oken,* b. i. s. 348.—Harmotom, *Haus.* Handb. b. ii. s. 557.—Harmotome, *Aikin,* p. 208.

External Characters.

Its most frequent colour is greyish-white, seldom yellowish and reddish white: the greyish-white passes into smoke-grey; and the yellowish-white into cream-yellow, brick-red, and flesh-red.

It

It occurs very rarely massive; most frequently crystallized.

Its primitive form is a double four-sided pyramid of 121° 58′, and 86° 36′. The following are the principal secondary forms which have been observed:

1. Broad, seldom equilateral, rectangular four-sided prism, rather acutely acuminated on the extremities with four planes, which are set on the lateral edges, fig. 84. Pl. 4. *.
2. The preceding figure, in which the edges formed by the meeting of the acuminating planes that rest on the broader lateral planes are truncated, fig. 85. Pl. 4. †. When these acuminating planes become so large that the original acuminating planes almost disappear, then the prism appears bevelled on the terminal planes. Very rarely No. 1. becomes very low, when a figure resembling the rhomboidal dodecahedron is formed.
3. Twin-crystal, which is formed by two crystals of No. 1. intersecting each other, in such a manner that a common axis and acumination is formed, and the broader lateral planes make four re-entering right angles, fig. 86. Pl. 4. ‡.

The crystals are small, middle-sized, and very small, and are singly superimposed.

The surface of the smaller lateral planes is double plumosely streaked, the broader lateral planes transversely streaked, and the acuminating planes streaked parallel with the smaller lateral planes.

Internally

* Harmotome dodecaedre, Haüy.

† Harmotome partiel, Haüy.

‡ Harmotome cruciforme, Haüy.

Internally it is glistening, and the lustre is intermediate between vitreous and pearly.

It has a cleavage, in which the folia are in three directions, two of them oblique, and one parallel with the axis.

The fracture is small and perfect conchoidal, passing into uneven.

It breaks into indeterminate angular and pretty sharp-edged fragments.

It is translucent, sometimes passing into semitransparent.

It is harder than fluor-spar, but softer than apatite.

It is easily frangible.

Specific gravity, 2.333, *Haüy*.—2.3, 2.4. *Mohs*.

Chemical Characters.

Before the blowpipe it exhibits a greenish-yellow phosphorescence, and then melts with intumescence into a colourless glass.

Constituent Parts.

Silica,	47.5	44 to 47	49
Alumina,	19.5	20 to 12	16
Barytes,	16.0	25 to 20	18
Water,	13.5	10 to 16	15
Iron,		4	
	96.5	100 99	98
	Tassaert.	*Westrumb.*	*Klap.* Beit. b. ii. s. 83.

Geognostic and Geographic Situations.

It has been hitherto found only in mineral veins and in agate balls. At Andreasberg in the Hartz, it occurs in veins

veins that traverse clay-slate and greywacke rocks, along with quartz, calcareous-spar, galena, or lead-glance, copper-pyrites, iron-pyrites, and grey copper-ore; and of all the materials of the veins, it is the uppermost. The mining district of Kongsberg in Norway, which is situated in primitive strata of mica-slate and hornblende-slate, is traversed by numerous metalliferous veins, containing native silver, ores of silver, lead, zinc, arsenic, and iron, and veinstones of calcareous-spar, heavy-spar, common quartz, and rock-crystal, and sometimes of adularia, zeolite, axinite, chlorite, mountain-cork, fluor-spar, schorl, brown-spar, and *cross-stone*. Strontian in Argyleshire is the only other place where it has been observed in veins; and there it occurs in galena veins that traverse gneiss. At Oberstein it occurs in single crystals, along with chabasite, in agate balls, in trap rocks, and in a similar situation near the village of Old Kilpatrick in this country *.

5. Di-prismatic Zeolite, or Laumonite †.

Di-prismatischer Schaum Spath, *Mohs.*

Lomonit, *Werner.*

Zeolithe efflorescente, *Haüy,* t. iv. p. p. 410.—Lomonit, *Haus.* s. 95. *Id. Karsten,* Tabel. s. 32.—Laumonite, *Haüy,* Tabl. p. 49. *Id. Lucas,* t. ii. p. 188. *Id. Steffens,* b. i. s. 409. *Id. Hoff.*

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* Dr Thomas Brown of Glasgow.

† This mineral is named *Laumonite,* in compliment to Gillet Laumont.

Hoff. b. ii. s. 267. *Id. Lenz,* b. i. s. 470.—Spathiger Laumonite, *Oken,* b. i. s. 393.—Laumonit, *Haus.* b. ii. s. 555. *Id. Aikin,* p. 210.

External Characters.

Its colours are yellowish-white, snow-white, and greyish-white.

It occurs in massive forms, which are arranged in large and coarse granular distinct concretions : also crystallized.

The primitive figure is a double prism, the one vertical, and the other horizontal. The obtuse angle of the vertical prism is 98°, of the horizontal prism 121° 34′. It may be described as an oblique four-sided prism, bevelled on the extremities; the bevelling planes set on the obtuser lateral edges. This prism has its lateral edges sometimes rounded off, so that the crystals become reed-like.

The crystals are small, superimposed, and form druses.

Internally it is sometimes shining, sometimes glistening, and the lustre is pearly.

The cleavage is double; and the folia are delicately longitudinally streaked.

The fragments are indeterminately angular and blunt-edged.

When in a fresh state it is transparent, but on exposure to the atmosphere, it very soon becomes opaque.

When fresh, it is rather harder than fluor-spar ; but on exposure to the atmosphere, it soon becomes so soft as to yield to the mere pressure of the finger.

It is uncommonly easily frangible.

Specific gravity, 2.234, *Bournon.*—2.3, 2.4, *Mohs.*

Chemical

Chemical Characters.

It forms a jelly with acids. According to Vogel, it dissolves with effervescence in cold muriatic and nitric acids, and the solution immediately forms a transparent jelly: it dissolves in sulphuric acid slightly heated, and forms with it a white-coloured opaque jelly. Before the blowpipe it intumesces, and is changed into a pearly shining compact mass.

Constituent Parts.

Silica,	49.0	
Alumina,	22.0	
Lime,	9.0	
Water,	17.5	
Carbonic Acid,	2.5	
	100	*Vogel.*

Geognostic and Geographic Situations.

Europe.—This mineral was first found, in the year 1785, in the lead-mines of Huelgoet in Brittanny, by M. Gillet Laumont, a distinguished French mineralogist. Since that period, it has been discovered in other parts of the world. It is found in secondary trap, along with analcime, needle-zeolite, and cross-stone, near the village of Old Kilpatrick in Dunbartonshire, and in Renfrewshire; in a similar rock in the counties of Fife and Perth; and in the island of Sky. At Portrush in Ireland, it is an inmate of trap-rocks, along with crystals of foliated zeolite and analcime; and in amygdaloid in the Faroe Islands. It has been brought from Dupapiatra, near Zalathna in Transylvania; and it is contained in the amygdaloid of the Vicentine; it likewise accompanies the beautiful apatite of St Gothard.

Asia.

Asia.—It is said to occur in China, along with prehnite.

America.—In greenstone near Newhaven in Connecticut.

Observations.

1. This mineral disintegrates so readily on exposure to the atmosphere, that if we wish to preserve our specimens unaltered, they must be kept in well-closed glass vessels, or their surface must be covered with gum or varnish; and it is said that they will not disintegrate if immersed in distilled water.

3. The most complete and satisfactory account of this mineral hitherto published, is that of Count de Bournon, in the first volume of the Memoirs of the Geological Society.

6. Prismatic Zeolite or Mesotype *.

Prismatischer Schaum Spath, *Mohs.*

Mesotype, *Haüy.*

This species is divided into three subspecies, viz. Fibrous Zeolite, Natrolite, and Mealy Zeolite.

First Subspecies.

Fibrous Zeolite.

Fasriger Zeolit, *Werner.*

This subspecies is divided into two kinds, viz. Acicular or Needle Zeolite, and Common Fibrous Zeolite.

First

* *Mesotype*, from the Greek words μεσος and τυπος, because its primitive figure is intermediate between those of two other species of this genus, viz. Analcime and Stilbite.

First Kind.

Acicular or Needle Zeolite.

Nadelzeolith, *Werner.*

Mesotype, *Haüy,* t. iii. p. 151.—Prismatischer Zeolith, *Karst.* Tabel. s. 30.—Prismatischer Mesotyp, *Steffens,* b. i. s. 388.—Nadelzeolith, *Hoff.* b. ii. s. 235.—Prismatisher Zeolith, *Lenz,* b. i. s. 455.—Sauliger Mesotyp, *Oken,* b. i. s. 352.—Mesotype, formes determinables, *Haüy,* Tabl. p. 48.—Glasartiger Zeolith, *Haus.* b. ii. s. 564.—Nadelstein, *Aikin,* p. 212.

External Characters.

Its colours are greyish or yellowish white, and frequently reddish-white.

It occurs massive, and in distinct concretions; these are prismatic and granular; the prismatic are thin, sometimes passing into fibrous, straight, and scopiform; the granular include the prismatic, and are large and coarse. It also occurs crystallized. The primitive figure is a prism of 91° 25′, and the following are the secondary figures:

1. Acicular rectangular four-sided prism, very flatly acuminated with four planes, which are set on the lateral planes, fig. 73. Pl. 4. *.
2. Sometimes two of the acuminating planes disappear, when there is formed an acute bevelment, which is set on somewhat obliquely.
3. The prism is sometimes truncated on the edges, as in fig. 74. Pl. 4. †.

* Mesotype pyramidée, Haüy.

† Mesotype dioctaedre of Haüy.

The crystals are sometimes scopiformly aggregated, sometimes promiscuously aggregated.

The lateral planes of the crystals are longitudinally streaked, but the acuminating planes are smooth.

Externally the crystals are shining, passing into splendent.

Internally it is glistening, and the lustre is vitreous, inclining to pearly.

The cleavage is twofold, in the direction of the lateral planes of the prism.

The fracture is small and fine-grained uneven.

It breaks into splintery and wedge-shaped fragments.

It is translucent; the crystals are semitransparent and transparent; and it refracts double.

It is as hard as apatite, but not so hard as felspar, *Mohs.*—Scratches calcareous-spar, but not fluor-spar, *Haus.*

It is brittle.

Specific gravity, 2.179, 2.198, 2.270, *Hoffmann.*—2.0, 2.3, *Mohs.*

Chemical Characters.

It intumesces before the blowpipe, and forms a jelly with acids.

Physical Characters.

It becomes electric by heating, and retains this property some time after it has cooled. The free extremity of the crystal, with the acumination, shews positive, and the attached end negative electricity.—*Haüy.*

Constituent

Constituent Parts.

Silica,	-	50.24	50
Alumina,	-	29.30	20
Lime,	-	9.46	8
Water,	-	10.00	22
		99.00	100
		Vauquelin, Jour. des Mines, N. 44. p. 576.	*Pelletier*, Mem. de Chimie, Paris, 1798, t. i. p. 41.

Geognostic and Geographic Situations.

Europe.—It occurs in secondary trap rocks, as in basalt, greenstone, and amygdaloid. In this country it occurs near the village of Old Kilpatrick, Dunbartonshire, also in Ayrshire and Perthshire, and always in trap-rocks. It is found in secondary trap-rocks in the island of Iceland, and in the Faroe Islands; also in the rocks of the Puy de Marman in Auvergne; and in the Tyrol.

America.—It occurs in secondary trap-rocks in the Island of Disco, in West Greenland, and in greenstone rocks in the United States.

Observations.

1. It is distinguished from *Radiated Zeolite* by its crystallization, vitreous lustre, prismatic distinct concretions, greater transparency, hardness, and brittleness: it is distinguished from *Common Fibrous Zeolite* by its more frequent and distinct crystallizations, its higher and more vitreous lustre, its prismatic distinct concretions, greater transparency, hardness, and brittleness.

Second Kind.

Common Fibrous Zeolite.

Gemeiner Faser Zeolith, *Werner.*

Faserzeolith, *Karsten,* Tabel. s. 30.—Fasriger Mesotyp, *Steffens,* b. i. s. 387.—Gemeiner Faserzeolith, *Hoff.* b. ii. s. 233.—Fasriger Zeolith, *Lenz,* b. i. s. 454.—Fasriger Mesotyp, *Oken,* b. i. s. 352.—Fasriger Zeolit, *Haus.* b. ii. s. 567.

External Characters.

Its colours are generally snow-white, greyish-white, or yellowish-white, seldom reddish-white: from reddish-white it passes into flesh-red, and into a colour intermediate between flesh-red and brick-red; and from yellowish-white into a colour intermediate between yellowish-grey and ochre-yellow, and into pale yellowish-brown.

It occurs massive, in blunt-angular pieces, in balls, and small reniform, and these forms are composed of distinct concretions, which are fibrous and granular. The fibrous concretions are thin, straight, scopiform, and stellular; the granular, which include the fibrous, are large and coarse longish or angulo-granular, and are very much grown together.

It also occurs in capillary crystals.

The external surface of the reniform varieties is rough and dull.

Internally it is strongly glimmering, passing into glistening, and the lustre is pearly.

It breaks into splintery or wedge-shaped fragments.

It is faintly translucent.

Its hardness is the same as needle zeolite.

It

It is rather brittle.

It is easily frangible.

Specific gravity 2.158 to 2.197, *Hoffmann.*

Its geognostic and geographic situations are the same with needle zeolite.

Chemical Characters.

It intumesces before the blowpipe, and forms a jelly with acids.

Constituent Parts.

Silica,	49.	54.46
Alumina,	27.	19.70
Lime,		1.61
Soda,	17.	15.09
Water,	9.5	9.83
	102.5	100.63
	Smithson, Phil. Trans. 1811, p. 171.	*Gehlen* in Schweigger's Journal, viii. 355.

Observations.

1. It is distinguished from the other kind by its inferior lustre, fibrous concretions, low degree of translucency; and to these we may add its almost total want of regular crystallizations.

2. It is distinguished from *Calc-sinter*, with which it has been confounded, by its distinct concretions, inferior weight, and its not effervescing with acids.

Second

Second Subspecies.

Natrolite.

Natrolith, *Werner.*

Natrolith, *Reuss,* b. iv. s. 153. *Id. Mohs,* b. i. s. 364. *Id. Brong.* t. i. p. 370. *Id. Brard,* p. 415. *Id. Haus.* s. 96. *Id. Leonhard,* Tabel. s. 15. *Id. Karst.* Tabel. s. 36. *Id. Haüy,* Tabl. p. 64. *Id. Steffens,* b. i. s. 412. *Id. Hoff.* b. ii. s. 273. *Id. Lenz,* b. ii. s. 945. *Id. Oken,* b. i. s. 356. *Id. Haus.* b. ii. s. 570. *Id. Aikin,* p. 212.

External Characters.

Its colour is intermediate between cream-yellow and ochre-yellow, sometimes approaching to pale yellowish-brown, or yellowish-white. The colours are generally arranged in narrow striped delineations, which are parallel with the reniform external shape.

It occurs massive, in plates, and reniform; also in distinct concretions, which are fibrous, granular, and lamellar; the fibrous are straight, and scopiform or stellular; these are collected into large and coarse granular, and both are intersected by curved lamellar concretions.

The surface of the concretions is streaked.

It is seldom regularly crystallized, and the crystals are only acicular and capillary.

Internally it is glistening, passing into glimmering, and the lustre is pearly.

The fracture is not visible.

It breaks in indeterminate angular, and wedge-shaped pieces.

It is translucent on the edges.

It has the same degree of hardness as needle zeolite.

It

It is easily frangible.

Specific gravity 2.200, *Klaproth.*

Chemical Characters.

Before the blowpipe it becomes first black, then red, intumesces, and melts into a white compact glass.

Constituent Parts.

Silica, - -	48.00
Alumina, -	24.25
Natron, -	16.50
Oxide of Iron, -	1.75
Water, -	9.00
	99.50

Klaproth, Beit. b. v. s. 44.

Geognostic and Geographic Situations.

It occurs in small cotemporaneous veins in clinkstone porphyry, in the hills of Hohentwiel, Stauffen, Hohenkrahen, and Magdeberg in Wurtemberg; and at Aussig in Bohemia. In Scotland, in the trap-tuff hill named the Bin, behind Burntisland, and in the trap-rocks of the islands of Mull and Canna.

Observations.

1. The colour, and in particular the circular colour-delineation, the reniform external shape, and the distinct concretions, are the principal characters of this subspecies. It is distinguished from *Fibrous Zeolite*, with which it has been confounded, by its colour, and distinct concretions.

2. It

2. It was first analysed by Klaproth, who gave it its name on account of the great quantity of Natron or mineral alkali which it contains.

Third Subspecies.

Mealy Zeolite.

Mehlzeolith, *Werner.*

Id. Wid. p. 361.—Zeolite, *Kirw.* vol. i. p. 278.—Mehl Zeolith, *Estner,* b. ii. s. 481. *Id. Emm.* b. i. s. 199.—Zeolite compatta terrea, *Nap.* p. 235.—La Zeolite farineuse, *Broch.* t. i. p. 298. Mehl Zeolith, *Reuss,* b. ii. s. 405. *Id. Mohs,* b. i. s. 370.—Erdiger Zeolith, *Haus.* s. 96. *Id. Leonhard,* Tabel. s. 16.—Mehl Zeolite, *Karsten,* Tabel. s. 30.—Mesotype altérée aspect terreux, *Haüy,* Tabl. p. 48.—Mehliger Mesotype, *Steffens,* b. i. s. 391.—Mehl Zeolith, *Hoff.* b. ii. s. 232. *Id. Lenz,* b. i. s. 451.—Mehlriger Mesotype, *Oken,* b. i. s. 352.—Mehliger Zeolith, *Haus.* b. ii. s. 568.—Pulverulent Mesotype, *Aikin,* p. 212.

External Characters.

Its colours are yellowish-white, greyish-white, and reddish-white; the latter sometimes passes to pale flesh-red, and even approaches to brick-red.

It occurs massive, reniform, coralloidal, and sometimes it forms a crust over the other subspecies of zeolite.

It is sometimes disposed in delicate fibrous concretions.

Internally it is dull, or very feebly glimmering.

The fracture is coarse earthy.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

The

The mass is very soft, but the individual parts as hard as fibrous zeolite.

It is rather sectile.

It is uncommonly easily frangible.

It does not adhere to the tongue.

It feels rough and meagre; and when we draw our finger across it, it emits a grating sound.

It is sometimes so light as nearly to swim in water.

Chemical Characters.

It intumesces before the blowpipe, and forms a jelly with acids.

Constituent Parts.

Silica, - -	60.0
Alumina, -	15.6
Lime, - -	8.0
Oxide of Iron, -	1.8
Loss, by exposure to heat,	11.6
	97

Hisinger's Afhandlingar i Fysik, &c. th. 3.

Geognostic Situation.

It occurs in similar repositories with the other subspecies.

Geographic Situation.

It is found near Tantallon Castle in East Lothian, in the islands of Sky, Mull, and Canna, also in the Faroe islands, Iceland, and Sweden.

7. Prismatoidal

7. Prismatoidal Zeolite or Stilbite *.

Prismatoidescher Schaumspath, *Mohs.*

Stilbite, *Haüy.*

THIS Species is divided into two Subspecies, viz. Foliated Zeolite, and Radiated Zeolite.

First Subspecies.

Foliated Zeolite.

Blätter-Zeolith, *Werner.*

Gemeiner Zeolith, *Wid.* p. 363.—Zeolith, *Kirw.* vol. i. p. 278.—Blättriger Zeolith, *Emm.* b. i. s. 204.—Zeolite commune, *Nap.* p. 228.—Zeolite nacrée, *Lam.* t. ii. p. 305.—Zeolite lamelleuse, *Broch.* t. i. p. 302.—Stilbite, *Haüy,* t. iii. p. 161.—Blättriger Zeolith, *Mohs,* b. i. s. 374.—Stilbite, *Brong.* t. i. p. 375.—Stilbit, *Haus.* s. 96.—Blättriger Zeolith, *Leonhard,* Tabel. s. 16.—Stilbit, *Karsten,* Tabel. s. 30.—Stilbit, *Steffens,* b. i. s. 393.—Blätterzeolith, *Hoff.* b. ii. s. 240.—Stilbit, *Lenz,* b. i. s. 465. *Id. Oken,* b. i. 353.—Blättricher Stilbite, *Haus.* b. ii. s. 573.—Stilbite, *Aikin,* p. 209.

External Characters.

Its colours are yellowish and greyish white, seldom milk, snow, and reddish white; from reddish-white it passes into flesh-red and brick-red, even into blood-red. It occurs also yellowish-grey and pinchbeck-brown.

It occurs massive, disseminated, globular, in amygdaloidal-shaped pieces; also in distinct concretions, which are large, coarse, and small angulo-granular; seldom thin and curved

* *Stilbite,* from the Greek word στίλβω, on accouns of its shining lustre.

curved lamellar *, which are again collected into granular. It is frequently crystallized. The primitive figure is a prism of 99° 22′, of which the following secondary forms occur:

1. Low, oblique, sometimes rather broad, four-sided prism.
   a. Truncated on the acute lateral edges.
   b. Also truncated on the angles of the obtuse lateral edges †. Fig. 76. Pl. 4.
   c. Truncated on all the angles ‡. Fig. 77. Pl. 4.
   When the truncating planes of the acuter lateral edges increase, there is formed a
2. Low equiangular six-sided prism, which is
   a. Perfect.
   b. Slightly truncated on all the angles.
3. Sometimes all the edges of the four-sided prism are truncated, and then an
4. Eight-sided prism is formed.

The crystals are middle-sized, small, and very small.

The lateral planes of the prisms are transversely streaked, the terminal planes are smooth.

The planes are sometimes shining, sometimes splendent, and the lustre is vitreous.

Internally it alternates from shining to splendent, and the lustre is pearly: the pinchbeck-brown has a semi-metallic lustre.

The cleavage is single, perfect, and slightly curved; in the four-sided prism is parallel with the terminal planes, and is parallel with corresponding planes in the other crystallizations.

The

* The lamellar varieties resemble straight lamellar heavy-spar.

† Stilbite anamorphique, Haüy.

‡ Stilbite octoduodecimale, Haüy.

The fracture is conchoidal.

The fragments are indeterminate angular and blunt-edged, and sometimes tabular.

The massive varieties are strongly translucent: some varieties, particularly the pinchbeck-brown, are only translucent on the edges; but the crystals are generally semi-transparent and transparent. It refracts single.

It is as hard as calcareous-spar, but seldom as hard as fluor-spar.

It is brittle.

It is easy frangible.

Specific gravity, 2.200, *Hoffmann.*—2. 2.2, *Mohs.*

Chemical Characters.

It intumesces and melts before the blowpipe, and during its intumescence emits a phosphoric light. It does not form a jelly with acids.

Constituent Parts.

Silica, -	58.3	52.6
Alumina, -	17.5	17.5
Lime, - -	6.6	9.0
Water, -	17.5	18.5
	100	97.0
	Meyer, in Beschäftigungen der Berl. Gesellschaft. Naturf-Freunde, b. ii. 1776, s. 475.	*Vauquelin*, Jour. de Mines, N. xxxix. p. 164.

Geognostic Situation.

It occurs principally in secondary amygdaloid, either in drusy cavities, along with calcareous-spar and calcedony, or in cotemporaneous veins. It is also met with in primitive

tive and transition mountains; there it occurs in metalliferous veins that traverse grey-wacke, as at Andreasberg in the Hartz, where the rectangular four-sided prism is associated with galena; in metalliferous primitive beds at Arendal in Norway, where it is accompanied with magnetic ironstone, quartz, hornblende, epidote, and augite; at Kongsberg in Norway, where it occurs in metalliferous veins that traverse mica-slate and hornblende-slate; and in primitive rocks in Dauphiny*.

Geographic Situation.

Europe.—In Scotland it occurs in drusy cavities or veins in the secondary trap-rocks that abound in the middle division of the country. Very beautiful specimens of the red foliated and radiated zeolites are found at Carbeth in Stirlingshire, and at Loch Humphrey in Dunbartonshire; and the same varieties occur on the coast between Bervie and Stonehaven in Angusshire; also in the secondary trap-rocks of the Hebrides, as of Canna, Skye, and Mull. In the north of Ireland it is an inmate of secondary trap-rocks. It abounds in the trap-rocks of the Faroe Islands, and of Iceland; but it is a rare mineral in the Scandinavian Peninsula. It is found in the trap-rocks of Hessia; in those of Bohemia, of Auvergne, &c.

America.—It occurs in the trap-rocks of Disco in West Greenland; and in those of Zimapan in Mexico.

Asia.—Count de Bournon mentions specimens of this mineral from Kergulen's Island, or the Island of Desolation, which are in his valuable collection †.

Second

* Lord Webb Seymour found this mineral in drusy cavities in the granite at Garbh choiré du, in the Island of Arran.

† Catalogue de la Collection Mineralogique du Comte de Bournon, p. 101.

Second Subspecies.

Radiated Zeolite.

Strahl Zeolith, *Werner.*

Id. Wid. p. 363. *Id. Emm.* b. i. s. 202.—Zeolite commune, *Nap.* p. 228.—Zeolite, first variety, *Lam.* t. ii. p. 305.—Zeolithe rayonnée, *Broch.* t. i. p. 301.—Stilbite, *Haüy,* t. iii. p. 161.—Strahl Zeolith, *Mohs,* b. i. s. 372.—Stilbite, *Brong.* t. i. p. 375. Stilbit, *Haus.* s. 96.—Strahliger Zeolith, *Leonhard,* Tabel. s. 16.—Stilbit, *Karsten,* Tabel. s. 30.—Zeolith, *Steffens,* b. i. s. 393.—Strahlzeolith, *Hoff.* b. ii. s. 237.—Stilbit, *Lenz,* b. i. s. 465. *Id. Oken,* b. i. s. 353.—Blättrich-strahliger Stilbit, *Haus.* Handb. b. ii. s. 575.

External Characters.

It occurs almost always yellowish-white and greyish-white, seldom snow-white and reddish-white, The yellowish-white passes into yellowish-grey, into a colour intermediate between ochre and lemon yellow, and into yellowish-brown; and the reddish-white into flesh-red, which sometimes borders on blood-red. The greyish-white sometimes nearly passes into smoke-grey.

It is found massive, in angular pieces, and globular; also in distinct concretions, which are prismatic and granular; the prismatic are broad and narrow scopiform, and stellular, and are collected into large, coarse, and small angulo-granular concretions.

It is frequently crystallized. The primitive figure is the same as that of foliated zeolite; and it exhibits the following secondary forms:

1. Broad rectangular four-sided prism, rather acutely acuminated on both extremities by four planes, which

which are set on the lateral edges, as in Fig. 75. Pl. 4. *.

2. The summits of the acuminations are sometimes more or less deeply truncated †. When very deeply truncated, the truncating plane passes into a terminal plane, and the acuminating planes form only truncations on the angles.
3. Sometimes N° 1. is so thin, that it may be considered as a long six-sided table, bevelled on the shorter terminal planes ‡.

The crystals are sometimes manipularly and scopiformly aggregated, and frequently so grown together that the acuminations only are visible, and project like pyramids.

The crystals are middle-sized, and small.

The broader lateral planes of the crystals are smooth, the smaller longitudinally streaked, and the acuminating planes are smooth, or rough.

The surfaces of the broader lateral planes of the crystals Nos. 1, 2. are splendent and pearly; the other planes are shining and vitreous: internally, the lustre is more or less shining, and is pearly.

The fragments are wedge-shaped or splintery.

The crystals are strongly translucent, sometimes passing into semi-transparent.

Hardness same as foliated zeolite.

It is brittle.

It is easily frangible.

Specific gravity, 2.132, 2.136, 2.164, *Hoffmann.*

Chemical

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* Stilbite dodecaedre of Haüy.

† Stilbite epointée of Haüy.

‡ Stilbite dodecaedre lamelliforme, Haüy.

Chemical Characters.

Same as foliated zeolite.

Constituent Parts.

Silica, - -	40.98
Alumina, - -	39.09
Lime, - - -	10.95
Water, - -	16.50
	99.52

Meyer, in Beschäftigungen der Berl. Gesellschaft Naturf-Freunde, b. ii. s. 475.

Its Geognostic and Geographic Situations are the same as those of Foliated Zeolite.

Observations.

1. Crystallization, lustre, fracture, degree of transparency, and distinct concretions, are the characteristic marks of this mineral.

2. It is distinguished from *Needle Zeolite*, by its crystallizations, pearly lustre, broad prismatic concretions.

3. It is distinguished from *Foliated Zeolite* by its crystallizations, and broad prismatic concretions.

8. Axifrangible Zeolite or Apophyllite.

Fishaugenstein, *Werner.*

Apophyllite, *Haüy.*

Ichthyophthalm, *Karsten.*

Zeolith von Hallesta, *Rieman,* Vetensk. Acad. Handl. 1784.—Zeolithus lamellaris, *Retzius,* Spec. Acad. de Zeolithis Suecicis,

cicis, auct. Müller, Lundæ, 1791, 4to, N. 12.—Apophyllite, *Lucas*, p. 266. *Id. Brard*, p. 137. *Id. Haüy*, Tabl. p. 36. *Id. Hausmann*, in Weber's Beiträge, b. ii. s. 59. *Id. Steffens*, b. i. s. 479.—Ichthyophthalm, *Hoff.* b. ii. s. 357. *Id. Lenz*, b. i. s. 528.—Kalkzeolith, *Oken*, b. i. s. 354. *Id. Haus.* b. ii. s. 581. —Ichthyophthalmite, *Aikin*, p. 213.

External Characters.

Its principal colour is greyish-white, which passes into greenish-white, seldom into yellowish or reddish white. The ends of the crystals are sometimes asparagus-green; and the same colour is to be observed in patches or spots throughout the crystals. The surface of the cleavage is strongly iridescent.

It occurs massive, and disseminated; the massive varieties are composed of straight and curved lamellar distinct concretions, with feebly streaked splendent pearly surfaces. It is frequently crystallized. The primitive figure is a pyramid, the angles of which are still undetermined. The following are the secondary forms:

1. Rectangular four-sided prism, which is sometimes so low as to appear tabular, and resemble a cube.
2. The preceding figure truncated on all the angles: when the truncating planes become so large that they touch each other, the prism appears acuminated with four planes, which are set on the lateral edges, and the apex of the acumination truncated *.
3. The rectangular four-sided prism, in which all the lateral edges are truncated, thus forming an eight-sided prism; sometimes the eight solid angles of this figure are truncated.

* Mesotype épointée, Hauy.

4. The rectangular four-sided prism bevelled on all the edges, or only on some of them : sometimes one of the bevelling planes is awanting, when the edge appears to be only obliquely truncated.
5. Slightly oblique four-sided prism. It is formed when the truncating planes of No. 3. become so large that the original planes disappear.
6. Rectangular four-sided prism, in which the angles are truncated, and the edges bevelled.
7. Rectangular four-sided table, in which the two opposite broader terminal planes are doubly bevelled, and the two smaller planes very flatly acuminated with four planes, of which two are set on the lateral planes, and the other two on the terminal planes, and the terminal edges bevelled.

The crystals are very small, small, middle-sized, and very rarely large.

The surface of the crystals Nos. 1, 2. and 4. is smooth; the surface of Nos. 3. and 5. and the acuminating planes of No. 7. are longitudinally furrowed ; the bevelling planes of Nos. 4. 6. and 7. are transversely streaked. All the other planes of the secondary crystals are smooth.

The middle point of the end of the crystals is often concave. The lateral planes occasionally bulging, and the terminal planes rose-like.

Externally it is splendent; but only the terminal planes of the prism are pearly.

It has a threefold cleavage: two of the cleavages are parallel with the lateral planes, and one with the terminal planes of a four-sided prism. Traces of other indistinct cleavages are visible: the most distinct cleavage is that parallel with the terminal planes, and which is splendent and pearly.

The

The fracture is small and perfect conchoidal, and the lustre is glistening and vitreous.

The fragments are tabular, and rather blunt-edged.

It is semitransparent, passing into transparent, and into translucent. It refracts single.

It is harder than fluor-spar, and sometimes as hard as apatite. When rubbed against a hard body, it splits like selenite into folia.

It is brittle, and very easily frangible.

Specific gravity, 2.417, *Riemann.*—2.467, *Haüy.*—2.430, *Rose.*—2.491, *Karsten.*—2.3, 2.5, *Mohs.*

Chemical Characters.

It exfoliates very readily before the blowpipe, (it even exfoliates when held in the flame of a candle), and melts easily into a white-coloured enamel. It phosphoresces during fusion. When thrown into acids, it exfoliates, and the folia speedily divide into smaller flocculi. When pulverized, and thrown into acids, it gelatinates in the same manner as fibrous zeolite.

Physical Characters.

It becomes feebly electric by rubbing.

Constituent Parts.

	Apophyllite of Hällestad.	Apophyllite of Utön.	
Silica,	55.0	50.0	52.00
Alumina,	2.3		
Magnesia,	0.5		
Lime,	24.7	28.6	24.50
Potash,	0.0	4.0	8.10
Water,	17.0	17.0	15.00
	99.5	99.0	99.60
	Riemann.	*Vauquelin.*	*Rose.*

 Rose

Rose found the water of the apophyllite to contain a small portion of ammonia; so that the volatile alkali appears, like potash and soda, to form a constituent part of some earthy minerals.

Geognostic and Geographic Situations.

It occurs in the secondary trap-rocks of the island of Sky: in rocks of the same description in the Faroe islands; in the island of Disco in West Greenland, and on the mainland of Greenland. One of the earliest known localities of this mineral is the Island of Utön, not far from Stockholm, where it occurs in beds of magnetic-ironstone, along with common felspar, calcareous-spar, and hornblende. It is found also in the great copper-mine of Fahlun; in the mine of Langsoe, at Arendal in Norway; and in ironstone beds at Hällestad in East Gothland; and it has been found in the Tyrol, and at Ausee in Bohemia.

Observations.

1. It is distinguished from Foliated Zeolite by its more perfect pearly lustre, distinct transverse cleavage, iridescence of its cleavage, concavity of the middle of the crystals, and greater hardness.

2. The mineral lately described by Werner, under the name *Albin*, is a variety of this species.

3. The Portuguese mineralogist D'Andrada, several years ago, described a mineral under the name Ichthyophthalme, which appears to be curved foliated pearly felspar. It is therefore a very different mineral from the present species. The name *Ichthyophthalm*, given to this species by Werner, is derived from the Greek words ιχθυς *fish*, and οφθαλμος *eye*, and was given to it on account of the resemblance of its pearly lustre to that of the eye of a fish.

fish. Haüy names it *Apophyllite*, from its great tendency to exfoliate.

* Wavellite (a).

Hydrargyllite, *Davy*, Nicholson's Journ. xi. p. 153.—*Gregor*, *Id.* xiii. p. 247.—Wavelit, *Karsten & Klaproth*, in Magazin der Gesellschaft Naturf. Freünde zu Berlin, b. ii. s. 2. *Id. Karsten*, Tabel. s. 48. *Id. Kid*, vol. i. p. 136. *Id. Haus.* s. 85. —Wavellite, *Lucas*, t. ii. p. 240. *Id. Brong.* t. i. p. 434. *Id. Aikin*, p. 237. *Id. Hoff.* b. iv. s. 148.

External Characters.

Its colours are greyish-white, greenish-white, ash-grey, asparagus-green, and sometimes is spotted-brown.

It occurs botryoidal, globular, stalactitic; and these forms are composed of fibrous or fine prismatic distinct concretions, which are scopiform or stellular; sometimes these prismatic concretions are collected into granular, and both are occasionally traversed by lamellar concretions.

It occurs crystallized, in the following figures:

1. Very oblique four-sided prism, flatly bevelled on the extremities, the bevelling planes set on the obtuse lateral edges.
2. The preceding figure, very deeply truncated on the obtuse lateral edges.

Externally it is shining: internally shining, passing into splendent; and the lustre is pearly.

The fragments are wedge-shaped.

It is translucent.

It is as hard as fluor-spar.

It

(a) I have not ventured to include Wavellite in the genus Zeolite as it is now constructed, but place it apart, and immediately following it, on account of its affinity with the species of the genus.

It is brittle.

Specific gravity, 2.270, *Lucas.*—2.22, 2.253, *Gregor.*—2.25, 2.4, *Aitken.*—2.7, *Davy.*—2.80, *Breithaupt.* The specific gravities of Davy and Breithaupt appear to be too high.

Chemical Characters.

It becomes opaque and soft by the action of the blowpipe, but neither decrepitates nor fuses. By the aid of heat it is soluble in the mineral acids and fixed alkalies, with effervescence, and leaves very little residue.

Constituent Parts.

	Barnstaple Wavellite.		Cornish Wavellite.	Hualgayoc Wavellite.
Alumina,	71.50	70.0	68.76	68.00
Oxide of Iron,	0.50		0.19	1.00
Lime, - -		1.4	0.37	
Silica, -			6.12	4.50
Water, -	28.0	26.2	30.75	26.50
Loss, - - - - - -			3.87	
	100	97.6	100	100
	Klap. Beit. b. iv. s. 110.	*Davy*, Nichol. Journ. xii. 157.	*Gregor.*	*Klap.* Beit. b. v. s. 111.

It is said also to contain a small portion of Fluoric Acid.

Geognostic and Geographic Situations.

This mineral occurs in veins, along with fluor-spar, quartz, tinstone, and copper-pyrites, in granite, at St Austle in Cornwall. At Barnstaple in Devonshire, where it was first found by Dr Wavell, it traverses slate-clay in the form of small cotemporaneous veins *. The Secretary of the Wernerian Society, Mr Neill, found it in a similar situation

* I satisfied myself of the true nature of these veins, by the examination of a beautiful and interesting collection of this mineral, which I owe to the politeness of Dr Wavell.

tion in Corrivelan, one of the Shiant Isles, in the Hebrides. Dr Fitton informs us, that it has been found at Spring Hill, about ten miles south-eastward from the city of Cork; and Captain Laskey collected specimens of it from rocks of slate-clay near Loch Humphry in Dunbartonshire. It occurs, along with chabasite, at Fassa in the Tyrol; also in Bohemia, and at Amberg in Bavaria; Sir C. Giesecké met with it in Greenland. Humboldt brought specimens of it from the mines of Hualgayoc in South America, where it is associated with grey copper-ore; and Mr Mawe found it in Brazil.

Observations.

This beautiful mineral was found many years ago by Dr Wavell in a quarry near Barnstaple in Devonshire. Dr Babington examined it, and from its characters concluded that it was a particular species, to which he gave the name *Wavellite*, from the discoverer.

Genus IV. AZURE-SPAR.

Lazur Spath, *Mohs.*

This genus contains four species, viz. Prismatic Azure-Spar, Prismatoidal Azure-Spar, Azurestone, and Calaite.

1. Prismatic Azure-Spar.

Prismatischer Lazur Spath, *Mohs.*

This species contains two subspecies, viz. Azurite and Haüyne.

First

First Subspecies.

Azurite.

Lazulit, *Werner.*

Le Lazulithe, *Broch.* t. i. p. 315. *Id. Haüy,* t. iii. p. 145—Unachter Lazurstein, *Reuss,* b. ii. s. 440.—Lazulit, *Lud.* b. i. s. 86. *Id. Suck.* 1r th. s. 319. *Id. Bert.* b. i. s. 263. *Id. Mohs,* b. i. s. 185. *Id. Lucas,* 277.—Lazulite de Klaproth, *Brong.* t. i. p. 369.—Gemeiner Lazulit, *Karst.* Tabel. s. 46.—Siderite, *Bernhardi,* Jour. fur Chem. p. 204.—Lazulit de Verner, *Haüy,* Tabl. p. 62.—Lazulith, *Steffens,* b. i. s. 418. *Id. Hoff.* b. ii. s. 285.—Gemeiner Lazulit, *Lenz,* b. i. s. 481. *Id. Oken,* b. i. s. 336.—Korniger Lazulith, *Haus.* Hand. b. ii, s. 372.

External Characters.

The most frequent colour of this mineral is indigo-blue, which sometimes inclines to sky-blue, sometimes to smalt-blue.

It occurs in small massive portions, disseminated, and crystallized in very oblique four-sided prisms, which are rather flatly acuminated on the extremities, with four planes, which are set on the lateral edges.

The cleavage is very perfect, and in the direction of the lateral planes of the prism. Its lustre is shining and vitreous.

The fracture is glistening, and the lustre vitreous.

The fracture is small, and fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque, or very feebly translucent on the edges.

It is harder than apatite, but not so hard as felspar.

It

It is easily frangible.

Specific gravity unknown.

Chemical Characters.

It is infusible without addition before the blowpipe; but with borax, it forms a clear pale wine-yellow vitreous bead.

Constituent Parts.

Alumina, - -	66	
Silica, - -	10	
Magnesia, -	18	
Lime, - -	2	
Oxide of Iron, -	2½	
	98½	*Tromsdorf.*

Geognostic Situation.

It occurs imbedded in small portions in quartz; also in fissures in clay-slate, along with sparry-ironstone, heavy-spar, and quartz.

Geographic Situation.

It occurs principally in the district of Vorau in Stiria; also in the neighbourhood of Wienerisch-Neustadt in Austria, and near Schwatz in the Tyrol. In all these places it is imbedded in quartz. It occurs in clay-slate in the Pinzgau, and near Werfen in Salzburg.

Observations.

1. The cleavage distinguishes it from *Azurestone.*

2. It is named *Azurite,* from its resemblance to azurestone in general appearance.

Second

Second Subspecies.

Haüyne.

Haüyn, *Karsten.*

Latialite, *Gismondi & Haüy,* Tabl. p. 62.—Saphirin, *Nose,* in Mineral Studien, p. 162.—Häuyn, *Steffens,* b. i. s. 416. *Id. Lenz,* b. i. s. 479. *Id. Oken,* b. i. s. 355. *Id. Haus.* b. ii. s. 545. *Id. Hoff.* b. iv. s. 204.

External Characters.

Its colours are pale indigo and Berlin blue, smalt-blue, sky-blue, and bluish-grey.

It occurs in imbedded grains; and rarely crystallized.

1. In acute oblique double four-sided pyramids, in which the lateral planes of the one are set on the lateral planes of the other.
2. Preceding figure truncated on the apices.
3. Preceding figure, in which the acute angles of the common basis are truncated. When the eight planes of the pyramid, the two truncating planes of its apices, and those of the acute angles on the basis, become nearly of equal magnitude, the figure has somewhat the appearance of a rhomboidal dodecahedron, although it belongs to the prismatic, not to the tessular system of crystallization.

The crystals are small, and very small, imbedded, or in very small druses.

Externally it is generally smooth, and sometimes rent, and edges rounded.

Externally and internally it alternates from splendent to glistening, and the lustre is vitreous.

It

It has quintuple cleavage: Of these the most distinct is that parallel with the truncating planes of the apices of the pyramids; the other four cleavages are parallel with the planes of the pyramid.

The fracture is imperfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is transparent and translucent.

It is harder than apatite, but softer than felspar.

It is brittle.

It is very easily frangible.

Specific gravity, 2.687, *Gmelin.*—3.100? *Neergaard.*

Chemical Characters.

It melts with difficulty before the blowpipe, into a white nearly opaque vesicular bead. With borax it melts into a transparent wine-yellow glass. With acids it forms a translucent jelly.

Constituent Parts.

Silica, - -	30.0	35.48
Alumina, -	15.0	18.87
Lime, - -	13.5	11.79
Sulphuric Acid, -	12.0	12.60
Potash, - -	11.0	15.45
Iron, - -	1.0	1.16
Trace of Sulphureted Hydrogen, and loss, -		3.45
Loss, - -	17.5	
	100	
	Vauquelin in Haüy's Tabl. Comp.	*Gmelin*, in Annals of of Philos. iv. 198.

Geognostic

Geognostic and Geographic Situations.

It occurs imbedded in the basalt rocks of Albano and Frascati, along with mica, augite, leucite, and vesuvian; also in the basalt of Andernach.

Observations.

1. It was first discovered by the Abbé Gismondi, who named it *Latialite*, from Latium, the ancient name of the country where it occurs: the German mineralogist Nose, who observed it in the trap-rocks of Andernach, considered it as allied to Sapphire, and has described it under the name *Saphirin:* Ferber names it *Blue-schorl* of Andernach: Cordier arranged it with Spinel: Bruun Neergaard, who has given the fullest account of it, has placed it in the system under the name *Haüyne;* and Steffens, in his System of Mineralogy, places it between Azurestone and Azurite.

2. It is very nearly allied to Azurestone, and probably they may prove to be but varieties of the same species.

2. Prismatoidal Azure-Spar, or Blue Spar.

Prismatoidischer Lazur Spath, *Mohs.*

Blauspath, *Werner.*

Id. Wid. Bergm. Journ. 1791, p. 345.—Felsite, *Kirw.* vol. i. p. 326.—Dichter Feldspath, *Emm.* b. i. s. 271.—Le Feldspath compacte, *Broch.* t. i. p. 367.—Feld-spath bleu? *Haüy*, t. ii. p. 605.—Dichter Feldspath, *Reuss,* b. ii. s. 46. *Id. Lud* b. i. s. 100.

s. 100. *Id. Suck.* 1r th. s. 420. *Id. Bert.* s. 238. *Id. Mohs,* b. i. s. 420. *Id. Leonhard,* Tabel. s. 19.—Feldspath Bleu, *Brong.* t. i. p. 360.—Spliteriger Lazulit, *Karsten,* Tabel. s. 46. —Blue Feldspar, *Kid,* vol. i. p. 160.—Feldspath Bleu, *Haüy,* Tabl. p. 60.—Blauspath, *Steffens,* b. i. s. 420. *Id. Hoff.* b. ii. s. 287. *Id. Lenz,* b. i. s. 479. *Id. Oken,* b. i. s. 337.—Splittriger Hartstein, *Haus.* Handb. b. ii. s. 373.—Blue Feldspar, *Aikin,* p. 188.

External Characters.

Its colour is pale smalt-blue, which sometimes passes into sky-blue, and occasionally into milk-white.

It occurs massive and disseminated.

Internally it is glistening, approaching to shining.

It displays one distinct cleavage, and another less distinct forms a right angle with it, or, according to some observers, an obtuse angle.

The fracture is splintery.

It is translucent in a low degree.

It is harder than apatite, and sometimes as hard as felspar.

It is rather difficultly frangible.

It yields a greyish-white coloured streak.

Specific gravity, 3.046, *Klaproth.*—3.060, *Karsten.*—3.0, 3.1, *Mohs.*

Chemical Characters.

Before the blowpipe it becomes white and opaque; and affords a black-coloured glass with borax.

Constituent

Constituent Parts.

Silica, - -	14.00
Alumina, - -	71.00
Magnesia, - -	5.00
Lime, - -	3.00
Potash, - -	0.25
Oxide of Iron, -	0.75
Water, - -	5.00
	99.00

Klaproth, Beit. b. iv. s. 285.

Geognostic and Geographic Situations.

It occurs along with quartz, mica, and garnets, and probably either in the form of a bed or a mountain-mass. It is found in the valley of Murz, near Krieglach, in Stiria.

Observations.

1. This species is not very extensive, and, as far as we know at present, does not appear to be of great importance. Its essential characters are its blue colour, low degree of lustre, imperfect cleavage, inconsiderable translucency, greyish-white coloured streak, hardness, and specific gravity.

2. It is allied on the one hand to Azurite, and on the other to Compact Felspar, with which it was long confounded. It is distinguished from *Azurite* by its paler colour, inferior lustre, less perfect cleavage, splintery fracture, its chemical relations, and composition: It is distinguished from *Compact Felspar* by its blue colour, higher lustre, more distinct cleavage, slightly inferior hardness, but greater weight, and also by its chemical characters and composition.

3. Azurestone

3. Azurestone or Lapis Lazuli.

Lausurstein, *Werner*.

Sapphirus, *Plin.* Hist. Nat. xxxvii. 9. & 39.; Cyanos, *Plin.*—Κυανος, *Theophr.?*—Zeolithes particulis, &c. Lapis lazzuli, *Wall.* t. ii. p. 326.—Lapis lazzuli, *Romé de Lisle*, t. ii. p. 49.—Lazurstein, *Wid.* s. 371.—Lapis lazuli, *Kirw.* vol. i. p. 283.—Lapis lazzoli, *Nap.* p. 241.—Lazulite, *Lam.* t. ii. p. 185.—La pierre d'azur, *Broch.* t. i. p. 313.—Lazulite, *Haüy*, t. iii. p. 145.—Lazurstein, *Reuss*, b. ii. s. 436. *Id. Lud.* b. i. s. 91. *Id. Suck.* 1r th. s. 423. *Id. Bert.* s. 169. *Id. Mohs*, b. i. s. 387. *Id. Hab.* s. 25.—Lazulite, *Lucas*, p. 66.—Lazurstein, *Leonhard*, Tabel. s. 16.—Lazulite, *Brong.* t. i. p. 367. *Id. Brard*, p. 164.—Lasurstein, *Haus.* s. 94 *Id. Karst.* Tabel. s. 44.—Lapis lazuli, *Kid*, vol. i. p. 244.—Lazulite, *Haüy*, Tabl. p. 47. Lasurstein, *Steffens*, b. i. s. 414. *Id. Hoff.* b. ii. s. 276. *Id. Lenz*, b. i. s. 475. *Id. Oken*, b. i. s. 355. *Id. Haus.* Handb. b. ii. s. 543.—Lapis Lazuli, *Aikin*, p. 214.

External Characters.

Its colour is azure-blue, of all degrees of intensity: the lighter varieties pass into Berlin-blue and smalt-blue; and the darker into blackish-blue. The white spots it sometimes contains, are probably owing to an intermixed mineral.

It is found massive, disseminated, and in rolled pieces.

Internally it is either glistening or glimmering.

The fracture is small and fine-grained uneven.

The fragments are indeterminate angular, and rather blunt-edged.

It

It is feebly translucent on the edges.

It scratches glass, and in some places gives a few sparks with steel.

It is easily frangible.

Specific gravity, 2.771, *Blumenbach.*—2.767 to 2.945, *Haüy.*—2.896, *Kirwan.*—2.761, *Brisson.*—2.959, *Karsten.*

Chemical Characters.

It retains its colour in a low degree of heat: in a higher heat, it melts into a blackish mass; and in a very high heat it melts into a white enamel. When pounded and calcined, it forms a jelly with acids.

It is deprived of its colour by all the mineral acids: with great rapidity by nitrous acid; less rapidity by muriatic acid; and most slowly by means of sulphuric acid.

Constituent Parts.

Silica, - -	46.00
Alumina, - -	14.50
Carbonate of Lime, -	28.00
Sulphate of Lime, -	6.50
Oxide of Iron, - -	3.00
Water, - -	2.00
	100

Klaproth, b. i. s. 196 *.

Geognostic

* The older chemists were of opinion, that the beautiful colour of this mineral was owing to copper; but it is now known that iron is the only colouring principle it contains.

Geognostic Situation.

Its geognostic situation is still imperfectly known. It appears sometimes to occur in primitive limestone, along with iron-pyrites, in Persia, Tartary and China; in veins that traverse granite, along with quartz, mica, and iron-pyrites in the Altain mountains; and at the southern end of the Lake Baikal in Siberia, in a vein, associated with garnets, mica, felspar, and iron-pyrites.

Geographic Situation.

It is found in Persia, Bucharia, China, Great Tartary, and Siberia. Mr Pennant, in his Outlines of the Globe, informs us, that it is found in considerable quantities in the Island of Hainan in the Chinese sea, from whence it is sent to Canton, where it is employed in china painting.

Uses.

On account of its beautiful blue colour, and the fine polish it is capable of receiving, it is much prized by lapidaries, and is cut as ring-stones, seal-stones, vases, snuff-boxes, and other ornamental articles of the same nature: it is also used in mosaic and Florentine work. It is highly valued by painters, on account of the fine ultramarine blue colour obtained from it.

The whole art in preparing this colour, consists in freeing the azurestone from all impurities, and reducing it to an extremely fine powder. This is done in the following manner: The azurestone is first reduced to a coarse powder, and then exposed for an hour in a crucible to a pretty strong heat. Vinegar is then poured on it, and the whole is allowed to stand for some days: at the end of this time, the vinegar is poured off, and the powder is still further comminuted, by rubbing in a glass mortar. The roasting or calcination of the azurestone must be repeated one or more times, if the first heating has not rendered it so friable as to allow of its being reduced to a sufficiently fine powder. The powder is now to be repeatedly washed with water, in order to free it from the vinegar with which it is combined, and then to be ground on a stone of porphyry or agate, until it is rendered completely impalpable. It is next to be thrown into a melted mixture of pitch, wax, and linseed oil, and carefully mixed with it, and then allowed to cool. Tepid water is next to be poured on this mixture, and the whole is to be well triturated by means of a pestle: the water becomes muddy, and is to be poured off; fresh water is to be added which very soon assumes a beautiful blue colour. When this water is sufficiently saturated, it is poured off, fresh water is added to the mixture, and soon assumes a blue colour, but of a paler tint than the former, and this process is repeated, until the water becomes only of a dirty grey colour. A powder is deposited from each of these ablutions, and the beauty of its colour depends on the purity of the azurestone and the ablution itself, the first always affording the finest and richest colour. The foreign parts remain combined with the cement. It was formerly an article of the materia medica, and was therefore kept in apothecaries' shops; but very often its place was supplied by azure copper-ore, mixed with limestone, which was named *Armenian Stone*.

Observations.

1. This mineral is distinguished by its colour, low degree of lustre, fracture, its low degree of translucency on the

the edges, its hardness, and geognostic situation. It has been confounded with Azure Copper-Ore; but it differs from that mineral in lustre, fracture, hardness, and geognostic situation.

2. Azurestone was well known to the Greeks and Romans, under the name of *Sapphire:* when it contained much disseminated iron-pyrites, it was then called *Sapphirus regius*, because the pyrites was supposed to be gold.

3. It is generally known under the name *Lapis lazuli:* Lazulus is derived from the Arabian word *azul*, the heaven, and refers to the fine blue colour of this mineral. The name *Ultramarine*, given to the fine pigment obtained from azurestone, is said to have been bestowed on it on account of its having been brought into Europe from beyond the sea.

4. Calaite, or Mineral Turquois.

Calaite, seu Borea, *Plin.* Hist. Nat. lib. xxxvii. cap. 8. *Id. Fischer,* Mem. de la Soc. Imper. des Naturalistes de Moscow, vol. i. p. 149.—Turcosa, *Fischer,* Onomast. (1811), p. 53.—Turkis, *Ullmann,* Mineral. einf. Fossilien, p. 76. n. 103.—Dichter Hydrargilite, *Haus.* Handb. b. ii. s. 444.—Calaite, *Fischer,* Essai sur la Turquoise, et sur la Calaite, 1816, Moscow.

External Characters.

Its colours are smalt-blue, sky-blue, apple-green, and pistachio-green; in specimens which have been exposed to the weather, the colours are celandine-green, siskin-green, and greenish-yellow.

It occurs massive, disseminated, reniform, and botryoidal.

Internally

Internally it is dull, or feebly glistening and resinous.

Its fracture is imperfect conchoidal, or coarse-grained uneven.

The fragments are indeterminate angular, and sharp-edged.

It is opaque, and very rarely feebly translucent on the edges.

It is harder than felspar, but softer than quartz.

Its streak is white.

Specific gravity 2.860, 3.0, *Fischer*.

Constituent Parts.

Alumina, - -	73.
Oxide of Copper, -	4.50
Water, - -	18.
Oxide of Iron, -	4.
Loss, - -	0,50
	100

John, in Fischer's Essai sur la Turquoise, p. 27.

Geognostic Situation.

It occurs in veins in clay ironstone, and also in small pieces in alluvial clay.

Geographic Situation.

It has hitherto been found only in the neighbourhood of Nichabour in the Khorasan in Persia.

Uses.

Uses.

It is very highly prized as an ornamental stone in Persia and the neighbouring countries. Although it is opaque, comparatively soft, and does not admit of a high polish, yet its agreeable colours and rarity have procured for it, even in Europe, a considerable rank among the gems. In Europe, it is cut in flat *cabochon*, and is used for ring-stones and ear-drops; it is sometimes surrounded with diamonds, and is generally set in gold. In Persia and Turkey, it is used for head-dresses, bracelets, and ring-stones, with or without diamonds; and is also much employed in ornamenting the handles of sabres and stilettoes. In Persia, it is a favourite material for talismans. It is sometimes imitated in paste; but these artificial turquoises are readily distinguished from the true, by their higher lustre, and greater brittleness.

Observations.

At first sight this mineral might be confounded with Malachite; but a very simple character distinguishes them,—malachite yields a green streak, whereas that of calaite is white.

END OF VOLUME FIRST.

Jameson, Robert
A system of mineralogy

SYSTEM

OF

MINERALOGY.

A

SYSTEM

OF

MINERALOGY,

IN WHICH

MINERALS ARE ARRANGED ACCORDING TO THE NATURAL HISTORY METHOD.

BY

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† Owing to some mistake, in page 321. the generic name Malachite is introduced, and the name of the Species, viz. Common or Acicular Malachite omitted.

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MINERAL

MINERAL SYSTEM.

CLASS I.

EARTHY MINERALS.

(CONTINUED.)

ORDER II. SPAR.—(*CONTINUED.*)

GENUS V.—FELSPAR.

THIS Genus contains four Species, viz. Prismatic Felspar, Pyramidal Felspar, Prismato-Pyramidal Felspar, and Rhomboidal Felspar.—* *Chiastolite*, ** *Sodalite*.

1. Prismatic Felspar.

Prismatischer Feldspath, *Mohs*.

THIS Species is divided into nine Subspecies, viz. 1. Adularia, 2. Glassy-Felspar, 3. Ice-Spar, 4. Common Felspar, 5. Labrador Felspar, 6. Compact Felspar, 7. Clinkstone, 8. Earthy Common Felspar; and, 9. Porcelain Earth.

First Subspecies.

Adularia.

Adular, *Werner.*

Moonstone, *Kirw.* vol. i. p. 322.—Adular, *Estner,* b. ii. s. 525. *Id. Emm.* b. i. s. 277.—Adularia, *Nap.* p. 218.—Adulaire, *La Meth.* t. ii. p. 194. *Id. Broch.* t. i. p. 371.—Feldspath nacré, *Haüy,* t. ii. p. 600.—Adular, *Reuss,* b. ii. s. 379. *Id. Lud.* b. i. s. 101.—Opalisirender Feldstein, *Bert.* s. 242.—Adular, *Suck.* 1r th. s. 389. *Id. Mohs,* b. i. s. 394.—Adularischer Feldspath, *Hab.* s. 21.—Feldspath nacré, *Lucas,* p. 50.—Opalisirender Feldspath, *Leonhard,* Tabel. s. 17.—Feldspath Adulaire, *Brong.* t. i. p. 358.—Feldspath limpide, *Brard,* p. 134. Opalisirender Feldspath, *Karsten,* Tabel. s. 34.—Adularia, *Kid,* vol. i. p. 158.—Feldspath nacré, Tabl. p. 36.—Adular, *Steffens,* b. i. s. 422. *Id. Hoff.* b. i. s. 296. *Id. Lenz,* b. i. s. 486.—Opalisirender Feldspath, *Oken,* b. i. s. 375.—Adular, *Haus.* Handb. b. ii. s. 532. *Id. Aikin,* p. 196.

External Characters.

The principal colour is greenish-white, which sometimes passes into greyish-white and milk-white, and even inclines to asparagus-green. It is frequently iridescent; and the milk-white varieties, in thin plates, when held between the eye and the light, sometimes appear pale flesh-red.

It occurs massive, and this variety is composed of granular and thick lamellar concretions; and frequently crystallized.

The primitive figure is an oblique four-sided prism, with two broad and two narrow lateral planes: the lateral edges are 120° and 60° *. The following are the most frequent secondary figures:

1. Oblique

* It is not necessary to repeat the description of the primitive form in the accounts of the other subspecies of a species, as it is understood throughout the whole work that it must be the same in all the members of the same species.

1. Oblique four-sided prism, flatly bevelled on the extremities, and the bevelling planes set on the obtuse lateral edges.

Sometimes two diagonally opposite bevelling planes become smaller than the others, and at length disappear, when there is formed

2. An oblique four-sided prism, in which the terminal planes are set on obliquely.

3. The figure N° 1. is sometimes truncated on the acute lateral edges. When these truncating planes become larger, there is at length formed

4. A broad rectangular six-sided prism, flatly bevelled on both extremities, and the bevelling planes are set on the lateral edges, which are formed by the smaller lateral planes.

Sometimes the prism becomes so broad and thin, that it may be described as a

5. Six-sided table, in which the smaller lateral planes of the preceding figure form bevelments on the terminal planes.

6. Rectangular four-sided prism, in which the terminal planes are obliquely bevelled.

Sometimes twin-crystals occur: one variety is the same as that afterwards to be described as occurring in common felspar; the other is formed by two tabular crystals of the variety 5. growing together by their broader lateral planes.

The crystals are generally middle-sized and large, sometimes very large, but seldom small. They are always superimposed, and either single or variously aggregated.

The lateral planes of the prism are longitudinally streaked.

Externally it is splendent; internally the cleavage is splendent, and the fracture shining and glistening. The lustre is intermediate between vitreous and pearly.

The cleavage is threefold: two very distinct cleavages are in the direction of the terminal and smaller lateral planes of the primitive figure; and one less distinct in the direction of the broader lateral planes.

The fracture is small and imperfect conchoidal, sometimes approaching to uneven.

The fragments are indeterminate angular and sharp-edged.

It is semi-transparent, sometimes inclining to transparent, or is translucent.

The translucent varieties, when viewed in a certain direction, sometimes exhibit a silvery or pearly light *. It refracts double.

It is harder than apatite, but softer than quartz.

It is easily frangible.

Specific gravity, 2.564, *Brisson.*—2.531 & 2.560, *Hoffmann.*—2.5, *Mohs.*

Chemical Characters.

It melts before the blowpipe, without addition, into a white-coloured transparent glass.

Constituent Parts.

Silica,	64
Alumina,	20
Lime,	2
Potash,	14
	100 *Vauquelin.*

Geognostic

* This beautiful pearly light is generally seen when the specimen is viewed in the direction of the imperfect or third cleavage.

Geognostic Situation.

It occurs in cotemporaneous veins or drusy cavities in granite and gneiss: in these repositories it is associated with rock-crystal, calcareous-spar, epidote, amianthus, but principally with chlorite and common felspar.

Geographic Situation.

Europe.—It occurs in the granite of the Island of Arran; and in the granite and gneiss rocks of Norway, Switzerland, France, and Germany. The largest and most beautiful crystals are found in the mountain of Stella, a part of St Gothard.

Asia.—Rolled pieces, having a most beautiful pearly light, are collected in the Island of Ceylon.

America.—Moonstone-adularia is found in Greenland; and all the varieties in the United States.

Uses.

The variety of adularia which exhibits the bluish pearly light, is valued by jewellers, and is sold by them under the name *Moonstone.* It is cut in a low oval form, and in such a manner as to present the pearly spot in the centre of the gem. It is set in rings or brooches, with rubies and emeralds, with which it forms an agreeable contrast. Sometimes ringstones of it are set round with diamonds, and its pearly light forms a striking and agreeable contrast with the lustre and colours of that gem. The finest specimens are brought from Ceylon; but even there, perfect stones are rare.

Another variety of adularia, found in Siberia, is known to jewellers under the name *Sunstone.* It is of a yellowish-grey colour, and numberless golden spots appear distributed throughout its whole substance. These shining gol-
den.

den reflections are either from minute fissures, or irregular cleavages of the mineral. The aventurine felspar of Archangel, to be afterwards mentioned, appears also to be sunstone.

Observations.

1. This mineral is known by its white colour, iridescence, pearly light, splendent external and internal lustre, conchoidal fracture, high degree of transparency, specific gravity, and considerable hardness.

2. It was first discovered by an Italian mineralogist, Professor Pini of Milan, in the mountain of Stella, belonging to the St Gothard group. He named it *Adularia Felspar*, in the belief that the mountain on which he had collected it was named *Adula;* but the truth is, the mountain of Adula does not occur near St Gothard; it is situated in the Grisons.

3. The moonstone appears to be the Hyaloides (Ὑαλοειδὴς) of Theophrastus, and the Astrios of Pliny. The Asteria of Pliny is not, as some imagine, a variety of adularia; it appears rather to belong to the Cat's-eye and Asteria-sapphire.

Second Subspecies.

Glassy Felspar.

Glasiger Feldspath, *Werner.*

Nose, Orthographische Briefe, 1. s. 128.—Nöggerath Studien. s. 27.—*Reuss,* Mineralogishe Briefe, 1. n. 2. a. a. o.—Glasiger Feldspath, *Karst.* Tabel. s. 34. *Id. Haus.* s. 88. *Id. Steffens,* b. i. s. 441. *Id. Hoff.* b. ii. s. 328. *Id. Lenz,* b. ii. s. 502. *Id. Oken,* b. i. s. 375. *Id. Haus.* Handb. b. ii. s. 532. —Glassy Felspar, *Aikin,* p. 197.

External

External Characters.

Its colour is greyish-white, sometimes passing into grey.

It occurs always crystallized, in broad rectangular four-sided prisms, bevelled on the extremities. These crystals are often very much cracked; they are generally small, seldom middle-sized, and always imbedded.

Internally it is splendent, and the lustre is vitreous.

The cleavage is the same as in adularia.

The fracture is uneven, or small and imperfect conchoidal.

It is transparent.

In all its other characters it agrees with adularia.

Specific gravity, 2.575, *Klap.*—2.518, 2.589, *Stucke.*

Chemical Characters.

Before the blowpipe, it melts without addition into a grey semi-transparent glass.

Constituent Parts.

Silica, - -	68.0
Alumina, -	15.0
Potash, - -	14.5
Oxide of Iron, -	0.5
	98.0

Klaproth, Beit. b. v. s. 18.

Geognostic and Geographic Situations.

It occurs imbedded in pitchstone-porphyry in Arran and Rume; in a porphyritic rock in the Siebengebirge; also in a rock composed of white felspar, and very small blackish-brown,

brown scales of mica, and fine disseminated magnetic iron-stone, in the Drachenfels on the Rhine. It is an inmate of the secondary trap-rocks of the Bohemian Mittelgebirge; and has been noticed in the porphyritic pumice of Hungary. It is said also to occur in veins in Dauphiny, along with axinite and epidote; and in the lava of Solfatara.

Observations.

Glassy Felspar is distinguished from the other minerals of the felspar species, by its white colour, splendent vitreous lustre, transparency, and the frequent rents or fissures with which it is traversed.

Third Subspecies.

Ice-Spar *

Eispath, *Werner*.

Eis-spath, *Chierici*, Moll's Ephem. 5. 1. s. 126. *Id. Steffens*, b. i. s. 478. *Id. Hoff.* b. ii. s. 369. *Id. Lenz*, b. i. s. 515.

External Characters.

Its colour is greyish-white, which inclines sometimes to yellowish-white, sometimes to greenish-white.

It occurs massive, cellular, and porous; also in large granular concretions, which are composed of thin and straight lamellar concretions. It is frequently crystallized in the form of small thin longish six-sided tables, in which the shorter terminal planes are bevelled.

The

* It is named *Ice-spar*, from its icy appearance and sparry structure.

The lateral planes of the tables are longitudinally streaked.

Externally the crystals are shining, and sometimes splendent: internally shining, and the lustre is vitreous.

The cleavage is imperfect.

The fragments are indeterminate angular and sharp-edged.

The massive and other varieties are strongly translucent; the crystals are transparent.

It is as hard as common felspar, and is very easily frangible.

Geognostic and Geographic Situations.

It occurs, along with nepheline, meionite, mica, and hornblende, at Monte Somma, near Naples.

Fourth Subspecies.

Common Felspar.

Frischer Gemeiner Feldspath, *Werner.*

Spathum scintillans, *Wall.* t. i. p. 214.—Feldspath, *Wid.* s. 335. *Id. Romé de Lisle,* t. ii. p. 445.—Common Felspar, *Kirw.* vol. i. p. 316.—Blättrig Feldstein, *Estner,* b. i. s. 513.—Gemeiner Feldspath, *Emm.* b. i. s. 266.—Feldispato commune, *Nap.* p. 213.—Feldspath, *Lam.* t. ii. p. 187. *Id. Haüy,* t. ii. p. 590.—Le Feldspath commun, *Broch.* t. i. p. 362.—Gemeiner Feldspath, *Reuss,* b. ii. s. 369. *Id. Lud.* b. i. s. 100. *Id. Suck.* 1r th. s. 380.—Gemeiner Feldstein, *Bert.* s. 238.—Gemeiner Feldspath, *Mohs,* b. i. s. 407. *Id. Hab.* s. 20.—Feldspath, *Lucas,* p. 50.—Gemeiner frischer Feldspath, *Leonhard,* Tabel. s. 18.—Feldspath commun, *Brong.* t. i. p. 367.—Feldspath, *Brard,* p. 131.—Gemeiner Feldspath, *Haus.* s. 88. *Id. Karsten,* Tabel. s. 34.—Felspar, *Kid,* vol. i. p. 157.—Feldspath,

Feldspath, *Haüy*, Tabl. p. 35.—Frischer gemeiner Feldspath, *Steffens*, b. i. s. 436. *Id. Hoff.* b. ii. s. 309. *Id. Lenz*, b. i. s. 494. *Id. Oken*, b. i. s. 374. *Id. Haus.* Handb. b. ii. s. 529. —Common Felspar, *Aikin*, p. 196.

External Characters.

Its most frequent colours are white and red, seldom grey, and rarely green and blue. The white varieties are greenish-white, milk-white, yellowish-white, greyish-white, snow-white, and reddish-white; from reddish-white it passes into flesh-red, and into a colour intermediate between flesh-red and blood-red: from greenish-white it passes into apple-green, asparagus-green, grass-green, emerald-green, leek-green, mountain-green, verdigris-green; and from this latter into sky-blue: from milk-white it passes into bluish-grey, smoke-grey, and yellowish-grey. The grey varieties are generally spotted.

It occurs most frequently massive and disseminated, seldom in blunt angular rolled pieces and grains, and frequently in granular distinct concretions, from the smallest to the largest size; and sometimes crystallized, in the following figures:

1. Very oblique four-sided prism, flatly bevelled on both extremities, and the bevelling planes set on the obtuse lateral edges, fig. 90. Pl. 5. *. This may be considered as the fundamental figure.
2. The preceding crystallization, in which two diagonally opposite bevelling planes are smaller than the two others †. Sometimes the latter entirely disappear, when there is formed
3. A perfect and very oblique four-sided prism, in which the terminal planes are set on obliquely; or when

* Feldspath ditetraedre, Haüy.

† The bevelling planes mentioned above, are those that form the greatest angle with the lateral edges.

when the prism becomes shorter, and all the planes diminish in an equal proportion, there is formed

4. An acute rhombus *, fig. 91. Pl. 5.

When the prism of the fundamental figure N° 1. becomes shorter, and the bevelling planes become much larger than the lateral planes, we can view the former as lateral planes, and the latter as bevelling planes, and thus there is formed

5. A very oblique four-sided prism, acutely bevelled on the extremities, and the bevelling planes set on the acute lateral edges. This figure sometimes passes into a kind of
6. Elongated octahedron.
7. The fundamental figure, truncated on the acute lateral edges.
8. The variety N° 3. truncated on the acute edges, in the same manner as the variety N° 7 †, fig. 92. Pl. 5.

When the truncating planes of the variety N° 7. become larger than the lateral planes, there is formed

9. A broad equiangular six-sided prism, flatly bevelled on the extremities, and the bevelling planes set on those lateral edges which are formed by the meeting of the smaller lateral planes, fig. 93. Pl. 5 ‡.
10. The preceding figure, in which the edges formed by the meeting of the larger and smaller lateral planes, are truncated. fig. 94. Pl. 5 ||.

11. The

* Feldspath binaire, Haüy.

† Feldspath prismatique, Haüy.

‡ Feldspath bibinaire, Haüy.

|| Felspath quadridecimal, Haüy.

11. The crystallization N° 9. in which the angles formed by the meeting of the smaller bevelling planes and the lateral edges on which they are set, are more or less deeply truncated, fig. 95 *. Pl. 5.
12. The preceding variety, in which the edges formed by the smaller bevelling planes and the broader lateral planes are truncated, fig. 96. Pl. 5 †.
13. The preceding variety, in which the edges formed by the meeting of the other bevelling planes with the broader lateral planes, are truncated ‡.
14. In all the preceding varieties from N° 9. the proper edge of the bevelment is sometimes truncated ||.
15. The smaller bevelling planes in N° 11. sometimes disappear, whilst the truncating planes on the angles become larger, and form with the larger bevelling plane a new and much more acute bevelment, fig. 97. §, Pl. 5.

When two bevelling planes in variety 9. become very large, as in N° 2. whilst the prism becomes very broad and short, so that these two large bevelling planes approach near to each other, and increase in equal proportion with the broader lateral planes

* Feldspath dihexaedre, Haüy.

† Feldspath sexdecimal, Haüy.

‡ These truncating planes, along with some others, occur in Haüy's Feldspath synoptique and Feldspath decidodecaedre.

|| This appearance is to be seen in Haüy's Feldspath apophane and Feldspath synoptique.

§ As in Haüy's Feldspath decidodecaedre.

planes with which they meet under a right angle, they form with these

16. A rectangular four-sided prism, in which the smaller lateral planes of the six-sided prism form a kind of oblique bevelment on the terminal planes, and which is variously modified by the remains of the smaller bevelling planes of the fundamental figure, and the other planes of alteration *.

17. The preceding figure truncated on the lateral edges. These truncating planes correspond with those of the 13th crystallization.

Sometimes the planes at the extremities of the figure N° 16. almost totally disappear, and there remain only the two truncating planes of the 11th crystallization, and then the figure becomes

18. A nearly perfect rectangular four-sided prism, in which the terminal planes are set on obliquely, fig. 98 †. Pl. 5.

Besides these simple crystallizations, twin-crystals also occur, of which the following are the principal varieties:

19. Twin-crystal, which we may suppose to have been formed by two prisms of Nos 9. or 15. being pushed into each other in the direction of their thickness, in such a manner that their axes are either parallel to each other, or form a more or less obtuse angle. The lateral planes, and also some of those

* Vid. Haüy, fig. 91. and 92. Romé de Lisle assumed this as the fundamental form of felspar.

† Feldspath unitaire, Haüy.

those at the extremities of the crystals, form re-entering angles.

20. Twin-crystal, which we can conceive to be formed when Nos. 16. & 17. are divided longitudinally from one extremity to the other, in the direction of the two opposite lateral planes, (the broader lateral planes of the six-sided prism), and the one-half turned completely around and applied to the other. In this way a rectangular four-sided prism is formed, in which the diagonally opposite planes of the two extremities of the single crystal will be placed together. This is the *hemitrope* crystal of Haüy *.

The crystals are generally small and middle-sized, seldom very small, large, and very large. They are generally imbedded, sometimes also superimposed, and variously aggregated, forming druses.

Internally the cleavage is shining, and sometimes splendent; the fracture is glistening, and frequently not more than feebly glistening. The lustre is intermediate between vitreous and pearly, but inclining rather more to the former than to the latter.

It has a three-fold cleavage, like that of adularia, and the folia are sometimes curved floriform.

The fracture is uneven or splintery.

The fragments are rhomboidal, and have only four splendent shining faces.

It is translucent, or only translucent on the edges.

It is hard, but in a lower degree than quartz.

It

* Romé de Lisle, t. ii. p. 478.—492. var. 10.—16. Pl. 3. fig. 94.—106.

It is very easily frangible.
Specific gravity, 2.594, *Brisson.*—2.551, 2.567, *Hoff.*

Chemical Characters.

Before the blow-pipe, it is fusible without addition into a grey semitransparent glass.

Constituent Parts.

	Siberian Green Felspar.	Flesh-red Felspar.	Felspar from Passau.
Silica,	62.83	66.75	60.25
Alumina,	17.02	17.50	22.00
Lime,	3.00	1.25	0.75
Potash,	13.00	12.00	14.00
Oxide of Iron,	1.00	0.75	a trace.
Water,	-		1.00
	96.85	98.25	98.00
	Vauquelin, Jour. des Mines, n. 49. p. 23.	*Rose*, in Scherer's Jour. der Chimie, b. 7. s. 244.	*Bucholz*, in Von Moll's Neue Jahrb der Berg und Hüttenkunde, b. 2. s. 361.

Geognostic Situation.

This is one of the most abundant minerals in nature, as it forms a principal constituent part of granite and gneiss, two of the most widely distributed rocks hitherto discovered. It occurs as an accidental mixed part in mica-slate and clay-slate. It is a constituent part of white-stone and syenite: in white-stone it is associated with garnet, mica, and hornblende: in syenite always with a subordinate portion of hornblende.

hornblende. It forms the basis of certain porphyries, and then it occurs in fine granular concretions. It appears in the form of imbedded crystals, in all the different kinds of porphyry, and very generally disseminated in quartz rock. Greenstone, a rock so abundant in Primitive country, is a compound of common felspar and hornblende, but in which the hornblende predominates. Frequently the felspar is tinged of a green colour, owing to an intermixture of hornblende, and in this state it is heavier than the pure varieties of this mineral. But it occurs not only as a constituent part, and accidentally mixed with primitive mountain rocks, but we find it also in beds alternating with these, in nests and kidneys contained in them, and in veins traversing them. The beds occurring in granite or gneiss, are sometimes entirely composed of felspar, with the addition of very little mica and quartz; or in them it is associated with hornblende, garnet, actynolite, epidote, and copper and iron ores, as in Sweden and Norway. The kidneys and nests vary from a few inches to several fathoms in extent, and are contained in granite or gneiss. The veins are of cotemporaneous formation with the granite and gneiss rocks in which they are contained: they are sometimes entirely composed of felspar: in other instances of felspar, with a little quartz and mica, or of felspar, with rock-crystal, mica, chlorite, epidote, schorl, beryl, and rutile. It is in these veins that the greater number of crystallizations of felspar occur. The most beautiful crystallizations occur in the Alps of Switzerland, in Lombardy, France, and Siberia. The green felspar analysed by Vauquelin, is said to occur in a vein in granite, in the government of Ubinsky, in the Uralian Mountains in Siberia; also in cotemporaneous masses in the granite of Onega.

Felspar is not confined to primitive rocks; it occurs abundantly in Transition mountains, and also in those of the

the Secondary class. In transition mountains, it forms an essential constituent part of granite, syenite, porphyry, greenstone, and greywacke; and occurs accidentally intermixed in other rocks of this class. In secondary rocks, it occurs in many sandstones, in porphyry, greenstone, clinkstone-porphyry, and basalt.

Geographic Situation.

As granite, gneiss, mica-slate, porphyry, syenite, greenstone, greywacke, sandstone, basalt, and other rocks in which common felspar occurs, are found in almost every great tract of country, it would be superfluous to attempt detailing the individual geographic localities of a mineral so widely distributed.

Uses.

It is one of the ingredients in the finer kinds of earthenware, and is said to be the substance used by the Chinese under the name *Petunse* or *Petunze*, in the manufacture of their porcelain *. The green varieties of felspar, which are rare, are considered as ornamental stones, and are cut and polished, and made into snuff-boxes, and other similar articles. When the green varieties are spotted with white, they are named *Aventurine Felspar*, and are prized by collectors. Other two varieties, having the same name, and much esteemed by collectors, are found in Russia: the one is a red felspar, with white spots, from the coast of the White Sea; the other a yellow felspar, with shining yellow spots, from the Island of Cedlowatoi, near Archangel. The

* Mr Clarke Abel is of opinion, that the petunse is quartz.—Travels in China, p. 218.

green felspar from South America, which is cut and polished, and sold under the name *Amazon Stone*, is found in small rolled pieces, on the banks of the river of Amazons.

Observations.

1. It is distinguished from the other subspecies of this species by its more extensive colour-suite, its want of changeability of colour, its distinct concretions, passing into fine granular, easy frangibility, and inferior translucency.

2. It has been confounded with Corundum, but it is distinguished from that mineral by its cleavage, inferior specific gravity, and inferior hardness. It is distinguished from *Chrysoberyl* by its fracture, inferior hardness, and inferior weight. The green-coloured felspar is distinguished from *Green Diallage* by its superior hardness, and its double cleavage.

3. The German name *Felspar* was given to this mineral on account of its sparry or foliated texture, and from the circumstance of its frequently occurring as a constituent part of those loose blocks of stone we observe scattered over the country, *(Feldern)*. Hence it appears that the name *Felspar*, used by the English, and sometimes by French authors, is not quite correct.

Fifth Subspecies.

Labrador Felspar.

Labradorstein, *Werner.*

Pierre de Labrador, *Romé de Lisle,* t. ii. p. 497.—Feldspath, var. *Wid.* s. 335.—Labradore-stone, *Kirw.* vol. i. p. 324.—Labradorstein, *Emm.* b. i. s. 273.—Feldspato commune, var. *Nap.*

Nap. p. 213.—Labradorite, *Lam.* t. ii. p. 197.—Feldspath opalin, *Haüy,* t. ii. p. 607.—La pierre de Labradore, *Broch.* t. i. p. 369.—Labradorstein, *Reuss,* b. ii. s. 387. *Id. Lud.* b. i. s. 100. *Id. Suck.* 1r th. s. 380.—Gemeiner Feldstein, *Bert.* s. 238.—Labradorstein, *Mohs,* b. i. s. 407.—Labradorischer Feldspath, *Hab.* s. 22.—Feldspath opalin, *Lucas,* p. 50.—Labradorischer Feldspath, *Leonhard,* Tabel. s. 18.—Feldspath opalin, *Brong.* t. i. p. 359. *Id. Brard,* p. 134.—Farbenspielender Feldspath, *Haus.* s. 88.—Labrador Feldspath, *Karst.* Tabel. s. 34.—Opaline Felspar, *Kid,* vol. i. p. 160.—Feldspath opalin, *Haüy,* Tabl. p. 36.—Labradorstein, *Steffens,* b. i. s. 432. *Id. Hoff.* b. ii. s. 304.—Labrador Felspath, *Lenz,* b. i. s. 490.—Labradorstein, *Oken,* b. i. s. 376.—Edler Feldspath, *Haus.* Handb. b. ii. s. 531.—Labrador Felspar, *Aikin,* p. 197.

External Characters.

Its most frequent colours are light and dark ash-grey, and smoke-grey, seldom yellowish-grey. When light falls on it in determinate directions, it exhibits a great variety of colours: of these the most frequent are blue and green more seldom yellow and red, and the rarest variety is pearl-grey. The blue varieties are indigo, Berlin, azure, violet, smalt, and sky blue: this latter colour passes into verdigris-green; from this variety through celandine, mountain, leek, emerald, grass, pistachio, olive, and oil, into siskin green; the siskin-green passes into sulphur-yellow, and through brass, gold, lemon, honey, and orange yellow, into yellowish and reddish-brown, copper-red, brick-red, flesh-red, brownish-red; and, lastly, into pearl-grey and bluish-grey. The same specimen exhibits different colours, which run imperceptibly into each other, and are disposed in large patches or stripes.

It occurs massive, or in rolled pieces; also in large, coarse, seldom in small granular, very seldom in thick and straight lamellar concretions.

The cleavage is splendent, the fracture glistening, and the lustre is intermediate between vitreous and pearly.

The cleavage and fracture are the same as in common felspar.

It breaks into rhomboidal and sharp-edged fragments.

It is translucent, but in a low degree.

It is rather more difficultly fragible than common felspar.

Specific gravity, 2.692, *Brisson*.—2.590, *Hoffmann*.—American 2.690, *Klaproth*.—Russian 2.756, *Klaproth*.—Norwegian 2.590, *Klaproth*.

Chemical Characters.

According to Mr Kirwan, it is more infusible than common felspar.

Geognostic and Geographic Situations.

It occurs in rolled masses of syenite, in which it is associated with common hornblende, hyperstene, and magnetic ironstone, in the Island of St Paul, on the coast of Labrador, where it was first discovered, upwards of thirty years ago, by the Moravian Missionaries settled in that remote and dreary region. Some years afterwards, several varieties of it were found imbedded in a granite rock in Ingermannland; but the colours of these were neither so vivid nor numerous as in the Labrador felspar of St Paul's. In the interesting country around Laurwig in Norway, Labrador felspar occurs as a constituent part of the zircon-syenite; its colours are brighter than in the Ingermannland varieties, but not so vivid as those of St Paul. Blue is the principal colour of the

the Norwegian felspar, but it sometimes also exhibits a beautiful bluish mother-of-pearl opalescence, like that observed in adularia. A variety of this mineral is said to occur in the Hartz. Rolled pieces of it have been brought from West Greenland; and it has been found on the banks of Lake Champlain in North America *.

Uses.

On account of its beautiful colours, it is valued as an ornamental stone, and is cut into ring-stones, snuff-boxes, and other similar articles. It receives a good polish; but the streaks caused by the edges of the folia of the cleavage are frequently so prominent as to injure the appearance of the stone.

Observations.

1. This mineral is distinguished by its grey colours, and its changeability of colours.

2. The beautiful changeability of colours which Labrador felspar exhibits, appears to be caused by small rents, that run parallel with the folia of the cleavage, in this differing from the play of colour observed in the precious opal, which is owing to rents that run in every direction.

Sixth

* I have specimens in my possession, said to have been found in Aberdeenshire.

Sixth Subspecies.

Compact Felspar.

Dichter Feldspath, *Werner.*

Petrosilex æquabilis; P. semipellucidus? *Wall.* t. i. p. 268. 271.—Continuous Felspar, *Kirw.* vol. i. p. 323.—Dichter Feldstein, *Estner,* b. ii. s. 511. *Id. Emm.* b. i. s. 271.—Felspato compatto, *Nap.* p. 218.—Petrosilex agathoide, *Haüy,* Traité, t. iv. p. 385.—Le Feldspath Compacte, *Broch.* t. i. p. 367.—Dichter Feldspath, *Reuss,* b. ii. s. 366. *Id. Lud.* b. i. s. 10. *Id. Suck.* 1r th. s. 393.—Dichter Feldstein, *Bert.* s. 238.—Dichter Feldspath, *Mohs,* b. i. s. 420. *Id. Hab.* s. 19.—Feldspath compacte, *Lucas,* p. 50.—Dichter Feldspath, *Leonhard,* Tabel. s. 19.—Petrosilex, *Brong.* t. i. p. 351.—Feldspath Compacte ceroide, *Brard,* p. 133.—Dichter Feldspath, *Haus.* s. 88. *Id. Karst.* Tabel. s. 34.—Feldspath Compacte ceroide, *Haüy,* Tabl. p. 35.—Dichter Feldspath, *Steffens,* b. i. s. 442. *Id. Hoff.* b. ii. s. 334. *Id. Lenz,* b. i. s. 506. *Id. Oken,* b. i. s. 299. *Id. Haus.* Handb. b. ii. s. 534.—Compact Felspar, *Aikin,* p. 197.

External Characters.

Its colours are white, grey, green, and red: it passes from greyish-white through greenish-white, into apple-green, oil-green, inclining to olive-green, mountain-green, greenish-grey, smoke-grey, pearl-grey, flesh-red, and brick-red.

It occurs massive, disseminated, in blunt angular rolled pieces, and in small angulo-granular concretions; also crystallized in rectangular four-sided prisms.

The crystals are either middle-sized, or small, and always imbedded.

Internally

Internally it is sometimes glistening, sometimes glimmering.

The fracture is even and splintery.

It breaks into fragments which are rather sharp-edged.

It is feebly translucent, sometimes only translucent on the edges.

It is as hard as common felspar.

When pure, it is rather easily frangible.

Specific gravity, 2.609, *Kirwan.*—2.666, *La Metheric.*—2.659, *Saussure.*—2.690, *Klaproth.*

Chemical Characters.

Before the blowpipe, it melts with difficulty into a whiti h enamel.

Constituent Parts.

Compact Felspar of Salberg in Sweden.		Compact Felspar of the Pentland Hills, near Edinburgh.			
Silica, -	68.0	Silica, -	71.17	Silica,	51.00
Alumina,	19.0	Alumina,	13.60	Alumina,	30.50
Lime, -	1.0	Lime, -	0.40	Lime,	11.25
Potash, -	5.5	Potash, -	3.19	Iron,	1.75
Oxide of Iron,	4.0	Oxide of Iron,	1.40	Natron,	4.00
Water, -	2.5	Manganese,	0.10	Water,	1.26
		Volatile Matter,	3.50		
	100		93.36		99.75
Godon de St Memin, Journal de Physique, t. 63. p. 60.		Loss, -	6.64	*Klaproth*, Chem. Abhandl. s. 264.	
			100		
		Mackenzie, Mem. Wern. Soc. vol. i. p. 618.			

Geognostic

Geognostic Situation.

This mineral occurs in mountain-masses, beds and veins, either pure, or intermixed with other minerals, in primitive, transition, and secondary rocks. In primitive mountains, it is associated with hornblende in greenstone, and greenstone-slate; and it forms the basis of several felspar-porphyries. Beds of it in a pure state occur in gneiss, and other primitive rocks. In transition mountains, it occurs in beds, as a constituent part of porphyry and greenstone; and beds of it occur either pure, or in porphyry, or in greenstone, in secondary mountains.

Geographic Situation.

The Pentland Hills contain beds of compact felspar, associated with claystone, red sandstone, and conglomerate. It occurs in a similar situation on the hill of Tinto, described by Dr Macknight in the 2d volume of the Memoirs of the Wernerian Society. Mr Mackenzie found it along with secondary rocks in the Ochil Hills *; and Dr Fleming observed it associated with rocks of the same nature in the Island of Papa Stour, one of the Shetland group †. Beds of it, which are sometimes porphyritic, occur in the transition rocks of Dumfriesshire and Galloway; and in rocks of the same class to the north of the Frith of Forth, as in Perthshire, and the Mearns ‡. In the primitive rocks to the north of the Frith of Forth, it occurs in beds and veins, either pure, or in the state of porphyry. Examples of both occur in Perthshire, in the course of the Gary and the

* Memoirs of the Wernerian Society, vol. ii. p. 20.

† Memoirs of the Wernerian Society, vol. i. p. 170.

‡ Imrie, in Transactions of Royal Society of Edinburgh, vol. vi.

the Tilt; in the country around Castletown, in the upper part of Aberdeenshire *.

Beautiful varieties of compact felspar are found at Sala, Dannemora, Hällefors and Götheborg in Sweden: grey and green varieties occur in greenstone slate at Siebenlehn and Gersdorf, in the Saxon Erzgebirge; in green porphyry in the Hartz, and also in the same rock in Egypt.

Observations.

1. The principal characteristic distinctions of this mineral are colour, distinct concretions, lustre, fracture, translucency, hardness, and weight.

2. It has been frequently confounded with Splintery Hornstone; but is distinguished from it by colour, and distinct concretions, but principally by its lustre, inferior hardness, easier frangibility, fusibility before the blowpipe, and its being frequently intermixed with hornblende and mica.

Seventh Subspecies.

Clinkstone †.

Klingstein, *Werner.*

Phonolith, *Daubuisson.*

Hornslate, *Kirw.* vol. i. p. 307.—Porphirschiefer, *Estner,* b. ii. s. 747. *Id. Emm.* b. iii. s. 344.—Pierre sonnante, *Broch.* t. i. p. 437.

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* Dr Macknight mentions several localities of this mineral in his elegant and interesting sketch of the scenery and mineralogy of the Highlands, in the 1st volume of the Memoirs of the Wernerian Society.

† The tabular varieties of this mineral, when struck, emit a ringing sound; hence the name *Clinkstone.*

p. 437.—Klingstein, *Klap.* Beit. b. iii. s. 229. *Id. Reuss,* b. ii. s. 340. *Id. Lud.* b. i. s. 123. *Id. Suck.* 1r th. s. 364. *Id. Bert.* s. 222. *Id. Mohs,* b. i. s. 509. *Id. Hab.* s. 16. *Id. Leonhard,* Tabel. s. 26.—Feldspath compacte sonoré, *Lucas,* p. 266.—Klingstein, *Karst.* Tabel. s. 38.—Clinkstone, *Kid,* vol. ii. App. p. 18.—Klingstein, *Steffens,* b. i. s. 338. *Id. Lenz,* b. ii. s. 613. *Id. Oken,* b. i. s. 363. *Id. Hoff.* b. ii. s. 180. *Id. Haus.* Handb. b. ii. s. 707.—Clinkstone, *Aikin,* p. 205.

External Characters.

Its most frequent colour is greenish-grey, which sometimes passes into yellowish-grey, and ash-grey; which latter passes into liver-brown, and it is occasionally mountain-green, olive-green, and oil-green.

It occurs massive; also in granular, columnar, globular, and tabular distinct concretions.

The lustre of the principal fracture is glistening and pearly; that of the cross fracture is faintly glimmering, almost dull.

The principal fracture is slaty, generally thick, and often curved slaty, with a scaly foliated aspect; the cross fracture is splintery, passing into even, and flat conchoidal.

The fragments are indeterminate angular, and often slaty.

It is strongly translucent on the edges, sometimes even translucent.

It is as hard as felspar.

It is rather easily frangible.

It is brittle.

In thin plates, it emits, when struck, a ringing sound.

Specific gravity, 2.575, *Klaproth.*—2.515, *Breithaupt.*

Chemical

Chemical Characters.

It melts before the blowpipe into a grey-coloured glass, but is more difficultly fusible than basalt.

Constituent Parts.

Silica, - -	57.25
Alumina, - -	23.50
Lime, -	2.75
Natron, - -	8.10
Oxide of Iron, -	3.25
Oxide of Manganese,	0.25
Water, - -	3.00
	98.10

Klaproth, Beit. b. iii. s. 243.

Geognostic Situation.

This subspecies of felspar generally contains imbedded crystals, when it forms the rock named Clinkstone Porphyry. It is generally associated with secondary trap and porphyry rocks.

Geographic Situation.

Europe.—The Bass rock at the mouth of the Frith of Forth, North Berwick Law, Traprain Law, and the Girleton Hills, all in East Lothian, are principally composed of clinkstone, and afford many beautiful and highly characteristic varieties of this mineral. It occurs in the island of Arran, isle of Lamlash, Ochil Hills, and other parts of Scotland. The Breiddin Hills in Montgomeryshire in Wales; and Devis Mountain in the county of Antrim, afford

ford several varieties of this mineral. On the Continent of Europe, it is found in many districts where basalt abounds, as in the Bohemian Mittelgebirge; also in Bavaria, Suabia, Lusatia, Hessia, France, Italy, and Hungary.

Africa.—Along with basalt, in the island of Teneriffe.

America.—Along with trap-rocks, both in North and South America.

Observations.

1. Charpentier was the person who first directed the particular attention of mineralogists to this substance: in his Mineralogical Description of the Electorate of Saxony, he gives a very interesting account of it under the name *Hornslate*, (Hornschiefer) *. Werner afterwards examined it with more minute attention, and introduced it into the oryctognostic system as a distinct substance, under the name *Clinkstone*.

2. It has been confounded with Basalt; but is distinguished from that rock by colour, lustre, fracture, and transparency.

Eighth Subspecies.

Earthy Common Felspar.

Aufgelöster gemeiner Feldspath, *Werner*.

External Characters.

Its colours are greyish-white, yellowish-white, and reddish-white, all of which incline very much to grey.

It

* Older mineralogists were of opinion, that clinkstone was the same mineral as that described by Wallerius under the name *Corneus fissilis*: hence they gave it the name Hornslate; but in this they erred, as Wallerius's mineral appears to be hornblende-slate. Born, Ferber, and others, include under their hornslate also some varieties of clay-slate, and of mica-slate.

It generally occurs massive, and disseminated, and sometimes in imbedded crystals, which agree in form with those of common felspar.

Internally it is sometimes glistening, sometimes glimmering, or even dull.

It has sometimes an imperfect cleavage.

The fracture is coarse and small grained uneven, which approaches to earthy.

It breaks into blunt angular pieces.

It is either translucent on the edges, or opaque.

In general, it is so soft as to yield to the nail: sometimes, however, it approaches in hardness to felspar.

It is sectile, and easily frangible.

The chemical characters and composition of this substance have not been ascertained.

Geognostic and Geographic Situations.

It occurs in granite and gneiss districts, as in Cairngorm and Arran in Scotland, and Cornwall in England. It is well known in Saxony, and other countries.

Observations.

This mineral seems in some instances to be felspar in a state of disintegration: in others, to be an unaltered substance, very nearly of the nature of common felspar. The *Growan* of Cornwall appears to contain principally the disintegrated felspar.

Ninth

Ninth Subspecies.

Porcelain Earth or Kaolin.

Porcellanerde, *Werner.*

Porcelain Clay, *Kirw.* vol. i. p. 178.—Argilla de Porcellana, *Nap.* p. 248.—La terre à Porcelaine, *Broch.* t. i. p. 320.—Feldspath argiliforme, *Haüy,* t. ii. p. 616.—Porcellanerde, *Reuss,* b. ii. s. 107. *Id. Lud.* b. i. s. 105. *Id. Suck.* 1r th. s. 492. *Id. Bert.* s. 213. *Id. Mohs,* b. i. s. 431. *Id. Hab.* s. 38. *Id. Leonhard,* Tabel. s. 21.—Argil Kaolin, *Brong.* t. i. p. 516.—Kaolin, *Haus.* s. 85. *Id. Karst.* Tabel. s. 36.—Porcelain Clay, *Kid,* vol. i. p. 165.—Feldspath decomposé, *Haüy,* Tabl. p. 36. Porcellanerde, *Steffens,* b. i. s. 445.—Kaolin, *Lenz,* b. ii. s. 546. Kieskaolin, *Oken,* b. i. s. 371.—Porzellanerde, *Hoff.* b. ii. s. 10.—Kaolin, *Haus.* Handb. b. ii. s. 450.

External Characters.

Its most frequent colour is reddish-white, of various degrees of intensity; also snow-white, and yellowish-white.

It is generally friable, and sometimes approaches to compact.

It is composed of dull dusty particles, which are feebly cohering.

It soils strongly.

It feels fine and soft, but meagre.

It adheres slightly to the tongue.

Specific gravity, 2.216, *Karsten.*

Chemical Characters.

It is infusible before the blowpipe.

Constituent

Constituent Parts.

		Porcelain Earth from Aue in Saxony.			
Silica, -	46.0	Silica,	52.00	Silica,	55.0
Alumina,	39.0	Alumina,	47.00	Alumina,	42.5
Oxide of Iron,	0.25	Iron,	0.33	Iron,	1.0
Water,	14.50			Lime,	1.0
	97.75		99.33		99.5
Klaproth, Chem. Abhandl. s. 278.			*Rose.*		*Gehlen.*

Geognostic Situation.

It generally occurs in granite and gneiss countries, either in beds contained in the granite, or gneiss, when it appears to be an original deposite, or on the sides and bottom of granite and gneiss hills, when it is certainly formed by the decomposition of the felspar of these rocks.

Geographic Situation.

Europe.—It occurs in the different granite and gneiss districts in Scotland, and in the Shetland Isles; also in England and Ireland. One of the best known and most celebrated mines of porcelain-earth, is that of Aue in Saxony, which is used in the porcelain manufactory at Meissen. It forms a bed about three fathoms thick, which is covered with from three to six fathoms of mica-slate. It rests on fresh or unchanged granite, and is divided in the middle into two strata by a bed of disintegrated granite. There can be no doubt of this bed being an original deposite, and not felspar which has undergone a process of decomposition. A similar bed of porcelain earth occurs in granite, in the valley of Gatach, above Haussach in Wirtemberg. The Austrian porcelain is made from a fine porcelain-earth which is is dug near Passau. At St Yrieux la Perche, near Limoges in France, there is a bed or vein of porcelain-earth, in granite; and it has been discovered in granite near to Bayonne.

Asia.—Very valuable varieties of this mineral are found in China and Japan, where they are denominated *Kaolin.*

Uses.

This mineral forms a principal ingredient in the different kinds of porcelain. It is not used in the state in which it is found in the earth, but is previously repeatedly washed, in order to free it from impurities. After the process of washing, only fifteen parts of pure white clay remain, which is the kaolin of the Chinese. This clay, mixed in proper proportions with quartz, flint, gypsum, steatite, and other substances, forms the composition of porcelain; and this mixture is sifted several times through hair-sieves. The mixture is afterwards moistened with rain-water, in order to form a paste, which is put into covered casks. This paste is called by the workmen thc *mass.* A fermentation soon takes place, which changes its smell, colour, and consistence. Sulphuretted hydrogen gas is evolved: the colour passes from white into dark-grey; and the matter becomes tougher and softer. It must be carefully moistened from time to time, to prevent it from drying. The preparation of the mixture, and the art of rightly managing the mass, are secrets in most manufactories. The second operation is to give the paste the form we wish; and this is done by first kneading it with the hands, in order to divide the mixture more completely, and then turning it on the lathe. A third operation is the baking, or firing, which is done in furnaces of a particular construction. The firing generally lasts

lasts from thirty-six to forty-eight hours; and we judge of the state of the baking by proof-pieces, as they are called, placed in convenient situations, and which we can draw out and examine from time to time. The porcelain in this state is named *biscuit porcelain* by workmen *. A fourth operation is the covering the surface of the biscuit with a varnish or enamel, which must be applied exactly over all the points of the surface, and incorporated with the paste, without cracking or flying. This enamel is composed of pure white quartz, white porcelain, and calcined crystals of gypsum, and sometimes principally of felspar: these substances are ground with the greatest care, then diffused through water, and formed into a paste. When we use it, it must be diluted in water, so as to give it considerable liquidity, and we then plunge into it the biscuit porcelain. The porcelain is now exposed to heat, sufficient to melt the enamel or covering, and then it constitutes white porcelain; and in this state it may be applied to every purpose. If the porcelain is to be painted, it must again be exposed to heat in the furnace. The colours used are all derived from metals; and many of them, though dull when applied, acquire a considerable lustre by the action of the fire. The colours are mixed with a flux, which varies in the different manufactories: in some, a mixture of glass, borax, and nitre, is employed; this mixture is melted in a crucible, and the glass is afterwards ground, and incorporated with the colour. Gum, or oil of lavender, is used as a vehicle, when we wish to lay it on the porcelain. When the painting is

 finished,

* Figures, and generally all porcelain articles which are neither to be painted nor exposed to water, have no occasion for any covering; they are then sold in the state of biscuit.

finished, the ware is exposed to a heat sufficient to melt the flux containing the colour.

The beautiful purple colours on porcelain, are from oxide of gold, called powder or *precipitate of Cassius*; the violet colours from gold precipitated by tin and silver; certain green colours by copper, precipitated from its solutions in the acids by alkalies; red colours from oxides of iron; blue from zaffre; yellow from diaphoretic antimony, mixed with glass of lead; brown and black colours from iron-filings and zaffre; and the finest green tints from oxide of chrome.

Porcelain has been manufactured in China and Japan from a very early period. The art itself was discovered in Europe by a German named Böttícher, who made his first porcelain-vessels in Dresden in the year 1706. These were of a brown and red colour. The white porcelain was not attempted until the year 1709; and the famous manufactory at Meissen, the earliest in Europe, was established in 1710.

Observations.

This mineral is distinguished from the other *Clays*, by the fineness of its particles, its soiling strongly, its fine but meagre feel, and its not becoming plastic in water.

2. Pyramidal

2. Pyramidal Felspar or Scapolite *.

Pyramidaler Feldspath, *Mohs.*

Scapolit, *Werner.*

Paranthine, *Haüy.*

This species is divided into four subspecies, viz. Radiated Scapolite, Foliated Scapolite, Compact Red Scapolite, and Elaolite.

First Subspecies.

Radiated Scapolite.

Strahliger & Nadelförmiger Skapolith, *Karsten,* Tabel. s. 34.—Glasartiger Scapolith, *Haus.* s. 189.—Strahliger & Glasartiger Skapolith, *Steffens,* b. i. s. 461. & 464.—Stangensteinartiger Scapolit, *Shumacher,* Verzeichniss, s. 97.—Strahliger grauer Skapolith, *Hoff.* b. ii. s. 346.—Paranthine dioctaedre, aciculaire & cylindroide, *Haüy,* Tabl. p. 46.—Strahliger Scapolite, *Haus.* Handb. b. ii. s. 514.

External Characters.

Its most frequent colour is grey, seldomer white and green: it occurs greyish-white, yellowish-white, greenish-white, yellowish-grey, greenish-grey, mountain-green, olive-green, and asparagus-green.

It occurs massive, and in distinct concretions; the concretions are radiated or fibrous, scopiform diverging, and are

* *Scapolite,* from σκαπος, *a rod,* in reference to the columnar mode of aggregation of its crystals.

are collected into others which are thick and wedge-shaped. It is most frequently crystallized. The primitive figure is a pyramid of 136° 38′; 62° 56′. The secondary forms are the following:

1. Rectangular four-sided prism, flatly acuminated on the extremities with four planes, which are set on the lateral planes.
2. The preceding figure, in which the lateral edges are truncated *.

The crystals vary very much in length as well as thickness; for we meet with them from the acicular form to the thickness of a finger, and from very long to short. Sometimes the long prisms are curved, and are traversed with rents.

The crystals are frequently columnarly aggregated, or intersect one another.

The lateral planes of the crystals are deeply longitudinally streaked, and shining.

Internally it is intermediate between shining and glistening, and the lustre is intermediate between resinous and pearly.

The cleavage is double, and in the direction of the lateral planes of the prism, and also of its diagonals.

The fracture is fine-grained uneven.

The fragments are indeterminate angular, and not very sharp-edged.

It is translucent, and semitransparent in crystals.

It is as hard as apatite, and sometimes even harder; but never so hard as felspar.

It is rather easily frangible.

Specific

* Paranthine dioctaedre, Haüy.

Specific gravity, 2.740, *Laugier.*—2.691, 2.773, *Simon.*—2.857, *Schumacher.*—2.660, 2.743, *Hausmann.*—2.5, 2.8, *Mohs.*

Chemical Characters.

Green scapolite, before the blowpipe, becomes white, and melts into a white glass.

Constituent Parts.

Silica,	53.50
Alumina,	15.00
Magnesia,	7.00
Lime,	13.75
Natron,	3.50
Iron,	2.00
Manganese,	4.00
Water,	0.50
	99.24

Simon, Chem. Journ. b. iv. s. 411.

Silica,	45.0
Alumina,	33.0
Lime,	17.6
Natron,	1.5
Potash,	0.5
Iron and Manganese,	1.0
	98.6

Laugier, Annales du Museum d'Hist. Nat. cah. ix. p. 472.

Geognostic and Geographic Situations.

This mineral occurs in the neighbourhood of Arendal in Norway, where it is associated with magnetic ironstone, felspar, quartz, mica, garnet, augite, hornblende, actynolite, and calcareous-spar.

The magnetic ironstone occurs in gneiss, in the form of beds, that vary in thickness from four to sixty feet. In these beds, the scapolite and other accompanying minerals already mentioned, are either contained in cotemporaneous veins, or are irregularly disseminated throughout the beds. M. Hausmann observed it in beds of specular iron-ore or iron-glance, in the Swedish Province of Wermeland,

Wermeland, where it is associated with calcareous-spar and garnet: and the same excellent mineralogist found it at Malsjo in Wermeland, in a bed of limestone; and at Garpenberg in Dalecarlia, in beds of copper-pyrites.

Observations.

1. All the subspecies decay very readily on exposure to the weather, a circumstance which has induced Haüy to name this species *Paranthine.*

2. The *Spreustein* of Werner is said to be Fibrous Scapolite.

Second Subspecies.

Foliated Scapolite.

Micarell, *Abilgaard.*—Talkartiger Scapolit, Blättriger Scapolit, Pinitartriger Scapolit, *Schumacher,* Verzeichniss, s. 98,–100. —Wernerit, *Karsten,* Tabel. s. 34.—Arcticit, *Werner.*—Gemeiner Skapolith & Glimmeriger Skapolith, *Steffens,* b. i. s. 462. 464.—Dichter Scapolit, *Haus.* in Magaz. Natf. Freund. b. iii. s. 220.—Wernerit, *Haüy,* Tabl. p. 45.—Blättriger grauer Skapolit, *Hoff.* b. ii. s. 353.—Fuscit & Gabbronit, *Schumacher.*

External Characters.

Its principal colours are grey, green, and black. The greenish-grey passes into mountain and asparagus green. The black colours are greyish-black, and pitch-black. The colours are seldom pure, generally pale and muddy, and sometimes two colours occur in the same specimen; and greenish-grey coloured crystals sometimes appear sky-blue externally.

It

It occurs massive, disseminated, and in large, coarse, and long angulo-granular concretions; also crystallized in low eight-sided prisms, flatly acuminated with four planes, which are set on the alternate lateral planes.

The crystals are sometimes middle-sized, seldom large, or very small, and are generally superimposed, but seldom imbedded.

Externally the crystals are shining or splendent, and vitreous.

The cleavage is shining, the fracture glistening, and the lustre intermediate between resinous and pearly.

The cleavage is the same as in the radiated subspecies. The fracture is small and fine-grained uneven, or small conchoidal.

The fragments are generally indeterminate angular, and sharp-edged.

It is generally translucent, and passes sometimes into transparent, sometimes to translucent on the edges.

It yields a white streak.

It is brittle.

It is very easily frangible.

Its hardness and specific gravity are the same as in the radiated subspecies.

Geognostic and Geographic Situations.

On the north-western acclivity of the Saxon Erzgebirge, there is a considerable extent of a very compact small granular granite, named *Whitestone*, which includes cotemporaneous masses of common granite, that vary in magnitude from a few feet to some miles in extent. In these granitic masses, various minerals have been observed, as schorl, tourmaline,

tourmaline, lepidolite, and *Foliated Scapolite* *. It occurs also in Scandinavia, along with the radiated subspecies.

Third Subspecies.

Compact Red Scapolite.

Dichter Scapolite.

External Characters.

Its colour is dark brick-red, passing into pale blood-red.

It seldom occurs massive, more frequently crystallized, in long, frequently acicular, four-sided prisms, which are often curved, and are without terminal crystallizations.

Externally the crystals are rough and dull.

Internally it is very feebly glistening, almost glimmering.

The fracture is fine-grained uneven, approaching to splintery.

The fragments are indeterminate angular, and sharp-edged.

It is opaque, or very faintly translucent on the edges.

It is hard in a low degree.

It is easily frangible.

Geognostic and Geographic Situations.

It occurs along with the other subspecies, in metalliferous beds at Arendal in Norway.

Observations.

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* Vid. Pusch, uber Granit.—Leonhard, Taschenbuch 1812, p. 137.

Observations.

This mineral is characterized by its red colour, low degree of lustre, compact fracture, and nearly complete opacity.

Fourth Subspecies.

Elaolite.

Eläolith, *Klaproth.*

Fettstein, *Werner.*

Dichter Wernerit, *Hausmann.*

External Characters.

The colours of this mineral are duck-blue, which inclines more or less to green, also flesh-red, which falls more or less into grey, sometimes even inclines to brown.

It occurs massive, and in very intimately aggregated granular concretions.

Internally it is shining or glistening, and the lustre is resinous.

The fracture, principally in the red variety, is flat and imperfect conchoidal. The blue variety has an imperfect double cleavage.

The fragments are indeterminate angular, and not very sharp-edged.

It is translucent in a low degree. The blue variety, when cut in a particular direction, displays a peculiar opalescence, not unlike that observed in the cat's-eye.

It has the same degree of hardness as the other subspecies.

It

It is rather easily frangible.

Specific gravity, 2.613, *Haüy.*—From 2.588 to 2.618, *Hoffmann.*

Chemical Character.

When pounded, and thrown into acids, it gelatinates. Before the blowpipe it melts into a milk white enamel.

Constituent Parts.

Silica -	46.50	Silica, -	44.00
Alumina, -	30.25	Alumina, -	34.00
Lime, - -	0.75	Lime, -	0.12
Potash, -	18.00	Potash and Soda,	16.50
Oxide of Iron, - -	1.00	Oxide of Iron,	4.00
Water, -	2.00		
	98.50		98.62

Klaproth, in Magazin für die Neuesten Endeckungen in der Naturkunde, &c. 3ter Jahrg, s. 45. Also *Klaproth*, Beit. b. v. s. 178.

Vauquelin, in Haüy's Tabl. Comparative, p. 178.

Geognostic and Geographic Situations.

The blue variety is found at Laurwig, and the red at Stavern and Friedrichswärn, both in the rock named *zircon syenite.*

Uses.

The pale blue variety, which has often an opalescence like that of the adularia-moonstone, is cut *en cabochon*, and used for ring-stones. When set, it is difficult to distinguish it from cat's-eye.

Observations.

Observations.

1. It is named *Elaolite* by Klaproth, and *Fettstein* by Werner, on account of its resinous lustre.

2. The *Sodaite* of Ekeberg, which is the *Natrolite* of Wollaston, appears to be a variety of Elaolite; and probably the *Lythrodes* of Karsten belongs to the same subspecies.

3. Few of the newer mineral species have had so many names given to them as Scapolite, as appears from the following enumeration:

Names given to Scapolite.

1. Paranthine; 2. Wernerite; 3. Arcticite; 4. Sodaite; 5. Natrolite; 6. Fuscite; 7. Gabbronite; 8. Elaolite; 9. Fettstein; 10. Lythrodes? 11. Spreustein? 12. Bergmannite.

3. Prismato-Pyramidal Felspar or Meionite*.

Prismato-Pyramidischer Feldspath, *Mohs.*

Meionite, *Haüy & Werner.*

Hyacinthe blanche de la Somma, *Romé de Lisle,* t. ii. p. 290.—Meionite, *Haüy,* t. ii. p. 586. *Id. Broch.* t. ii. p. 519, 520. *Id. Lucas,* p. 49. *Id. Leonhard,* Tabel. s. 17. *Id. Brong.* t. i. p. 583. *Id. Brard,* p. 130. *Id. Haus.* s. 95. *Id. Karst.* Tabel. s. 34. *Id. Haüy,* Tabl. p. 34. *Id. Steffens,* b. i. s. 458. *Id. Hoff.* b. ii. s. 361. *Id. Lenz,* b. i. s. 512. *Id. Oken,* b. i. s. 351. *Id. Haus.* Handb. b. ii. s. 549. *Id. Aikin,* p. 207.

External Characters.

Its colour is greyish-white.

The

* *Meionite,* is derived from the Greek word μειων, *smaller, shorter,* because the acumination of its principal crystallizations is flatter, and also lower than in similar crystallizations in other minerals.

It occurs sometimes massive, but more frequently crystallized.

The primitive figure is a pyramid, in which the angles are 136° 22′, 68° 22′.

The following are the secondary figures:

1. Rectangular four-sided prism, flatly acuminated with four planes, which are set on the lateral edges.
2. The preceding figure, truncated on the lateral edges, Fig. 99. Pl. 5. *:

   Sometimes one of the acuminating planes becomes so large that the others disappear, when there is formed
3. A four-sided prism, in which the terminal planes are set on obliquely.
4. N° 1. bevelled on the lateral edges, and the edges of the bevelment truncated; and the edges between the acuminating planes and the lateral planes also truncated, Fig. 100. Pl. 5. †.

The crystals are small, seldom middle-sized; they are superimposed, and form druses.

Externally the crystals are smooth and splendent, internally splendent and vitreous.

It has a double rectangular cleavage, in which the folia are parallel with the lateral planes of the prism.

The fragments are indeterminate angular.

It is generally transparent, or semi-transparent, seldom translucent.

It

* Meionite dioctaedre, Haüy.

† Meionite soustractive, Haüy.

It is harder than common felspar, but softer than quartz.

It is easily frangible.

Specific gravity 2.5, 2.7, *Mohs*.

Chemical Characters.

It is easily fusible before the blowpipe; intumesces during fusion, and is converted into a white vesicular glass.

It has not hitherto been analysed.

Geognostic and Geographic Situations.

It occurs, along with ceylanite and nepheline, in granular limestone, at Monte Somma, near Naples. It is said also to occur in basalt, along with augite and leucite, at Capo di Bove, near Rome.

Observations.

1. This species is characterized by its white colour, simple crystallizations, splendent vitreous lustre, cleavage, transparency, hardness, low specific gravity, and the changes it experiences before the blowpipe.

2. It is distinguished from *Adularia* by its crystallizations, its cleavage, and the changes it undergoes before the blowpipe: its crystallizations, cleavage, and easy frangibility, distinguish it from *Nepheline*: it is readily distinguished from *Cross-stone*, by the flatness of its acuminations, the equality of its lateral planes, and its never occurring in twin crystals; it is further discriminated by its stronger lustre, cleavage and fusibility: It was formerly confounded with *Hyacinth* or *Zircon*, but is distinguished from that mineral by colour-suite, the flatness of its acuminations, perfect

perfect vitreous lustre, double cleavage, inferior hardness and weight, and infusibility before the blowpipe.

3. It was Romé de Lisle, who first attended to the crystallization of this mineral: it was more particularly examined by Haüy, who established it as a distinct species, under the name *Meionite*.

4. Rhomboidal Felspar, or Nepheline *.

Rhomboedrischer Feldspath, *Mohs*.

Nepheline, *Haüy* & *Werner*.

Sommite, *La Metherie*, t. ii. p. 271.—Nepheline, *Broch.* t. ii. p. 522. *Id. Haüy*, t. iii. p. 186. *Id. Lucas*, p. 72.—Sommit, *Leonhard*, Tabel. s. 16.—Nepheline, *Brong.* t. i. p. 387. *Id. Brard*, p. 176. *Id. Haus.* s. 94.—Sommit, *Karsten*, Tabel. s. 32.—Nepheline, *Haüy*, Tabl. p. 51. *Id. Steffens*, b. i. s. 476. *Id. Hoff.* b. ii. s. 365.—Sommit, *Lenz*, b. i. s. 513.—Weicher Smaragd, *Oken*, b. i. s. 319.—Nephelin, *Haus.* Handb. b. ii. s. 552.—Sommite, *Aikin*, p. 207.

External Characters.

The colours are snow-white, greyish-white, yellowish-white, and greenish-white, which latter sometimes passes into greenish-grey.

It occurs massive and crystallized.

The primitive form is a di-rhomboid of 152° 44′; 56° 15′. The secondary forms are the following.

1. Perfect equiangular six-sided prism, fig. 101 †. Pl. 5.

2. The

* *Nepheline*, from νεφελη, *a cloud*, because transparent pieces, when immersed in nitrous acid, become cloudy in the interior.

† Nepheline primitive of Haüy.

2. The preceding figure, truncated on the terminal edges, fig. 102 *. Pl. 5.

When the prism becomes shorter, there is formed.

3. A thick six-sided table, in which the lateral edges are truncated.

The crystals are small and very small, always superimposed, and forming druses.

Externally the crystals are splendent: internally shining, and the lustre is vitreous.

A fourfold cleavage is to be observed: three of the cleavages are parallel with the lateral planes, and one with the terminal planes of the prism.

The fracture is conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is strongly translucent, passing into transparent.

It is as hard as felspar.

Specific gravity 2.6, 2.7, *Mohs.*

Chemical Characters.

It melts with difficulty before the blowpipe into a dark glass.

Constituent Parts.

Silica,	46	
Alumina,	49	
Lime,	2	
Oxide of Iron,	1	
	98	*Vauquelin.*

Geognostic

* Nepheline annulaire, Haüy.

Geognostic and Geographic Situations.

It occurs in drusy cavities in granular limestone, along with ceylanite, vesuvian, and meionite, at Monte Somma, near Naples; also in fissures of basalt at Capo di Bove, near Rome. It is mentioned also as a production of the Isle of Bourbon.

Observations.

1. This species is characterized by its white colours, which sometimes incline to green, its crystallizations, vitreous lustre, conchoidal fracture, high degree of translucency, inferior hardness, and specific gravity.

2. It is distinguished from *Meionite* by its crystallizations, fourfold cleavage, and appearance when exposed to heat: its conchoidal fracture, and superior hardness, distinguish it from *Apatite*: it is readily distinguished from *Prismatic felspar* by its crystallizations: and its colour, and inferior hardness, distinguish it from *Emerald* and *Beryl*.

3. It is described by early writers under the name *White Schorl*. La Metherie named it *Sommite*, from the place where it was first found; and Haüy denominates it *Nepheline*.

4. The small acicular crystals of this species found near Rome, are described by Fleuriau Bellevue, under the name *Pseudo-Nepheline*, and are considered as belonging to a distinct species. Judging from the accounts of this pseudo-nepheline published by authors, we are still inclined to consider it but as a variety of nepheline.

* Chiastolite.

* Chiastolite (a).

Hohlspath, *Werner*.

Robien, in Nouv. idées sur la Format. des Foss. p. 108.—Pierre de croix, *Romé de Lisle*, t. ii. p. 440.—Crucite, *Lam.* t. ii. p. 292.—Macle, *Broch.* t. ii. p. 514. *Id. Haüy*, t. iii. p. 267. —Chiastolith, *Reuss*, b. ii. s. 47. *Id. Lud.* b. i. s. 149. *Id. Suck.* 1r th. s. 476. *Id. Bert.* s. 201. *Id. Mohs*, b. i. s. 539. *Id. Hab.* s. 35.—Macle, *Lucas*, p. 85.—Chiastolith, *Leonhard*, Tabel. s. 20.—Macle, *Brong.* t. i. p. 498. *Id. Brard*, p. 200. Chiastolith, *Haus.* s. 88. *Id. Karst.* Tabel. s. 84.—Macle, *Haüy*, Tabl. p. 56.—Chiastolith, *Steffens*, b. i. s. 447.—Hohlspath, *Hoff.* b. ii. s. 330.—Chiastolith, *Lenz*, b. i. s. 503.—Hohlspath, *Oken*, b. i. s. 324.—Chiastolith, *Haus.* Handb. b. ii. s. 540. *Id. Aikin*, p. 198.

External Characters.

Its colours are white and grey: the white colours are yellowish-white, greenish-white, greyish-white, and reddish-white: the grey colours are pearl-grey, greenish-grey, and yellowish-grey.

It occurs always crystallized.

Its primitive form appears to be an oblique four-sided prism, with lateral edges of 84° 48′, and 95° 12′ *. The following are the secondary forms.

1. Four-sided prism, in which the lateral edges are rounded †.
2. Four prisms arranged in the form of a cross ‡.

 These

(a) *Chiastolite*, from the Greek word χιαζω and λιθος, because the ends of the prisms appear marked with a figure like that of the Greek letter χ.

* Macle prismatique, Haüy. † Macle cylindroide, Haüy.

‡ Macle quaternée, Haüy.

These crystals always appear as if they had been at one time hollow, and these hollows filled up with clay-slate, the position of which varies in regard to the crystals, and gives rise to the following varieties:

a. In the centre of the crystal there is a small prism of clay-slate, the lateral planes of which are parallel with those of the crystal, and from the angles of this prism black lines run to each angle of the crystal *, fig. 87. Pl. 4.

b. In this variety there is, in addition to the central prism and black lines of the former, smaller black-coloured prisms of clay-slate, one on each angle of the crystal, and their lateral planes are parallel with those of the crystal ‡, fig. 88. Pl. 4.

c. In this variety the terminal planes of the crystal are marked with black lines, which run from each of the lateral planes, parallel with the adjacent planes, to the black diagonal lines †, fig. 89. Pl. 4.

d. A black prism, in which the lateral planes are covered with a thick or thin crust of the hollow-spar ||.

The black or clay-slate mass is often thickest in the middle, and becomes thinner towards the extremities of the crystal: in other instances it is thinnest in the middle, and becomes gradually thicker towards the extremities of the crystal; and frequently the clay-slate mass is of equal thickness throughout.

The crystals are large, middle-sized, and small; sometimes also acicular, and always imbedded.

The cleavage is double, and in the direction of the lateral planes of the prism.

The

---

* Macle tetragrammé, Haüy.

‡ Macle polygrammé, Haüy.

† Macle pentarhombique, Haüy.

|| Macle circonscrite, Haüy.

The lustre of the cleavage is glistening, that of the fracture glimmering.

The fracture is splintery.

It is translucent.

It is hard; it scratches glass.

It is rather difficultly frangible.

Specific gravity, 2.944, *Haüy*.—2.923, *Karsten*.

Chemical Characters.

It is infusible before the blowpipe, and becomes white and nearly opaque.

Its constituent parts have not hitherto been ascertained.

Geognostic and Geographic Situations.

It occurs in small acicular crystals in clay-slate in Wolfscrag near Keswick, and near the summit of Skiddaw in Cumberland; also at Aghavanagh, and Baltinglas-hill, in the county of Wicklow *. The largest and most beautiful crystals are found in clay-slate near to St Brieux in Brittany: smaller crystals occur in the clay-slate of St Jago di Compostella in Gallicia; the variety *d* is found in the valley of Barreges in the Pyrenees; and the variety 3. in the plain of Thourmouse, in the High Pyrenees. It has been observed in micaceous clay-slate in the Serra de Marao in Portugal; and in very small acicular crystals in clay-slate near Gefrees in Bareuth.

America.—In clay-slate near Lancaster in Massachusets; also in New Hampshire and Maine †. In emery in the Estro de las Cruces in Peru ‡.

D 2 *Observations.*

* Fitton's Mineralogy of Dublin, p. 51. & 52.

† Cleaveland's Mineralogy, p. 342.

‡ Sent to Europe by the late Mr Christian Heuland.

Observations.

Chiastolite is placed immediately after the species of the Felspar genus, on account of its supposed affinity with them; but its characters are still so imperfectly known, that it cannot be arranged in any of the present genera.

** Sodalite (a).

Sodalite, *Thomson.*

Transactions of Royal Society of Edinburgh, vol. iv. p. 390.

External Characters.

Its colour is intermediate between celandine and mountain green.

It occurs massive, and crystallized in rhomboidal or garnet dodecahedrons.

Externally it is smooth, and shining or glistening: internally the longitudinal fracture is vitreous, and the cross fracture resinous.

It has a double cleavage.

The fracture is small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is translucent.

It is as hard as felspar.

It is brittle, and easily frangible.

Specific gravity, 2.378.

Chemical Characters.

When heated to redness, it does not decrepitate, nor fall to

(a) *Sodalite*, so named on account of the great quantity of soda it contains.

to powder, but becomes dark-grey; and is infusible before the blowpipe.

Constituent Parts.

Silica, - -	38.52	36.00
Alumina, -	27.48	32.00
Lime, - -	2.70	
Oxide of Iron, -	1.00	0.25
Soda, - -	25.50	25.00
Muriatic Acid, -	3.00	6.75
Volatile Matter, -	2.10	
Loss, - -	1.70	
	100.00	100.00
	Thomson, in Tr. R. S. of Ed. vol. vi. p. 394.	*Ekeberg*, in Tr. R. S. of Ed. vol. vi. p. 395.

Geognostic and Geographic Situations.

It was discovered at Kanerdluarsuk, a narrow tongue of land, upward of three miles in length, in lat. 61°, in West Greenland, by Sir Charles Giesecké. It is found in a bed from six to twelve feet thick, in mica-slate, and is associated with sahlite, augite, hornblende, and garnet *.

Observations.

Sodalite was first described and analysed by Dr Thomson. The description of this mineral being incomplete, its true place in the system cannot be determined. It appears nearly allied to felspar.

APPEN-

* Article *Greenland*, in Edinburgh Encyclopædia.

APPENDIX.

CLAY AND LITHOMARGE FAMILIES.

The minerals included under these titles have no regular form or cleavage, and cannot therefore be connected with any of the mineral species. We place them here on account of their affinity with some of the members of the preceding genus.

* Clay Family.

In this group or family we include the following minerals, 1. Aluminite, 2. Common Clay, 3. Variegated Clay, 4. Slate-Clay, 5. Bituminous Shale, 6. Claystone, 7. Adhesive Slate, 8. Polier Slate, 9. Tripoli.

** Lithomarge Family.

The minerals of this family have many alliances with the preceding, and hence are placed immediately after them.

1. Lithomarge, 2. Mountain Soap, 3. Yellow Earth, 4. Cimolite, 5. Kollyrite, 6. Bole, 7. Sphragide.

* Clay

* Clay Family.

1. Aluminite.

Reine Thonerde, *Werner*.

Reine Thonerde, *Wid.* s. 385. *Id.* *Wern.* Cronst. s. 176.—Native Argil, *Kirw.* vol. i. p. 175.—Argilla pura, *Nap.* p. 246. —L'Alumine pure, *Broch.* t. i. p. 318.—Reine Thonerde, *Reuss*, b. ii. s. 102. *Id. Lud.* b. i. s. 104. *Id. Suck.* b. i. s. 471. *Id. Bert.* s. 277. *Id. Mohs*, b. i. s. 434. *Id. Leonhard*, Tabel. s. 20.—Argil native, *Brong.* t. i. p. 515.—Aluminit, *Haus.* s. 85. *Id. Karsten*, Tabel. s. 48.—Alumine pure, *Haüy*, Tabl. p. 58.—Alumenit, *Steffens*, b. i. s. 194. *Id. Lenz*, b. i. s. 541. —Verwitterter Alaunstein, *Oken*, b. i. s. 368.—Reine Thonerde, *Hoff.* b. ii. s. 4.

External Characters.

Its colour is snow-white, which verges on yellowish-white.

It occurs in small reniform pieces.

It has no lustre.

The fracture is fine earthy: its consistence is intermediate between friable and solid.

It is opaque.

It soils slightly.

It affords a glistening streak.

It adheres feebly to the tongue.

It passes from very soft into friable.

It feels fine, but meagre.

Specific gravity, 1.669, *Schreber*.

Chemical Characters.

It is very difficultly fusible. It absorbs water greedily, but does not fall in pieces.

Constituent

Constituent Parts.

Alumina, -	32.50	31.0
Water, -	47.00	45.0
Sulphuric Acid,	19.25	21.5
Silica, -	0.45	
Lime, -	0.35	2.0
Iron, -	0.45	
		99.5
	Simon, in Allgem. Journ. der Chemie, 5 Jahrg. s. 137.	*Bucholz.*

Geognostic and Geographic Situations.

It occurs, along with selenite, in calcareous loam, which rests on brown coal, in the alluvial strata around Halle in Saxony; and it is said to occur at Newhaven, near Brightelmstone in England. The white crusts sometimes observed in the clay ironstone of Scotland, appear to be aluminite.

Observations.

Steffens and Keferstein are of opinion, that this mineral, and the selenite with which it is accompanied, are formed by the decomposition of iron-pyrites: the sulphuric acid thus formed, is supposed to unite with the lime and alumina; with the lime it forms sulphate of lime or selenite, and with the alumina an alum, with a superabundance of alumina.

2. Common

2. Common Clay.

Under this head we include Loam and Potters-Clay.

Loam.

Leim, *Werner*.

Magerer Thon, *Karsten*, Tabel. s. 28.—Leimen, *Hab.* s. 42. *Id.* *Steffens*, b. i. s. 197. *Id.* *Lenz*, b. ii. s. 549. *Id.* *Oken*, b. i. s. 370.—Lehm, *Hoff.* b. ii. s. 23.

External Characters.

Its colour is yellowish-grey, sometimes inclining to greenish-grey, and is spotted yellow and brown.

It occurs massive.

It is dull, and feebly glimmering when small scales of mica are present.

The fracture is coarse and small-grained uneven in the large, and in the small earthy.

It soils slightly.

It is very easily frangible.

It is sectile, and the streak is slightly resinous.

It is intermediate between friable and soft, but inclining more to the first.

It adheres slightly to the tongue.

It feels feels rather rough, and very slightly greasy, or meagre.

It is rather heavy, bordering on light.

Geognostic and Geographic Situations.

It occurs in great beds in alluvial districts, when it sometimes contains remains of elephants, and other fossil animals; also in secondary mountains, along with wacke and basalt, and in fissures, forming veins. It appears in general

neral to be an alluvial deposite, only a comparatively small portion of it occurring in secondary rocks.

It is so very widely and generally distributed, that it is not necessary to specify any locality.

Uses.

The mud-houses we meet with in different countries are built of loam. They are generally reared on a foundation of stone and lime, to secure them from damp. It is the practice to build them in spring, and allow them to dry during the summer: they are plastered with lime in autumn, in order to protect them from rain. The loam is mixed with straw or hair, to prevent its cracking. The most advantageous practice is to form the loam into bricks, to dry these in the shade, and afterwards in the sun. The use of loam-bricks is of high antiquity; for we are told that the ancient city of Damascus, and the walls of Babylon, were built of bricks of this substance.

Observations.

It is characterized by its muddy grey colours, rough meagre feel, slight adherence to the tongue, nearly dull streak, and slight soiling. These characters distinguish it from *Potters-Clay*.

Potters-Clay.

Töpferthon, *Werner.*

There are two kinds of this clay, viz. Earthy and Slaty.

a. Earthy Potters-Clay.

Erdiger Töpferthon, *Werner.*

Erdiger Töpferthon, *Steffens,* b. i. s. 198. *Id. Lenz,* b. ii. s. 550. *Id. Hoff.* b. ii. s. 32.

External

External Characters.

Its colours are greyish and yellowish white; also yellowish, ash, pearl, smoke, greenish, and bluish grey. Very seldom mountain-green.

It occurs massive; and is friable, approaching to solid.

Internally it is dull, or feebly glimmering, from intermixed scales of mica.

The fracture in the large is coarse-grained uneven; in the small fine earthy.

It is more or less shining in the streak.

The fragments are very blunt-edged.

It is opaque.

It soils slightly.

It is very soft, passing into friable.

It is sectile.

It adheres strongly to the tongue; more strongly than loam.

It feels rather greasy.

It becomes plastic in water.

Specific gravity, 2.085, *Karsten.*—1.723. *Poole, Berger,* 1.800, 2.000, *Kirwan.*

Chemical Characters.

It is infusible.

Constituent Parts.

Silica, -	61.	63.00
Alumina, -	27.	37.00
Oxide of Iron,	1.	
Water, -	11.	
	100.	100.00
	Klaproth, Chem. Abhandl. s. 282.	*Kirwan.*

Geognostic

Geognostic Situation.

It is a frequent mineral in alluvial districts, where it sometimes occurs in beds of considerable thickness; it has also been observed in secondary or flœtz formations.

Geographic Situation.

It occurs in many districts both in England, Scotland, and Ireland.

Uses.

It is used in potteries, in the manufacture of the different kinds of earthen-ware: it is also made into bricks, tiles, crucibles, and tobacco-pipes; and is employed in improving sandy and calcareous soils.

Observations.

1. It is distinguished from *Loam* by its colour, fracture, its shining streak, and its stronger adherence to the tongue.

2. It is distinguished from *Porcelain-Earth* by greater coherence, stronger adherence to the tongue, greasy feel, and its plasticity with water.

3. The finer varieties are named *Pipe-Clay.*

b. Slaty Potters-Clay.

Schiefriger Töpferthon, *Werner.*

Schiefriger Töpferthon, *Steffens,* b. i. s. 200. *Id. Lenz,* b. ii. s. 554. *Id. Hoff.* b. ii. s. 52.

External Characters.

Its most frequent colour is dark smoke-grey, seldomer bluish and pearl grey.

It

It occurs massive.

The lustre of the principal fracture is glistening; the cross fracture dull.

The principal fracture is very imperfect slaty; the cross fracture fine earthy.

The fragments are often tabular.

It does not adhere so strongly to the tongue as the earthy kind, but becomes more shining in the streak; and it feels more greasy.

Geognostic Situation.

It occurs in considerable beds in alluvial districts, along with Earthy Potters-Clay.

3. Variegated Clay.

Bunter Thon, *Werner.*

Bunter Thon, *Steffens,* b. i. s. 200. *Id. Lenz,* b. ii. s. 554. *Id. Hoff.* b. ii. s. 54.

External Characters.

Its colours are white, grey, yellow, red and brown; the varieties are yellowish and reddish white, flesh and peach blossom red, pearl-grey, yellowish-grey, ochre-yellow, and yellowish-brown.

These colours are generally arranged in broad stripes, and often in veined and spotted delineations.

It occurs massive.

Internally it is dull.

The fracture is coarse earthy, inclining to slaty.

The fragments are blunt-edged.

It

It becomes strongly resinous in the streak, more so than the preceding kinds.

It is soft, inclining to friable.

It is sectile.

It adheres pretty strongly to the tongue.

It feels rather greasy.

Geognostic and Geographic Situations.

It occurs in alluvial deposites near Wehrau, in Upper Lusatia.

Observations.

It is closely allied to Lithomarge, and even passes into it.

4. Slate-Clay.

Schiefer Thon, *Werner.*

Slate-clay, Shale, *Kirw.* vol. i. p. 182.—L'Argile schisteuse, *Broch.* t. i. p. 327. *Id. Haüy,* t. iv. p. 446.—Schiefer Thon, *Reuss,* b. ii. s. 99. *Id. Lud.* b. i. s. 107. *Id. Suck.* 1r th. s. 490. *Id. Bert.* s. 211. *Id. Mohs,* b. i. s. 440. *Id. Hab.* s. 47. *Id. Leonhard,* Tabel. s. 22.—Argille feuilletée, *Brong.* t. i. p. 525.? Schiefriger Thon, *Karsten,* Tabel. s. 28.—Schiefer Thon, *Steffens,* b. i. s. 201. *Id. Lenz,* b. ii. s. 555. *Id. Hoff.* b. ii. s. 56.

External Characters.

Its colours are smoke and ash grey, greyish-black, and sometimes bluish and yellowish grey, and brownish-red.

It occasionally contains impressions of unknown ferns and reeds.

It

It is massive.

It is dull, or glimmering, owing to intermixed scales of mica.

The fracture in the large is more or less perfect slaty; in the small, earthy.

The fragments are tabular.

It is opaque.

It is intermediate between soft and very soft.

It affords a dull grey-coloured streak.

It is easily frangible.

It adheres slightly to the tongue.

It feels somewhat greasy.

Specific gravity, 2.636, *Karsten*.—2.680, *Kirwan*.

Geognostic Situation.

It occurs in beds in all the secondary coal-formations. It passes into claystone, sandstone, and bituminous-shale, and sometimes inclines to clay-slate.

Geographic Situation.

It occurs more or less abundantly in all the coal-districts in this island; and in other parts of the world where coal, and its accompanying rocks, have been particularly examined.

5. Bituminous Shale.

Brandschiefer, *Werner*.

Shistus pinguis? *Wall.* t. i. p. 354.; Schistus carbonarius, *Id.* p. 358.—Brandschiefer, *Wid.* s. 394.—Bituminous Shale, *Kirw.* vol. i. p. 183.—Brandschiefer, *Estner*, b. ii. s. 658. *Id.* *Emm.*

Emm. b. i. s. 289.—Schisto bituminoso, *Nap.* p. 263.—Argillite bitumineux, *Lam.* t. ii. p. 116.—Varieté de l'Argile schisteuse, *Haüy.*—Le Schiste bitumineux, *Broch.* t. i. p. 389.—Brandschiefer, *Reuss,* b. ii. s. 120. *Id. Lud.* b. i. s. 111. *Id. Suck.* 1r th. s. 504. *Id. Bert.* s. 218. *Id. Mohs,* b. i. s. 456. *Id. Leonhard,* Tabel. s. 23. *Id. Karsten,* Tabel. s. 36.—Bituminous Shale, *Kid,* vol. i. p. 189.—Brandschiefer, *Steffens,* b. i. s. 204. *Id. Lenz,* b. i. s. 573. *Id. Oken,* b. i. s. 361. *Id. Hoff.* b. ii. s. 88.

External Characters.

Its colour is light brownish-black, which sometimes passes into blackish-brown.

It occurs only massive.

Internally its lustre is feebly glimmering.

The fracture is rather thin and straight slaty.

The fragments are tabular.

It it opaque.

It becomes resinous in the streak, but the colour is not changed.

It is very soft, approaching to soft.

It is rather sectile, and easily frangible.

It feels rather greasy.

Specific gravity, 1.991, 2.049, *Kirwan.*—2.060, *Karsten.*

Constituent Parts.

Two hundred grains afforded the following parts, partly as educts, partly as products:

Carbonated

Carbonated Hydrogen Gas,	80 cubic inches.
Empyreumatic Oil, -	30 grains.
Thick Pitchy Oil, - -	5 do.
Ammoniacal Water, - -	4
Carbon, - -	20
Silica, - -	87½
Alumina, - -	6½
Lime, - - -	10½
Magnesia, - -	1
Oxide of Iron, - - -	3

Klaproth, Beit. b. v. s. 184.

Geognostic Situation.

It occurs principally in rocks of the coal-formation, where it frequently alternates with, and passes into, slate-clay, and also into coal. It sometimes contains vegetable impressions, and also animal remains, particularly of shells. It occurs in beds of considerable magnitude in hills of iron-clay.

Geographic Situation.

It occurs in all the coal districts in this island, and also in those of Bohemia, Poland, Silesia, and other countries.

Observations.

1. From *Slate-Clay*, with which it has been confounded, it is distinguished by the streak: in Slate-Clay, the streak is always dull; whereas it is invariably shining and resinous in Bituminous-Shale.

2. In this species the clay is combined with bitumen, but in Alum-slate with carbon.

3. Some mineralogists consider the *Ampelitis* of the ancients as drawing-slate, others as bituminous shale.

6. Claystone.

Thonstein, *Werner*.

L'Argile endurcie, *Broch.* t. i. p. 325.—Thonstein, *Reuss,* b. ii. s. 96. *Id. Lud.* b. i. s. 106.—Verhärteter Thon, *Suck.* 1r th. s. 489.—Thonstein, *Bert.* s. 210. *Id. Mohs,* b. i. s. 442. *Id. Hab.* s. 48. *Id. Leonhard,* Tabel. s. 22. *Id. Karst.* Tabel. s. 36. *Id. Steffens,* b. i. s. 192. *Id. Lenz,* b. ii. s. 559.—Roche argilleuse, *Haüy.*—Thonstein, *Hoff.* b. ii. s. 60. *Id. Haus.* Handb. b. ii. s. 464.

External Characters.

Its colours are pearl, bluish, smoke, and yellowish grey: from yellowish-grey it passes into yellowish-white; from pearl-grey into lavender-blue, flesh and brownish red. It is sometimes veined, spotted and striped.

It occurs massive, in great beds, and mountain masses, and sometimes contains vegetable impressions.

Internally it is dull, when it does not contain accidentally mixed glimmering particles.

The fracture is fine earthy, but sometimes passes to fine-grained uneven, and sometimes inclines to slaty, and conchoidal.

The fragments are indeterminate angular, and rather blunt-edged; sometimes they incline to tabular.

It is opaque.

It is semi-hard, sometimes soft, and even very soft.

It is rather easily frangible; and brittle in a low degree.

It does not adhere to the tongue.
Specific gravity 2.210, *Karsten.*

Geognostic Situation.

It occurs in beds, along with porphyry; also forming the basis of clay-porphyry, and appears in beds, along with black coal, and is a constituent of some kinds of tuff.

Geographic Situation.

It occurs along with secondary porphyry in the Pentland Hills; in a similar situation in the Island of Arran; on the mountain of Tinto; in the Ochil Hills; and in many other places in Scotland. It occurs frequently on the Continent of Europe; and it has been observed associated with the porphyries of Asia and America.

Uses.

When of sufficient hardness, it is used as a building-stone; also for lintels and door-posts, and can be formed into water-troughs. It forms an indifferent paving-stone.

Observations.

1. This mineral is characterized by colour, want of lustre, fracture, hardness, non-adherence to the tongue, and meagre feel.

2. It passes into Felspar, Slate-clay, and Striped Jasper.

7. Adhesive Slate *.

Klebschiefer, *Werner*.

Klebschiefer, *Reuss*, b. iv. s. 159.—Polierschiefer, *Leonhard*, Tabel. s. 22.—Klebschiefer, *Karsten*, Tabel. s. 26. *Id. Steffens*, b. i. s. 151. *Id. Lenz*, b. ii. s. 560. *Id. Haus.* b. ii. s. 418. *Id. Hoff.* b. ii. s. 63.

External Characters.

Its colour is very pale yellowish-grey, which passes into yellowish-white; and sometimes inclines to greenish-grey and smoke-grey.

It occurs massive.

It is dull.

The fracture is straight slaty; it is thick or thin slaty; and in the thick slaty varieties, the cross fracture is even, inclining to flat conchoidal.

The fragments are tabular.

It is feebly translucent on the edges.

It becomes shining in the streak, particularly when moist.

It is soft, passing into very soft.

It is sectile.

It splits very easily.

It exfoliates very readily in the direction of the foliated fracture, particularly when exposed in warm and dry situations.

It adheres strongly to the tongue.

It feels somewhat greasy.

Specific gravity 2.080, *Klaproth*.

Chemical

* It is so named from its adhering very strongly to the tongue.

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

Silica, -	62.50	Silica, - -	58.0
Alumina,	00.50	Alumina, - -	5.0
Magnesia,	8.00	Magnesia, - -	6.5
Lime, -	00.25	Lime, - -	1.5
Carbon, -	00.75	Iron & Manganese,	9.0
Iron, -	4.00	Water, - -	19.9
Water, -	22.00		
	98.00		100.0
	Klaproth.		*Bucholz.*

Geognostic Situation.

It occurs in beds in secondary gypsum, and contains imbedded menilite.

Geographic Situation.

It has hitherto been found only in the gypsum formation around Paris.

Observations.

It is distinguished from *Polier Slate*, by its strong adherence to the tongue, its exfoliation, slight greasy feel, and greater hardness.

8. Polier

8. Polier or Polishing Slate.

Polierschiefer, *Werner.*

Polierschiefer, *Mohs, Karsten, Steffens, Lenz,* and *Hoffmann.*

External Characters.

Its colours are partly yellowish-white, partly yellowish-grey, which latter passes into brown and isabella-yellow. Sometimes these colours are arranged in stripes.

It occurs massive.

It is dull.

The principal fracture is straight and thin slaty, the cross fracture fine earthy.

The fragments are tabular.

It is opaque.

It soils slightly.

It is very soft, passing into friable.

It is uncommonly easily frangible.

It scarcely adheres to the tongue.

It feels fine, but meagre.

It is so light as to swim in water.

Specific gravity 0.590—0.606, *Haberle.*

Constituent Parts.

Silica, - -	79.00
Alumina, - -	1.00
Lime, - - -	1.00
Oxide of Iron, -	4.00
Water, - -	14.00
	99.00

Bucholz, in Journ. fur d. Chemie & Physik, b. ii. s. 28.

Geognostic

Geognostic and Geographic Situations.

It forms a bed in the neighbourhood of rocks of the coal-formation, at Planitz in Saxony; also near Bilin in Bohemia; and it is said to occur at Menat, near Riom in Auvergne *. The variety found near Bilin, rests upon a mineral nearly allied to polier slate, and described by Haberle under the name *Saugschiefer.*

Uses.

It is used for polishing silver; and also for polishing marble, and other comparatively soft minerals.

Observations.

1. Werner considers it as a pseudo-volcanic production.

2. It has been described as a variety of Adhesive-slate, but it is distinguished from that mineral by its extremely thin slaty fracture, easy frangibility, meagre feel, softness, and lightness.

9. Tripoli †.

Tripel, *Werner.*

Tripela, *Wall.* t. i. p. 94.—Trippel, *Wid.* s. 353.—Tripoli, *Kirw.* vol. i. p. 202.—Tripel, *Estner,* b. ii. s. 631. *Id. Emm.* b. i. s. 307. *Id. Nap.* p. 210. *Id. La Meth.* t. ii. p. 457.—Le Tripoli, *Broch.* t. i. p. 379.—Quartz aluminifere Tripoléene, *Haüy,* t. iv. p. 467.—Tripel, *Reuss,* b. ii. s. 446. *Id. Lud.* b. i. s. 108. *Id. Suck.* 1r th. s. 428. *Id. Bert.* s. 247. *Id. Mohs,* b. i. s. 449. *Id.*

* The Auvergne mineral is described by Haüy under the name *Thermantide Tripoléene,* and is also described by Saussure.—Vid. Haüy, t. iv. p. 499, and 500.—Brongniart, Min. t. i. p. 330.

† The varieties of this mineral first used in the arts were brought from Tripoli; hence the name given to it.

Id. Hab. s. 6.—Tripoli, *Lucas*, s. 60.—Tripel, *Leonhard*, Tabel. s. 22.—Tripoli, *Brong.* t. i. p. 329.—Tripel, *Karst.* Tabel. s. 24.—Tripoli, *Kid*, Appendix, p. 31.—Tripel, *Steffens*, b. i. s. 147. *Id. Lenz*, b. i. s. 564. *Id. Oken*, b. i. s. 278. *Id. Hoff.* b. ii. s. 72. *Id. Haus.* Handb. b. ii. s. 417.

External Characters.

Its principal colour is yellowish-grey, which sometimes passes into yellowish-white, or into isabella-yellow, and ochre-yellow; it sometimes inclines to ash-grey.

It occurs massive, and in whole beds.

It is dull.

The fracture is sometimes fine, sometimes coarse earthy, and in the great inclines to slaty.

The fragments are blunt angular, or slaty.

It is opaque.

It is soft, sometimes passing into very soft.

It is not very brittle, and is rather easily frangible.

It feels meagre, and rather rough.

It does not adhere to the tongue.

Specific gravity 2.202, *Bucholz.*

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

				Rottenstone.	
Silica, -	81.00	Silica,	90	Silica,	4
Alumina,	1.50	Alumina,	7	Alumina,	86
Trace of Lime.		Black and Red		Carbon,	10
Black and Red		Oxide of Iron,	3		——
Oxide of Iron,	8.00		——		100
Sulphuric Acid,	3.45		100		*Phillips.*
Water, -	4.55		*Haase.*		
Loss, -	1.50				
	——				
	100	*Bucholz.*			

The sulphuric acid and water are considered as accidental constituent parts.

Geognostic Situation.

It occurs in beds in coal-fields; also in beds, along with secondary limestone, and alternating with clay, under basalt.

Geographic Situation.

It is found at Bakewell in Derbyshire, where it is named *Rottenstone:* also in the coal-fields of Dresden and Thuringia; in secondary trap districts in Bohemia; in Auvergne, where it is said to be associated with pseudo-volcanic rocks; in the island of Corfu; at Ronneburg and Kerms in Austria; near Burgos in Spain; and Tripoli in Barbary.

Uses.

On account of the hardness of its particles, it is used for polishing stones, metals, and glasses. If it contain any coarse quartzy particles, these must be separated by washing before it is used, because they injure the surfaces of the substances intended to be polished. When used for polishing precious stones, it is mixed with sulphur, in the proportion of two parts of tripoli to one of sulphur: these are well ground together on a marble slab, and then applied to the mineral by means of a piece of leather. When mixed with red ironstone, it is used for polishing optical glasses. It is used sometimes for moulds, in which small metallic or glass figures and medallions are cast.

It is said that a fine species of tripoli, found near Burgos in Spain, is used as an ingredient in the manufacture of of porcelain. The tripoli of Corfu is reckoned the most valuable by artists.

The Rottenstone of Derbyshire, which seems to be a variety of this mineral, is used for similar purposes, and is well known in this country. Sometimes a sandy marl is dug and sold for tripoli; but its effervescence with acids, and its very rough feel, distinguish it from that substance.

Observations.

Some mineralogists are of opinion, that it is a mixture of fine sand and clay, therefore that it is a mechanical deposite: others are inclined to view it as a chemical formation,—an opinion which appears to be countenanced by its geognostic relations.

** Lithomarge Family.

1. Lithomarge [a].

Steinmark, *Werner.*

There are two kinds, viz. Friable Lithomarge, and Indurated Lithomarge.

a. Friable Lithomarge.

Zerreiblicher Steinmark, *Werner.*

Friable Lithomarge, *Kirwan,* vol. i. p. 187.—Zerreiblicher Steinmark, *Reuss,* b. ii. s. 49. *Id. Leonhard,* Tabel. s. 26. *Id. Karsten,*

(a) It occurs in veins and cavities in rocks, somewhat like marrow in bones; hence the name *Lithomarge* or *Rock Marrow.*

Karsten, Tabel. s. 28. *Id. Steffens*, b. i. s. 246. *Id. Lenz*, b. ii. s. 618. *Id. Hoff.* b. ii. s. 201. *Id. Haus.* Handb. b. ii. s. 455. —Lithomarge, *Aikin*, p. 240.

External Characters.

Its colours are snow-white, and yellowish-white.

It occurs massive, disseminated, and sometimes in crusts.

It consists of very fine scaly or dusty, feebly glimmering particles.

It becomes shining in the streak.

It is generally slightly cohering, seldom loose.

It soils slightly.

It feels rather greasy.

It adheres to the tongue.

It is light.

It phosphoresces in the dark.

Constituent Parts.

Earth or Lithomarge of Sinopis.

Silica, - -	32.00
Alumina, - -	26.50
Iron, - -	21.00
Muriate of Soda, -	1.50
Water, - -	17.00
	98.00

Klaproth, Beit. b. iv. s. 349.

Geognostic

Geognostic and Geographic Situations.

It generally occurs in small quantity, often associated with compact lithomarge, and for the most part in tinstone veins, where it is accompanied with tinstone, fluor-spar, quartz, and sometimes ores of silver. It is found in tinstone veins at Ehrenfriedersdorf, also at Penig; in fissures in greywacke, in the Hartz; in manganese veins with red ironstone at Walkenried; and it is said also in Nassau, Bavaria, and Transylvania.

Observations.

1. Klaproth describes a substance under the name *Earth of Sinopis*, which is found in Pontus. It is of a dark red colour, and, according to Karsten, is but a variety of the friable lithomarge. The analysis here given is of the Earth of Sinopis.

2. Colour, appearance of the particles, adherence to the tongue, fine and greasy feel, and geognostic situation, are characteristics of this mineral. Colour, aspect of the particles, and greasy feel, distinguish it from *Porcelain Earth*.

b. Indurated Lithomarge.

Verhärtetes Steinmark, *Werner*.

Terra miraculosa Saxoniæ, *Schütz*, in Nov. Act. Cæs. Nat. Curios. 3. App. p. 93.—Steinmark, *Hoffmann*, Bergm. Journ. 1788, 1. 2. s. 520.—Indurated Lithomarge, *Kirwan*, vol. i. p. 188. —La Möelle de Pierre, ou Lithomarge, *Broch*. t. i. p. 447.— Argil Lithomarge, *Haüy*, t. iv. p. 444.—Steinmark, *Reuss*, b. ii. s. 164. *Id. Leonhard*, Tabel. s. 26.—Argile Lithomarge, *Brong*.

Brong. t. i. p. 521.—Verhärtetes Steinmark, *Haus.* s. 86. *Id. Karst.* Tabel. s. 28. *Id. Steffens,* b. i. s. 248. *Id. Lenz,* b. ii. s. 619. *Id. Hoff.* b. ii. s. 202. *Id. Haus.* Handb. b. ii. s. 453.

External Characters.

Its colours are yellowish and reddish *white*, which latter passes from pearl-*grey*, through lavender-*blue*, pale plum-blue, into flesh *red*, and nearly into brick-red; the yellowish-white passes into ochre-*yellow*. The white and red varieties are generally uniform; but the others are disposed in clouded, spotted, veined, and striped delineations.

It occurs massive, disseminated, and globular or amygdaloidal *.

It is dull.

The fracture is fine earthy in the small, and large conchoidal, and sometimes even, in the great.

The fragments are indeterminate angular, and rather blunt edged.

It is opaque.

It becomes shining in the streak.

It is very soft, sectile, and easily frangible.

It adheres strongly to the tongue.

It feels fine and greasy.

Specific gravity, 2.419, *Kopp.*—2.435—2.492, *Breithaupt.*

Chemical Characters.

It is infusible before the blowpipe. Several of the varieties

* It sometimes occurs in prisms, like those of prismatic felspar. These prisms are supposed to be felspar changed into lithomarge. For accounts of these, vid. Estner, Min. b. ii. s. 771.; also Klaproth's Chem. Abhandl.

ties phosphoresce when heated; and others, when moistened with water, afford an agreeable smell, like that of nuts.

Constituent Parts.

	Red Lithomarge of Rochlitz.	Lithomarge from Flachenseifen.
Silica, -	45.25	58
Alumina, -	36.50	32
Oxide of Iron,	2.75	2
Water, -	14.0	7
Trace of Potash.		
	98.50	99
	Klaproth, Chem. Abhandl. s. 287.	Id. s. 285.

Geognostic Situation.

It occurs in veins in porphyry, gneiss, grey-wacke, and serpentine: in drusy cavities in topaz-rock; or nidular, in basalt, amygdaloid, and serpentine; and it is said also in beds, in a coal-formation.

Geographic Situation.

At Rochlitz in Saxony, it occurs in cotemporaneous veins, traversing clay-porphyry; at Ehrenfriedersdorf and Altenberg, also in Saxony, the white and red varieties occur in veins in gneiss; at Zöblitz, it traverses serpentine, in the form of veins; the yellow variety lines the drusy cavities of the topaz-rock: it is remarked of the topazes, that when the accompanying lithomarge is yellow, they also have the same colour, and when the topazes are white, the lithomarge is white; and the Saxon *Terra miraculosa*, a variety of this mineral, appears to occur in small beds, in a coal-formation near Planitz. In the Hartz, it occurs in veins that

that traverse grey-wacke; and it is described as a production of the mountains of Bavaria, Bohemia, and Norway. In secondary hills, it occurs in balls in amygdaloid.

Uses.

The Chinese are said to use it, when mixed with the root of Veratrum album, in place of snuff: in Germany it is employed for polishing serpentine; and it was formerly an article of the Materia Medica. The blue variegated variety from Planitz in Saxony, named *Terra miraculosa Saxoniæ*, used to be kept in apothecaries shops.

Observations.

1. The friable kind is characterized by its scaly particles, soiling, and low degree of coherence; the indurated by fracture, streak, softness, and sectility.

2. It is distinguished from *Potters-Clay*, by its colours, greater hardness, not soiling, rather greater specific gravity, and also by its fracture, and geognostic situation: it is nearly allied to *Variegated Clay*, but that mineral is softer, lighter, and wants the conchoidal or even fracture; and its strong adherence to the tongue, fracture, and inferior weight, distinguish it from *Steatite*.

2. Mountain Soap *.

Bergseife, *Werner*.

Bergseife, *Wid.* s. 436. *Id. Emm.* b. i. s. 360.—Le Savon de Montagne, *Broch.* t. i. p. 453.—Bergseife, *Reuss*, b. ii. s. 171. *Id.*

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* This mineral is named *Mountain Soap*, on account of its greasiness, sectility, and softness.

Id. Lud. b. i. s. 127. *Id. Suck.* 1r th. s. 502. *Id. Bert.* s. 208. *Id. Mohs,* b. i. s. 522. *Id. Leonhard,* Tabel. s. 26. *Id. Karst.* Tabel. s. 28. *Id. Haus.* s. 86. *Id. Steffens,* b. i. s. 256. *Id. Lenz,* b. ii. s. 625. *Id. Oken,* b. i. s. 385. *Id. Hoff.* b. ii. s. 206. *Id. Haus.* Handb. b. ii. s. 456.

External Characters.

Its colour is pale brownish-black.
It occurs massive.
It is dull.
The fracture is fine earthy.
The fragments are indeterminate angular.
It is opaque.
It becomes shining in the streak.
It writes, but does not soil.
It is very soft, and perfectly sectile.
It is easily frangible.
It adheres strongly to the tongue.
It feels very greasy.
It is light, bordering on rather heavy.

Geognostic and Geographic Situations.

It occurs in trap-rocks in the Island of Skye. It was formerly found at Olkutzk in Gallicia, but is now no longer to be met with in that quarter. It is said to occur in a bed in the district of Nassau; and in a bed, immediately under the soil, along with potters-clay and loam, near Waltershaus, at the foot of the mountains of the Forest of Thuringia.

Use.

It is valued by painters as a crayon.

Observations.

Observations.

1. This mineral is characterized by its colour, fracture, streak, greasy feel, perfect sectility, adherence to the tongue, its writing without soiling, and low specific gravity.

2. Its colour and property of writing, distinguish it from *Lithomarge:* from *Bole*, it is distinguished by its dull and fine earthy fracture, its writing, greater sectility and greasiness, and its not falling into pieces in water, which is the case with bole; and its colour distinguishes it from *Fullers Earth.*

3. It is allied to Bole and Lithomarge.

4. It was first established as a distinct mineral by Werner, and particularly described by Stift, in Moll's Ephemer. 4. 1. s. 31.; and by Schlottheim, in the Magaz. Naturf. Fr. in Berlin, 1. 4. s. 406.

5. Its black colour is alleged to be owing to bitumen; but its chemical constitution is still unknown.

3. Yellow Earth.

Gelberde, *Werner.*

Argile ocreuse jaune graphique, *Haüy.*

Gelberde, *Wid.* p. 427.—Yellow Earth, *Kirw.* vol. i. p. 194.—Gelberde, *Estner,* b. i. s. 362.—La Terre jaune, *Broch.* t. i. p. 455.—Gelberde, *Reuss,* b. ii. s. 101. *Id. Lud.* b. i. s. 128. *Id. Suck.* 1r th. s. 524. *Id. Bert.* s. 302. *Id. Mohs,* b. i. s. 524. *Id. Hab.* s. 48. *Id. Leonhard,* Tabel. s. 26. *Id. Karsten,* Tabel. s. 48. *Id. Steffens,* b. i. s. 261. *Id. Lenz,* b. i. s. 626. *Id. Oken,* b. i. s. 372. *Id. Hoff.* b. ii. s. 210. *Id. Haus.* Handb. b. ii. s. 457.

External Characters.

Its colour is ochre-yellow, of different degrees of intensity.

 It

It occurs massive.

It is dull on the cross fracture, but glimmering on the principal fracture.

The fracture in the large inclines to slaty; in the small, it is earthy.

The fragments are tabular, or indeterminate angular.

It becomes somewhat shining in the streak.

It is opaque.

It soils and writes slightly.

It is very soft, passing into friable.

It is easily frangible.

It adheres pretty strongly to the tongue.

It feels rather greasy.

Specific gravity 2.240, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it is converted into a black and shining enamel.

Constituent Parts.

From Bitry in France.

Silica, - -	92
Alumina, - -	2
Lime, - - -	3
Iron, - - -	3
	100

Merat Guillot, Brong. Min. t. i. p. 544.

Geognostic and Geographic Situations.

It is found at Wehraw, in Upper Lusatia, where it is associated with clay, and clay ironstone; near Meissen, mixed ed with quartz sand; in the district of Berry, and at Bitry, in the department of Nievre in France.

Uses.

It may be employed as a yellow pigment; and when burnt, it is sold by the Dutch under the name of *English red.* The remains in Pompeii, show that it was used as a pigment, both in its yellow and red state, by the ancient Romans. It appears even to have been known to Theophrastus as a yellow pigment.

4. Cimolite *.

Cimolith, *Klaproth.*

Creta Cimolia, *Plin.* Hist. Nat. xxxv. 57.—Cimolith, *Klaproth,* Beit. b. i. s. 291.—La Cimolite, *Haüy,* t. iv. p. 446. *Id. Reuss,* b. ii. s. 169. *Id.* b. i. s. 150. *Id. Suck.* 1r th. s. 500. *Id. Bert.* s. 212. *Id. Leonhard,* Tabel. s. 21. *Id. Haus.* s. 86. *Id. Karsten,* Tabel. s. 28. *Id. Steffens,* b. i. s. 260.—Kimolit, *Lenz,* b. ii. s 544.—Cimolith, *Oken,* b. i. s. 372. *Id. Haus.* Handb. b. ii. s. 463.

External Characters.

Its colours are greyish-white, and pearl-grey, which become reddish by the action of the weather.

It occurs massive.

It is dull.

The fracture is earthy, sometimes inclining to slaty.

It is opaque.

It becomes shining in the streak.

* So named from Cimolia, the island where it is principally found.

It soils very slightly.
It is very soft.
It is rather easily frangible.
It adheres pretty strongly to the tongue.
Specific gravity, 2.00, *Klaproth*.—2.187, *Karsten*.

Chemical Characters.

It is infusible.

Constituent Parts.

Silica, -	63.00	Silica, -	54.00
Alumina, -	23.00	Alumina,	26.50
Iron, -	1.25	Iron, -	1.50
Water, -	12.00	Potash, -	5.50
		Water, -	12.00
	99.25		99.50
	Klaproth, Beit. b. i. s. 299.		*Klaproth*, Chem. Abhandl. s. 284.

Geognostic and Geographic Situations.

It appears to occur in beds, in the islands of Argentiera or Cimolia, and Milo, in the Mediterranean Sea.

Uses.

It was highly prized as a medicine by the ancients; they also used it for cleansing woollen and other stuffs, for which purpose it is excellently suited.

Observations.

1. This mineral is mentioned by several ancient writers, as Theophrastus, Dioscorides, Strabo, Pliny, and Ovid; and in modern times, first by Tournefort, and next by Klaproth,

Klaproth, who in the year 1794 received specimens of it from Mr Hawkins, who had collected it in the island of Cimolia.

2. It appears to be nearly allied to Fullers Earth.

5. Kollyrite *.

Kollyrit, *Karsten.*

Natürlicher Alaunerde, *Klaproth,* Beit. b. i. s. 257.—*Fichtel,* Mineralog. Aufsätze, 170.—Kollyrit, *Leonhard,* Tabel. s. 21. *Id. Karsten,* Tabel. s. 48. *Id. Haus.* s. 85. *Id. Steffens,* b. i. s. 259. *Id. Lenz,* b. ii. s. 543. *Id. Oken,* b. i. s. 370. *Id. Hoff.* b. iv. s. 161. *Id. Haus.* Handb. b. ii. s. 446.

External Characters.

Its colours are snow, greyish, reddish, and yellowish white.

It occurs massive.

Internally it is dull; but the reddish-white variety is feebly glimmering.

The fracture is fine earthy in the small, and flat conchoidal in the large.

The fragments are indeterminate angular and rather sharp edged.

The snow-white is feebly, the reddish-white is strongly translucent on the edges.

It becomes shining and slightly resinous in the streak.

It soils slightly.

It

* It is the κολλυριον of Dioscorides, which he describes as an earth having the property of adhering strongly to the tongue.

It is very soft; the snow-white variety friable, the reddish-white approaching to very soft.

It is rather brittle, and very easily frangible.

It adheres strongly to the tongue.

It feels greasy, but in a low degree.

It is light.

Chemical Characters.

It is infusible. It becomes transparent in water, and falls into pieces with a crackling noise.

Constituent Parts.

Silica,	14
Alumina,	45
Water,	42

Klaproth, Beit. b. i. s. 257.

Geognostic and Geographic Situations.

It is found in the Stephen's pit at Schemnitz in Hungary, where it forms a vein from four to five inches wide in porphyry; and it occurs in veins in sandstone, at Weissenfels in Saxony.

6. Bole *.

Bol, *Werner.*

Bolus, *Waller.* t. i. p. 51.—Bole, *Kirw.* vol. i. p. 191.—Bol, *Estner*, b. ii. s. 784. *Id. Emm.* b. i. s. 381.—Bolo, *Nap.* p. 256. —Le

* The name *Bole*, is derived from the Greek word *βωλος*, *a lump of earth*. All the clayey substances formerly [illegible], were named *bolus*.

—Le Bol, *Broch.* t. i. p. 459.—Bol, *Reuss,* b. ii. s. 115. *Id. Lud.* b. i. s. 129. *Id. Suck.* 1r th. s. 495. *Id. Bert.* s. 207. *Id. Mohs,* b. i. s. 525. *Id. Hab.* s. 39. *Id. Leonhard,* Tabel. s. 26. —Le Bol Armenie, *Brong.* t. i. p. 543.—Bol, *Haus.* s. 86. *Id. Karsten,* Tabel. s. 28.—Bole, *Kid,* vol. i. p. 179.—Bol, *Steffens,* b. i. s. 253. *Id. Lenz,* b. ii. s. 634. *Id. Hoff.* b. ii. s. 226. *Id. Haus.* Handb. b. ii. s. 458.

External Characters.

Its colour is pale yellowish-brown, which passes on the one side into reddish-brown, and isabella-yellow, and very rarely into pale flesh-red; on the other into chesnut-brown and brownish-black. Sometimes it is spotted and dendritic.

It is massive, and disseminated.

Internally its lustre is glimmering, and very rarely dull.

The fracture is perfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

The red variety is feebly translucent, the yellow translucent on the edges, and the brown and the black opaque.

It is very soft, approaching to soft.

It is rather sectile, and very easily frangible.

It feels greasy.

It becomes shining and resinous in the streak.

It adheres to the tongue.

Specific gravity, 1.922, *Karsten.*—From 1.4 to 2.00, *Kirwan.*—1.977, 2.051, *Breithaupt.*

Chemical Characters.

When immersed in water, it breaks in pieces with an audible noise, with the evolution of air-bubbles, and falls into powder.

Before

Before the blowpipe, it melts into a greenish-grey coloured slag.

Constituent Parts.

Silica, - -	47.00
Alumina, - -	19.00
Magnesia, - -	6.20
Lime, - -	5.40
Iron, - -	5.40
Water, - -	7.50

Bergmann, Opusc. t. iv. p. 152.

It is still uncertain whether this analysis of Bergmann is of true bole.

Geognostic Situation.

The geognostic situation of this mineral is rather circumscribed, it having been hitherto observed only in secondary or flœtz trap-rocks, principally in trap-tuff, wacke, and basalt, in which it occurs in angular pieces, and disseminated *.

Geographic Situation.

Europe.—It is found at Strigau in Silesia; at Artern in Thuringia; in the Habichtwald in Hessia; the chesnut and reddish brown varieties are found at Sienna in Tuscany, and known under the name *Ochria di Siena.* The yellowish-brown occurs in the island of Lemnos.

Uses.

* It is said to occur in shell limestone, in the neighbourhood of Waltersdorf in Gotha.—Von Schlottheim, in the Magazin Naturf Freunde zu Berlin, L. 4. s. 305.

Uses.

It was formerly an article of the Materia Medica, and was used as an astringent, and in some places is still employed in veterinary practice. It is said that tobacco-pipes are sometimes made of bole, and that it is an ingredient in the glaze of some kinds of earthen-ware.

Observations.

1. Formerly a number of clayey brick-red and brownish coloured clays, were preserved in collections under the name *Bole*. The bole of modern mineralogists, of which we have given a description, was first established as a distinct mineral by Werner.

2. It inclines sometimes to Lithomarge, sometimes to Clay.

7. Sphragide, or Lemnian Earth.

Sphragid, *Werner*.

Λημνια σφραγις of the Greeks.—Terra Lemnia, *Galenus*, De Simpl. Med. Facult. l. ix. the first variety.—Sphragid, *Karsten*, Tabel. s. 28.—Lemnische Erde, *Steffens*, b. i. s. 255.—Sphragid, *Lenz*, b. ii. s. 643. *Id. Oken*, b. i. s. 384. *Id. Haus*. Handb. b. ii. s. 460.

External Characters.

Its colours are yellowish-grey, and yellowish-white. On the surface, it appears frequently marbled with rust-like spots.

It is dull.

The fracture is fine earthy.

It

It is meagre to the feel.

It adheres slightly to the tongue.

When immersed in water, it falls into pieces, and numerous air-bubbles are evolved.

Constituent Parts.

Silica,	66.00
Alumina,	14.50
Magnesia,	0.25
Lime,	0.25
Natron,	3.50
Oxide of Iron,	6.00
Water,	8.50
	99 00

Klaproth, Beit. b. iv. s. 336.

Geographic Situation.

Its geognostic situation is unknown, and it has hitherto been found only in the island of Stalimene (Lemnos of the ancients) in the Mediterranean.

Uses.

In Stalimene or Lemnos, it is dug but once a-year, on the 15th of August, in the presence of the clergy and magistrates of the island, after the reading of prayers. The clay is cut into spindle-shaped pieces, of an ounce weight, and each of them is afterwards stamped with a seal, having on it the Turkish name of the mineral. Even so early as the time of Homer, this substance was used as a medicine againt poison and the plague, and was then in great repute, as it is at present, in eastern countries. In early times, it

was

was also sold, bearing on it the impression of a seal: hence it was called σφραγὶς, *sigillum*; and it was in such estimation, that none but priests durst handle it, and severe punishments were inflicted on those who presumed to dig for it at any other but the stated period. It is mentioned, that Scultetus Montanus, physician to the Emperor Rodolph, in the year 1568, ordered this earth to be kept in apothecaries shops.

Observations.

The only analysis we possess is that by M. Klaproth, who received specimens of it from Mr Hawkins.

GENUS VI. SPODUMENE *.

THIS genus contains but one species, viz. Prismatic Spodumene.

1. Prismatic Spodumene.

Prismatischer Triphan Spath, *Mohs.*

Triphane, *Haüy.*

Spodumene, *D'Andrada,* Scherer's Journ. b. iv. 19. s. 30. *Id.* *Reuss,* b. ii. s. 495. *Id. Lud.* b. ii. s. 162. *Id. Suck.* 1r th. s. 725.

* On exposure to the blowpipe, it first separates into golden-coloured scales, and then into a kind of powder or ash; hence the name *Spodumene,* from σποδόω, *I change into ash,* or σποδὸς, *ashes.*

s. 725. *Id. Bert.* s. 174.—Triphane, *Lucas,* p. 209.—Spodumene, *Leonhard,* Tabel. s. 19.—Triphane, *Brong.* t. i. p. 388. *Id. Brard,* p. 417. *Id. Haus.* s. 88.—Spodumen, *Karsten,* Tabel. s. 34.—Triphane, *Haüy,* Tabl. p. 37.—Spodumene, *Steffens,* b. i. s. 474. *Id. Hoff.* b. ii. s. 341.—Triphan, *Lenz,* b. i. s. 525. *Id. Oken,* b. i. s. 372. *Id. Haus.* Handb. b. ii. s. 525.—Spodumene, *Aikin,* p 198.

External Characters.

Its colour is intermediate between greenish-white and mountain-grey, and sometimes passes into oil-green.

It occurs massive, disseminated, and in large and coarse granular concretions.

The cleavage is shining, the fracture glistening, and the lustre is pearly.

It has a distinct threefold cleavage; two of the cleavages are parallel with the lateral planes of an oblique four-sided prism of about 100°, and the third with the smaller diagonal of the basis of the same prism.

The fracture is fine-grained uneven.

It sometimes breaks into very oblique rhomboidal fragments, but more frequently into such as are tabular and indeterminately angular.

It is translucent.

It is as hard as felspar.

It is uncommonly easily frangible.

Specific gravity, 3.192, *Haüy.*—3.218, *D'Andrada.*—3.0, 3.1, *Mohs.*

Chemical Characters.

Before the blowpipe, it first separates into small gold-yellow coloured folia; and if the heat is continued, they melt into a greenish-white coloured glass.

Constituent

Constituent Parts.

Silica, -	63.50	64.4
Alumina, -	23.50	24.4
Lime, -	1.75	3.0
Potash, -	6.00 *	5.0
Oxide of Iron,	2.50	2.2
Water, -	2.00	
Manganese, -	trace.	
	99.25	99.0
	Vogel, in Annal. of Phil. Nov. 1818.	*Vauquelin*, Haüy's Tabl. p. 168.

Geognostic and Geographic Situations.

This mineral was first discovered in the island of Utön, in Sudermanland, in Sweden, where it is associated with red felspar and quartz. It has been lately found in the vicinity of Dublin †; and in the Tyrol, on the road to Sterzing, in granite, and along with tourmaline.

GENUS VII.

* According to some analyses, it contains 8 *per cent.* of a new alkali named *lithina.*

† It was first found in Ireland by Dr Taylor.

Genus VII.—KYANITE *.

Disthene Spath, *Mohs.*

This genus contains one species, viz. Prismatic Kyanite.

1. Prismatic Kyanite.

Prismatischer Disthene Spath, *Mohs.*

Kyanite, *Werner.*

Sappare, *Saussure*, Voyages, § 1900. & Jour. de Phys. 1789, p. 213.—Cyanite, *Wid.* s. 475. *Id. Kirwan*, vol. i. p. 209.—*Id. Estner*, b. ii. s. 690. *Id. Emm.* b. i. s. 412. *Id. Nap.* p. 328. *Id. Lam.* t. ii. p. 256.—Disthene, *Haüy*, t. iii. p. 220.—La Cyanite, *Broch.* t. i. p. 501.—Cyanit, *Reuss*, b. ii. 2. s. 61. *Id. Lud.* b. i. s. 139. *Id. Suck.* 1r th. s. 463. *Id. Bert.* s. 285. *Id. Mohs*, b. i. s. 575. *Id. Hab.* s. 34.—Disthene, *Lucas*, p. 76.—Cyanit, *Leonhard*, Tabel. s. 30.—Disthene, *Brong.* t. i. p. 423. *Id. Brard*, p. 186.—Cyanit, *Karsten*, Tabel. s. 48.—Kyanit, *Haus.* s. 102.—Cyanite, *Kid*, vol. i. p. 182.—Disthene, *Haüy*, Tabl. p. 54.—Kyanit, *Steffens*, b. i. s. 299.—Cyanit, *Lenz*, b. ii. s. 696.—Talkschorl, *Oken*, b. i. s. 303.—Kyanit, *Hoff.* b. ii. s. 313. *Id. Haus.* Handb. b. ii. s. 634. *Id. Aikin*, p. 189.

External Characters.

Its principal colour is Berlin-blue, which passes on the one side into bluish-grey, and milk-white, on the other into sky-

* *Kyanite*, from the Greek word *κυανος*, *sky-blue*, a frequent colour of this mineral.

sky-blue, celandine-green, and greenish-grey. The white varieties are often marked with blue-coloured flame delineations.

It occurs massive and disseminated; also in distinct concretions, which are large and longish angulo-granular, and also wedge-shaped prismatic, which are straight or curved, and sometimes disposed in scopiform or stellular directions. It is sometimes regularly crystallized. The primitive figure is an oblique four-sided prism, in which the lateral edges meet under angles of 106° 15′, and 73° 45′ *. The following are the secondary forms.

1. Oblique four-sided prism, truncated on the two opposite acute lateral edges.
2. Preceding figure, in which all the lateral edges are truncated.
3. Twin-crystal: it may be considered as two flat four-sided prisms joined together by their broader lateral planes †.

The narrow lateral planes are longitudinally streaked, and glistening: the broad are smooth, or delicately transversely streaked, and splendent.

The crystals are middle-sized, small, and very small: are singly imbedded, or intersect one another.

The lustre is splendent and pearly.

It has a three-fold cleavage, in which the folia are parallel with the lateral and terminal planes of the prism. Of these cleavages or folia, those parallel with the broader lateral planes are the most distinct; the others, indeed, are very imperfect.

The

* Forme primitive, Hauy.

† Disthene perihexaedre, Hauy.

‡ Disthene double, Hauy.

The fragments are splintery, or imperfectly rhomboidal.

The massive varieties are translucent; the crystals are in general transparent.

The surface of the broader lateral planes is as hard as apatite, while that of the angles is as hard as quartz.

It is rather brittle.

It is easily frangible.

Specific gravity, 3.470, *Karsten.*—3.517, *Saussure.*—3.680, *Klaproth.*—3.5, 3.7, *Mohs.*

Physical Characters.

When pure, it is idio-electric. Some crystals, by rubbing, acquire negative electricity, even on perfectly smooth planes, others positive electricity: hence the name *Disthene* given by Haüy to this mineral, on account of its double electrical powers.

Chemical Character.

It is infusible before the blowpipe.

Constituent Parts.

Silica,	29.2	Silica,	38.50	Silica, -	43.00
Alumina,	55.0	Alumina,	55.50	Alumina,	55.50
Magnesia,	2.0	Lime,	0.50	Iron, -	0.50
Lime, -	0.25	Iron, -	2.75	Trace of Potash.	
Iron, -	6.65	Water,	0.75		
Water,	4.9				99.00
Saussure the Son, Voyages dans les Alpes, N° 1900.		*Laugier*, Annales du Mus. t. v. 25 cahier, p. 17.		*Klaproth*, Beit. b. v. s. 10.	

Geognostic

Geognostic Situation.

It has been hitherto found only in primitive mountains, where it occurs in compact granite (white-stone), mica-slate and talc-slate, accompanied with several other minerals.

Geographic Situation.

Europe.—It occurs in primitive rocks, near Banchory in Aberdeenshire, and Boharm in Banffshire; in mica-slate near Sandiodge *, and in the same rock near Hillswick † in Mainland, the largest of the Shetland Islands. At Airolo, on St Gothard, it is found in a beautiful silver-white mica-slate, associated with felspar, garnet, grenatite, and quartz; in the Saualp in Carinthia, with quartz, calcareous-spar, garnet, and common actynolite; in the Zillerthal in the Tyrol, with quartz and hornblende; and imbedded in white-stone at Waldenberg, in the Saxon Erzgebirge; Prizbram in Bohemia; also in France, Transylvania, Hungary, and Spain.

Asia.—In the Uralian Mountains; also in India.

America.—It is found in Maryland associated with grenatite, garnet, and magnetic ironstone, in mica-slate. In Pennsylvania in crystals upwards of a foot in length; in mica-slate in Connecticut; in Massachusets along with garnets and quartz; and in the district of Maine.

At Maniquarez in South America; and in Brazil.

* Jameson's Mineralogy of Shetland.

† Fine specimens of this mineral were found near Hillswick by Dr Hibbert.

Uses.

In India it is cut and polished, and sold as an inferior kind of sapphire.

Observations.

1. It is distinguished from *Actynolite* by its cleavage and infusibility; from *blue-coloured Quartz*, and *Sapphire*, by its inferior hardness: from *Mica* by its superior hardness, its infusibility, and its being common flexible, whereas mica is elastic-flexible; from *Tremolite*, by colour, figure, and infusibility.

2. It was first described as a kind of schorl, under the names *violet schorl*, *blue schorl-spar*, *pseudo-schorl*; afterwards as belonging to the mica or talc species, under the names *blue mica* and *blue talc*. Some observers arranged it with felspar, and named it *skye-blue foliated felspar*; and by others it was denominated *foliated beryl*. It was Werner who first correctly pointed out its characters.

Genus VIII. AUGITE *.

This genus contains four species, viz. 1. Oblique-edged Augite; 2. Straight-edged Augite; 3. Prismatoidal Augite; 4. Prismatic Augite.

1. Oblique

* *Augite* is a name applied to a particular mineral by Pliny, and is derived from the Greek word αὐγη, *lustre*, because this character is striking in several of the varieties of this species.

1. Oblique-edged Augite *.

Schiefkantiger Augit, *Mohs.*

This species contains seven subspecies, viz. Foliated Augite, Granular Augite, Conchoidal Augite, Common Augite, Coccolite, Diopside, and Sahlite.

First Subspecies.

Foliated Augite.

Blættriger Augit, *Werner.*

Schorl des volcans, *Daubenton,* Tabl. p. 11.—Pyroxène noire des terrains volcaniques, *Haüy,* Tabl. p. 41.—Blättriger Augit, *Hoff.* b. i. s. 453.

External Characters.

Its colour passes from velvet-black through greenish-black, into blackish-green, and sometimes even approaches to dark leek-green.

It has hitherto been found only crystallized, and the crystals are sharp-edged, and imbedded. The primitive form is an oblique four-sided prism, in which the lateral planes meet under angles of 92° 18′, and 87° 42′. The following are the secondary forms.

G 2 1. Broad

* In all the varieties of this species, the edge of the bevelment on the extremity of the prism, is generally oblique; hence the specific name *Oblique-edged.* This name is retained, until one more appropriate shall be discovered.

1. Broad six-sided prism, with two opposite acuter lateral edges *, Pl. 6. fig. 112. It is generally
   a. Flatly bevelled on the extremities, and the bevelling planes set on the acuter lateral edges †, Pl. 7. fig. 113. Sometimes also
   b. The edge of the bevelment is slightly truncated, and, in some instances,
   c. The acuter angles of the bevelment are deeply truncated.
2. Broad six-sided prism, bevelled on the extremities, and truncated on the acuter lateral edges ‡, Pl. 6. fig. 114.
3. Broad, nearly equiangular, eight-sided prism, bevelled on the extremity, in the same manner as N° 1., and one of the angles of the bevelment truncated ||, Pl. 6. fig. 115.
4. Eight-sided prism, in which the obtuse terminal edges of two and two opposite planes, that meet under acute angles, are truncated §, Pl. 6. fig. 116.
5. Twin-crystal, in which the crystals are joined together by their broader lateral planes ¶, Pl. 6. fig. 117.
6. Twin-crystal, in which the crystals intersect each other **, Pl. 6. fig. 118.

The crystals are middle-sized, and small.

They are all around crystallized, and therefore originally imbedded.

The surface is sometimes smooth, sometimes rough; when smooth it is shining, when rough glimmering.

Internally it is shining, inclining to splendent, and the lustre is resino-vitreous.

It

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* Pyroxene peri-hexaedre, Haüy.
† Pyroxene bis-unitaire, Haüy.
‡ Pyroxene tri-unitaire, Haüy.
|| Pyroxene soustractif, Haüy.
§ Pyroxene dioctaedre, Haüy.
¶ Pyroxene hemitrope, Haüy.
** Pyroxene hemitrope, Hauy.

It has a distinct cleavage, in which the folia are parallel to the sides and to the diagonal of the primitive form.

The fracture is conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque, or translucent on the edges.

It is harder than apatite, but softer than felspar.

It is rather easily frangible.

Specific gravity,—

Green variety, out of basalt,	3.471,	*Werner.*
Crystallized, from Frascati,	3.400,	*Klaproth.*
	3.350, 3.397,	*Hoffmann.*
From Lipari,	3.459,	*Hoffmann.*
From Vesuvius,	3.357,	*Haüy.*
	3.226,	*Haüy.*
	3.2, 3.5,	*Mohs.*

Chemical Characters.

Fusible with difficulty into a black enamel.

Constituent Parts.

	From Ætna.	From Frascati.
Silica,	52.00	48.00
Alumina, -	3.33	5.00
Magnesia, -	10.00	8.75
Lime, -	13.20	24.00
Oxide of Iron,	14.66	12.00
Oxide of Manganese,	2.00	1.00
		Trace of Potash.
	95.19	98.75
	Vauquelin, Journ. de Min. N. 39. p. 176.	*Klaproth*, Beit. b. 5. s. 166.

Geognostic

Geognostic Situation.

It occurs only in secondary trap-rocks, and in lava.

Geographic Situation.

It is found in basalt in different districts in Scotland. On the continent, it occurs in the basalts of Bohemia, Auvergne, and in the lavas and secondary trap-rocks of Vesuvius, Frascati, and Ætna.

Observations.

1. The most characteristic features of this mineral are, besides the colour and crystallization, the strong internal lustre, and the perfection of the cleavage.

2. *Distinctive Characters.*—*a.* Between Augite and *Basaltic Hornblende.*—Basaltic hornblende has always a velvet-black colour, augite generally a green colour; the lustre of basaltic hornblende is vitreous and splendent, that of augite is resino-vitreous, and shining; basaltic hornblende is softer than augite; in basaltic hornblende, the edge of the bevelment on the extremity of the prism is generally straight, whereas it is oblique in augite; and, lastly, basaltic hornblende is easily fusible before the blowpipe, but augite very difficultly fusible.—*b.* Between Augite and *Schorl.* In schorl the lateral planes of the crystals are deeply longitudinally streaked, whereas those of augite are smooth; the lustre of schorl is vitreous, but that of augite is resino-vitreous; it is harder than augite; it becomes electrical by heating, but augite does not; and schorl is more easily fusible than augite.—*c.* Between Augite and *Melanite.* In melanite the crystallizations are tessular, whereas those of augite are prismatic; and the specific gravity of melanite is 3.3, that of augite 3.2—3.5.

Second

Second Subspecies.

Granular Augite.

Körniger Augit, *Werner.*

Pyroxene, cristaux noirs de Norwege, *Haüy,* Tabl. p. 41.—Körniger Augit, *Hoff.* b. i. s. 449.

External Characters.

Its colour is greenish-black.

It occurs massive, and in coarse and small angulo-granular concretions. Also crystallized, and in the following figures:

1. Broad six-sided prism, with two opposite acuter edges. This prism is generally .
   - *a.* Flatly bevelled on the extremities, and the bevelling planes are set obliquely, but parallelly, on the acuter lateral edges *. It is seldom
   - *b.* Acuminated on the extremities with four planes, which are set on the obtuser lateral edges. Sometimes
   - *c.* The bevelment, and also
   - *d.* The acumination, are truncated. The truncating planes are often convex, and thus there is formed
   - *e.* Prisms with convex terminal faces.
2. Six-sided prism truncated on the acuter lateral edges †.

When these truncating planes become as large as

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* Pyroxene bis-unitaire, Haüy.

† Pyroxene tri-unitaire, Haüy.

as the other planes of the prism, there is formed a

3. Broad, nearly equiangular eight-sided prism, which has the same bevelments and acuminations as N° 1.
4. Four-sided prism, which is formed when the broader lateral planes of N° 1. disappear. Both the eight and four sided prisms occur very rarely.

The crystals are seldom sharp-edged and perfect.

They are generally middle-sized, attached by one end, and forming druses.

The surface is rough and glistening. Internally it is glistening and resinous.

It has an imperfect cleavage.

The fracture is uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

Hardness same as that of foliated augite.

Specific gravity, 3.318, 3.388, *Hoffmann.*—3.448, 3.465, *Schumacher.*—3.573, *Hausmann.*

Chemical Characters.

According to Simon does not melt before the blowpipe.

Constituent Parts.

Silica, - -	$50\frac{1}{4}$
Alumina, - -	$3\frac{1}{2}$
Magnesia, -	7
Lime, - -	$25\frac{1}{2}$
Iron, - -	$10\frac{1}{3}$
Manganese, - -	$2\frac{1}{4}$
Water, - -	$\frac{1}{2}$
	$99\frac{1}{3}$ *Simon.*

Geognostic

Geognostic and Geographic Situations.

This subspecies of augite has been hitherto found only at Arendal in Norway, in several of the iron-mines, particularly that named Ulve-Grube. It occurs in beds of magnetic ironstone in gneiss, where it is associated with common garnet, epidote, hornblende, and calcareous-spar.

Observations.

1. The essential characters of this subspecies are its constant black colour, the bluntness of the crystals, feeble lustre, fracture, and opacity.

2. It is nearly allied to *Coccolite*, but differs from it by its darker colours, resinous lustre, less perfect cleavage, closer aggregation of the distinct concretions, opacity, and rather greater hardness. It is distinguished from *Epidote* by its darker green colour, crystallization, different cleavage, and opacity; and from *Common Garnet* by its crystallization, resinous lustre, foliated fracture, and inferior hardness and weight.

Third Subspecies.

Conchoidal Augite.

Muschlicher Augit, *Werner.*

Muschlicher Augit, *Hoff.* b. i. s. 462.

External Characters.

Its colour is greenish-black, passing into blackish-green; also into a very dark olive-green, and sometimes even into liver-brown.

It

It occurs in imbedded grains.

Its lustre is splendent, and is resino-vitreous.

The fracture is imperfect, and flat conchoidal.

It is translucent on the edges, or translucent.

It agrees in its other characters with the foregoing subspecies.

Constituent Parts.

Silica, -	52.00	55.00
Alumina, -	5.75	5.50
Magnesia, -	12.75	13.75
Lime, -	14.00	12.50
Oxide of Iron,	12.25	11.00
Manganese, -	0.25	Trace.
Potash, -	0.25	1.00
	97.25	98.78

Klaproth, Beit. b. v. s. 159, 162.

Geognostic and Geographic Situations.

It occurs only in secondary trap-rocks, and is the rarest of the subspecies of this species. The finest specimens, from two to three inches in diameter, are found in the vesicular basalt of Fulda.

Observations.

1. This species of augite is characterised by its high lustre, conchoidal fracture, translucency, and colour.

2. It somewhat resembles Vesuvian, and also Olivine. Its granular form, conchoidal fracture, strong lustre, and inferior translucency, distinguish it from *Vesuvian*; and its colour, stronger lustre, more perfect conchoidal fracture, and rather greater hardness, distinguish it from *Olivine*.

Fourth

Fourth Subspecies.

Common Augite.

Gemeiner Augit, *Werner.*

Gemeiner Augit, *Hoff.* b. i. s. 464.

External Characters.

Its colours are blackish-green and velvet-black.

It occurs in large and small imbedded grains.

Internally its lustre is intermediate, between shining and glistening, and is resinous.

The fracture is coarse, and small-grained uneven. Sometimes inclining to imperfect conchoidal.

It is translucent on the edges, seldom translucent.

In its other characters it agrees with the foliated subspecies.

Geognostic and Geographic Situations.

It occurs principally in secondary trap-rocks, as basalt and greenstone, and also in lavas. The secondary trap-rocks of France, Germany, and Britain, and the lavas of Vesuvius and Iceland, in many cases abound with this mineral.

Observations.

The dark colour, granular form, inferior lustre, compact fracture, and low transparency, are the distinguishing characters of this subspecies.

Fifth

Fifth Subspecies.

Coccolite *.

Kokkolith, *Werner.*

Körniger Augit, *Karsten.*

Coccolith, *D'Andrada,* Scherer's Journal, b. iv. 19. s. 30. *Id. Schumacher,* Verzeichn. s. 30. *Id. Broch.* t. ii. p. 504. *Id. Haüy,* t. iv. p. 355. *Id. Reuss,* b. i. s. 86. *Id. Lud.* b. ii. s. 134. *Id. Suck.* 1r th. s. 184. *Id. Bert.* s. 159. *Id. Mohs,* b. i. s. 55. *Id. Lucas,* p. 194. *Id. Leonhard,* Tabel. s. 2.—Pyroxene Coccolithe, *Brong.* t. i. p. 447.—Pyroxene granuleux, *Brard,* p. 141.—Körniger Augit, *Karsten,* Tabel. s. 40. *Id. Haus.* s. 98.—Pyroxene granuliforme, *Haüy,* Tabl. p. 42. —Kokkolith, *Steffens,* b. i. s. 347. *Id. Hoff.* b. i. s. 443.—Körniger Augit, *Lenz,* b. i. s. 208.—Coccolith, *Oken,* b. i. s. 336. *Id. Aikin,* p. 228.

External Characters.

Its principal colour is leek-green, which passes on the one side into pistachio-green, blackish-green, even into olive-green, and oil-green, and on the other into mountain-green.

It occurs massive, also in distinct concretions, which are coarse or small, seldom fine angulo-granular, and are so loosely aggregated together, as frequently to be separable by the simple pressure of the finger. Sometimes the concretions are longish granular. It is sometimes crystallized, in the following forms:

1. Six-

* *Coccolith,* from the Greek word *κοκκος, granum,* and λιθος, on account of the granular concretions that characterize it.

1. Six-sided prism, with two opposite acute lateral edges, and bevelled on the extremities; the bevelling planes set on the acute lateral edges. Sometimes two additional planes occur, when the bevelment passes into a four-planed acumination; and in other varieties two of the opposite lateral planes disappear, when the planes that meet under acute angles form a
2. Four-sided prism.

The crystals are generally blunt, or rounded on the angles and edges, even appear with convex lateral faces, and hence pass into longish grains.

The crystals are generally middle-sized, seldom small, and occur either singly imbedded, as is the case with the grains, or in druses.

The surface of the distinct concretions is sometimes rough, and strongly glimmering, sometimes smooth and glistening.

Externally the crystals are sometimes smooth, sometimes rough; the first is shining and glistening, the other strongly glimmering.

Internally it is shining, sometimes approaching to glistening, and the lustre is vitreous, inclining to resinous.

It has a double oblique angular cleavage.

The fracture is uneven.

The fragments are more or less sharp-edged.

It is translucent, or translucent on the edges.

It is hard in a low degree: it scratches apatite, but not felspar.

It is brittle.

It is very easily frangible.

Specific gravity, 3.316, *D'Andrada*.—3.303, *Karsten*.—3.15, 3.06, *Schumacher*.—3.373, *Haüy*.

Chemical

Chemical Characters.

It is very difficultly fusible before the blowpipe.

Constituent Parts.

Silica,	50.0	
Lime,	24.0	
Magnesia,	10.0	
Alumina,	1.5	
Oxide of Iron,	7.0	
Oxide of Manganese,	3.0	
Loss,	4.5	
	100	*Vauquelin.*

Geognostic Situation.

It occurs in mineral beds subordinate to the primitive trap formation, where it is associated with granular limestone, garnet, and magnetic ironstone.

Geographic Situation.

It occurs at Arendal in Norway; in the iron mines of Hellsta and Assebro in Sudermanland; and in many places in Nericke, in Sweden. The mountain-green variety is found at Barkas in Finland. It is mentioned as occurring in the Harzeburg Forest in the Hartz, in Lower Saxony; and also in Spain.

Observations.

1. *Distinctive Characters.—a.* Between Coccolite and *Common Garnet:* The internal lustre of common garnet is resinous, that of coccolite vitreous; common garnet has no cleavage, while coccolite has a distinct cleavage; common

mon garnet scratches quartz, coccolite only apatite; common garnet has a specific gravity of 3.75, coccolite of 3.33.—*b.* Between Coccolite and *Common Augite:* The colour-suites of the two minerals are different; the lustre of common augite is resinous, that of coccolite is vitreous; in common augite the distinct concretions are grown together, whereas they are so loosely aggregated in coccolite, as frequently to be separable by the mere pressure of the fingers; coccolite is rather softer than augite; and the concretions in coccolite are frequently enveloped in an extremely delicate crust, which is not the case with common augite.

2. It was first described by D'Andrada, under its present name.

Sixth Subspecies.

Diopside.

Diopsid, *Werner.*

Cristaux gris-verdâtres, transparens; formes tres prononcés, du Depart. du Po; *Alalite* de *Bonvoisin,* Journal de Physique, Mai 1806, p. 409, &c.—Varieté du *Diopside,* Journal des Mines, n. 115. p. 65. &c.—Cristaux gris-verdâtres, ou blancs grisâtres, offrant la forme primitive peu prononcé, de Depart. du Po; *Mussite* de *Bonvoisin,* Journal de Physique, ib.—Varieté du Diopside, Journal des Mines, ib.—*Pyroxene;* also Pyroxene cylindroide, comprimé, et fibro-granulaire, *Haüy,* Tabl. p. 41, 42.—Diopsiod, *Steffens,* b. i. s. 349. *Id. Hoff.* b. ii. s. 467. *Id. Lenz,* b. i. s. 212.—Strahliger Pyroxen, *Oken,* b. i. s. 335.—Diopsid, *Haus.* Handb. b. ii. s. 494.

External

* *Diopside,* from δὶς and ὄψις, because when viewed as a distinct species, the cleavage appeared to point out a double series of crystallizations.

External Characters.

Its colours are greenish-white, greenish-grey, and pale mountain-green.

It occurs massive, disseminated, in lamellar concretions, which sometimes approach to prismatic; and crystallized in the following figures:

1. Low, oblique four-sided prism, sometimes equilateral, sometimes broad *.
2. The preceding figure truncated on the acute lateral edges, bevelled on the obtuse edges, and the edge of the bevelment truncated: also rather acutely acuminated by four planes, two of the large acuminating planes set on the truncating planes of the acute lateral edges of the prism, the two smaller on the truncating planes of the bevelment. The two edges of the larger truncating planes, and the truncating planes of the acute edges of the prism, and the apex of the acumination, truncated. The broader lateral planes of the prism, and the truncating planes of the acumination, belong to the primitive form †.
3. Eight-sided prism, with alternate broader and smaller lateral planes, acuminated with four planes, the acuminating planes set on the smaller lateral planes, and this acumination again acuminated with four planes, set obliquely on the planes of the lower acumination, and of which two adjacent planes are large, and two small. The summit of the second acumination, and also the angles of the truncated summit, and the lateral edges of the larger planes, are truncated. The smaller lateral planes of the prism,

* Diopside primitive, Haüy; Mussite, Bonvoisin.

† Diopside didodecaedre, Haüy; Alalite, Bonvoisin.

prism, and acuminating planes of the upper acumination, belong to the primitive form *.

The broader lateral planes are deeply longitudinally streaked; but the smaller lateral planes, and the acuminating planes, are smooth.

The crystals are middle-sized and small; occur resting on one another, intersecting one another, and collected into scopiform groups.

Externally it is shining and glistening, and pearly; internally it is shining and vitreous.

The cleavage is the same as in sahlite.

The fracture is uneven, sometimes inclining to imperfect and small conchoidal.

The fragments are splintery, or indeterminate angular.

It is translucent.

It is as hard as augite.

Specific gravity 3.310, *Haüy*.

Chemical Characters.

It melts with difficulty before the blowpipe.

Constituent Parts.

Silica,	57.50
Magnesia,	18.25
Lime,	16.50
Iron and Manganese,	6.00

Laugier.

* Diopside octovigesimal, Haüy.

Geognostic and Geographic Situations.

It is found in the hill of Ciarmetta in Piedmont; also in the Black Rock at Mussa, near the town of Ala, in veins, along with epidote or pistacite, and hyacinth-red garnets; and in the same district, in a vein traversing serpentine, along with prehnite, calcareous-spar, and iron-glance or specular iron-ore. It is said also to occur at St Nicolas, in the Upper Valais.

Observations.

1. This mineral was discovered by Dr Bonvoisin, who formed it into two species, named *Alalite* and *Mussite:* the white-coloured and massive varieties, and those crystallized in the form N° 2. he refers to alalite; the green, with scopiformly aggregated crystals, and radiated fracture, he considers as mussite. Haüy having ascertained that mussite and alalite have the same primitive form, ranked them in the system as one species, under the name *Diopside;* afterwards, he ascertained that the primitive form of diopside did not differ from that of augite, and consequently abolished the diopside species, and arranged it in the system as a variety of augite.

2. The Fassaite of Werner, the Pyrogom of Breithaupt, is a particular variety or subspecies of oblique-edged augite.

Seventh

Seventh Subspecies.

Sahlite *.

Sahlit, *Werner.*

Sahlit, *D'Andrada,* Scherer's Journal, b. iv. 19. s. 81. *Id. Schumacher,* Verzeichniss, s. 32. *Id. Haüy,* t. iv. p. 379. *Id. Broch.* t. ii. p. 518. *Id. Reuss,* b. ii. s. 474. *Id. Lud.* b. i. s. 158.—Malacolith, *Suck.* 1r th. s. 186. *Id. Bert.* s. 162. *Id. Mohs,* b. i. s. 488.—Malacolithe, *Lucas,* p. 201.—Sahlit, *Leonhard,* Tabel. s. 31.—Malacolithe, *Brong.* t. i. p. 445. *Id. Brard,* p. 414.—Sahlit, *Karsten,* Tabel. s. 44.—Salait, *Haus.* s. 98.—Pyroxene laminaire gris-verdâtre, *Haüy,* Tabl. p. 42.—Malacolith, *Steffens,* b. i. s. 354.—Sahlit, *Lenz,* b. ii. s. 700.—Schaliger Pyroxene, *Oken,* b. i. s. 333.—Sahlit, *Hoff.* b. ii. s. 319. *Id. Aikin,* p. 228.

External Characters.

Its colours are greenish-grey, mountain, leek, and blackish green.

It occurs massive, and in straight lamellar and coarse granular concretions; also crystallized in the following figures:

1. Broad rectangular four-sided prism, which approaches to the tabular form.
2. Preceding figure, with truncated lateral edges, and in which the terminal planes are set on obliquely.

The crystals are occasionally superimposed, and are middle-sized and small.

* So named from Sala in Sweden where it was first found.

Internally the lustre of the principal fracture is shining, splendent and vitreous; that of the cross fracture dull.

It has a fivefold cleavage: one of the cleavages is parallel with the terminal planes; two with the lateral planes; and two with the diagonals of the prism: the prism splits easily in the direction of all the planes, but most easily in the direction of the terminal planes.

The fracture is uneven.

The fragments are sometimes indeterminate angular, sometimes rhomboidal.

It is strongly translucent on the edges.

It is harder than augite.

It is rather brittle.

It is rather easily frangible.

Specific gravity, 3.223, *Haüy*.—3.265, *Breithaupt*.—3.473, *Dr Wollaston*.

Chemical Characters.

It melts with great difficulty before the blowpipe.

Constituent Parts.

Silica, - -	53.00
Magnesia, - -	19.00
Alumina, - -	3.00
Lime, - -	20.00
Iron, and Manganese, -	4.00

Vauquelin, in Haüy, t. iv. p. 302.

Geognostic and Geographic Situations.

Europe.—It occurs in the island of Unst in Shetland: in granular limestone in the island of Tiree, one of the Hebrides: in limestone in Glen Tilt; in Rannoch: in the

silver

silver mines of Sala, in Westmanland in Sweden, associated with asbestous actynolite, calcareous-spar, iron-pyrites, and galena; near Arendal in Norway, along with magnetic iron-stone, common hornblende, calcareous-spar, and seldom with felspar and black mica.

Asia.—At Odon-Tschelong, near the river Amour in Syberia, along with beryl, mica, and calcareous-spar, and on the shores of the Lake Baikal *.

America.—In South Greenland †; and on the banks of Lake Champlain.

Observations.

This mineral was first described as a variety of felspar, from which, however, it is distinguished by colour, lustre, cleavages, inferior hardness, and greater specific gravity: It is more nearly allied to hornblende, but its crystallizations, cleavage, greater transparency, and hardness, show that it is a different species; and its dark green colours, granular concretions, and inferior translucency, distinguish it from *Diopside*.

2. Straight-Edged Augite ‡.

Rechtkantiger Augit, *Mohs*

This Species contains five Subspecies, viz. Carinthin, Hornblende, Actynolite, Tremolite, and Asbestus.

First

* The variety from Baikal has been described under the name *Baikalite.*

† Gieseckė.

‡ In most of the varieties of this species, the edge formed by the meeting of the bevelling planes on the ends of the prisms, is straight; hence the name *Straight-edged Augite.*

First Subspecies.

Carinthin *.

Karinthin, *Werner.*

Keraphyllit, *Steffens,* Handb. b. i. s. 303.—Blättricher Augit, *Karsten,* in Klap. Beit. b. iv. s. 185. *Id. Hoff.* b. i. s. 459.—Blättricher Strahlstein, *Haus.* Handb. b. ii. s. 723.—Amphibole laminaire, *Haüy,* Tabl. p. 40.

External Characters.

Its colours are greenish and velvet black.

It occurs massive and disseminated; and the massive varieties in coarse granular concretions.

Internally it is splendent, and the lustre is resino-vitreous.

It has a distinct double cleavage, in which the folia meet under angles of 55° 50′, and 124° 50′.

The fracture is conchoidal.

The fragments are indeterminate angular, and very sharp-edged.

The greenish-black varieties are strongly translucent on the edges, but the velvet-black is opaque.

It is as hard as hornblende.

Specific gravity, 3.085, *Klaproth.*—3.161, 3.194, *Breithaupt.*

Chemical Characters.

It is difficultly fusible.

Constituent

* *Carinthin,* from Carinthia, the country where it occurs.

Constituent Parts.

Silica,	- -	52.50
Alumina,	- -	7.25
Magnesia,	- -	12.50
Lime,	- -	9.00
Potash,	- -	0.50
Oxide of Iron,	- -	16.25
		98.00

Klaproth, Beit. b. iv. s. 189.

Geognostic and Geographic Situation.

It occurs in the Saualpe in Carinthia, in a bed in primitive rock, associated with quartz, kyanite, garnet, and zoisite.

Observations.

1. This mineral is distinguished from *Hornblende* by its high degree of lustre, kind of lustre, perfect conchoidal fracture, greater hardness, and rather inferior specific gravity. Its cleavage and inferior hardness distinguish it from *Augite*.

2. It was first described as a particular species under the name Saualpite; afterwards by Werner and Karsten, as a variety of Foliated Augite; by Hausmann, as Foliated Actynolite; by Steffens as a new species, under the name *Keraphyllit*; and, lastly, again, by Werner, as a new species, under the name Carinthin.

Second

Second Subspecies.

Hornblende *.

Hornblende, *Werner.*

THIS Species is divided into three Kinds, viz. Common Hornblende, Hornblende-Slate, and Basaltic Hornblende.

First Kind.

Common Hornblende.

Gemeiner Hornblende, *Werner.*

Corneus facie spatosa, striata, *Wall.* gen. 26. spec. 171.—Hornblende, *Kirw.* vol. i. p. 213.—Gemeiner Hornblende, *Estner,* b. ii. s. 699. *Id. Emm.* b. i. s. 322. & b. iii. s. 267.—Orniblenda commune, *Nap.* p. 276.—La Hornblende commune, *Broch.* t. i. p. 415.—Amphibole laminaire, *Haüy,* t. iii. p. 63. —Gemeiner Hornblende, *Reuss,* b. ii. s. 144. *Id. Lud.* b. i. s. 118. *Id. Suck.* 1r th. s. 118. *Id. Bert.* s. 185. *Id. Mohs,* b. i. s. 492. *Id. Hab.* s. 31. *Id. Leonhard,* Tabel. s. 24.—Amphibole schorlique commun, *Brong.* t. i. p. 452.—Gemeiner Hornblende, *Karsten,* Tabel. s. 38. *Id. Haus.* s. 91.—Amphibole lamellaire, *Haüy,* Tabl. p. 40.—Gemeiner Hornblende, *Steffens,* b. i. s. 304. *Id. Lenz,* b. i. s. 317. *Id. Oken,* b. i. s. 323. *Id. Hoff.* b. ii. s. 147. *Id. Haus.* Handb. b. ii. s. 700.—Common Hornblende, *Aikin,* p. 221.

External Characters.

Its most frequent colour is greenish-black, sometimes greyish-

* This mineral is frequently found mixed with others; hence the name *blende,* from the Swedish *blandat,* mixed; and the prefix *horn,* refers to its toughness, or difficult frangibility, in which it agrees with horn.

greyish-black, seldom velvet-black; from greyish-black it passes into dark greenish-grey; and from greenish-black into blackish-green, leek-green, and dark olive-green.

It occurs massive and disseminated, and in distinct concretions, which are large, coarse, and small granular, and also wedge-shaped prismatic. It is rarely crystallized, and the principal forms are the following:

1. Broad, long, thin, very oblique four-sided prism, in which the obtuse lateral edges are sometimes rounded, thus giving a reed-like form to the crystals; or the acuter edges are truncated, and the prism bevelled on the one extremity, the bevelling planes set on the acuter lateral edges, and often the edge of the bevelment is truncated. Very frequently there are no terminal crystallizations.

When the truncating planes of the acuter lateral edges of the oblique prisms increase in magnitude, there is formed

2. A six-sided prism, with four opposite broader lateral planes, and very flatly acuminated on one extremity, with three planes, which are set on the alternate lateral edges.

The crystals are small and middle-sized; often occur intersecting one another, or scopiformly or stellularly aggregated, and are either imbedded or superimposed.

The lateral planes of the prism are deeply longitudinally streaked.

Internally the lustre is shining and pearly.

The cleavage is twofold, and oblique angular, and the folia are longitudinally streaked. The angles of the cleavage the same as in carinthin.

The fracture is coarse and small grained uneven.

The

The fragments are indeterminate angular, and rather sharp-edged.

The black coloured varieties are opaque, but the green generally translucent on the edges.

It is harder than apatite, but not so hard as felspar; it is not so hard as augite.

It yields a mountain-green, inclining to a greenish-grey coloured streak.

When breathed on or moistened, even when brought from a colder to a warmer place, it yields what is called a bitter smell.

It is rather brittle.

It is rather difficultly frangible.

Specific gravity, 3.202, 3.287, *Karsten.*—3.243, *Klaproth.*

Chemical Characters.

It melts before the blowpipe, with violent ebullition, into a greyish-black coloured glass.

Constituent Parts.

	Common Hornblende from Nora in Westmanland.
Silica, - -	42.00
Alumina, - -	12.00
Lime, - -	11.00
Magnesia, - -	2.25
Oxide of Iron, - -	30.00
Ferruginous Manganese,	0.25
Water, - -	0.75
Trace of Potash.	
	98.25

Klaproth, Beit. b. v. s. 158.

Geognostic

Geognostic Situation.

It forms an essential ingredient in several mountain rocks: is sometimes accidentally intermixed with others; and it frequently occurs in beds of considerable magnitude. Thus, it forms an essential ingredient of syenite and primitive greenstone; also of transition syenite and greenstone; and of secondary greenstone. It occurs occasionally in granite, gneiss, mica-slate, clay-slate, and porphyry; and beds of it, frequently associated with ores of different kinds, as magnetic-ironstone, and iron-pyrites, appear in gneiss, mica-slate, and clay-slate.

Geographic Situations.

Europe.—It occurs very abundantly in Scotland, in greenstone and syenite; and imbedded in limestone, gneiss, and mica-slate. It is found in similar rocks in England; and plentifully in the primitive and secondary trap-rocks of Ireland. On the Continent, it occurs abundantly in Sweden; in Norway, as at Arendal, where it is associated with coccolite, felspar, quartz, granular limestone, titanite, and magnetic-ironstone: in Lower Saxony, as in the Hartz, where it forms a constituent part of transition greenstone; in Upper Saxony, as in the Erzgebirge; also in Hessia, Silesia, Franconia, Bavaria, Switzerland, Austria, Hungary, Transylvania, Italy, France, and Spain.

Asia.—It occurs very abundantly in many parts of Siberia, as Kolyvan, Irkutzk, Catharinenburg, &c.

America.—In North America, it has been observed in primitive and secondary, and also in transition rocks, from Greenland, and the shores of Hudson's Bay, to the Isthmus of Darien.

Observations.

Observations.

This mineral is characterized by its frequent dark-green colours, crystallizations, lustre and fracture, distinct concretions, weight and smell. It is distinguished from *Actynolite* by its darker colours, kind of lustre, opacity, darker streak, inferior hardness, and greater weight.

It sometimes very nearly resembles *Epidote*, from which, however, it may be distinguished by its cleavage, opacity, streak, and inferior hardness.

Second Kind.

Hornblende-Slate.

Hornblende Schiefer, *Werner*.

Corneus rigidus non nitens, apparenter lamellis parallelis; Corneus fissilis, *Wall.*—Schistose Hornblende, *Kirw.* vol. i. p. 222. —La Hornblende schisteuse, *Broch.* t. i. p. 428.—Schiefriger Hornblende, *Reuss*, b. ii. s. 151.—Hornblende-Schiefer, *Lud.* b. i. s. 120. *Id. Suck.* 1r th. s. 238. *Id. Bert.* s. 187. *Id. Hab.* s. 32. *Id. Leonhard*, Tabel. s. 25.—Amphibole hornblende shisteux, *Brong.* t. i. p. 453.—Schiefrige Hornblende, *Karst.* Tabel. s. 38.—Hornblende-Schiefer, *Steffens*, b. i. s. 310.—Schiefrige Hornblende, *Lenz*, b. i. s. 321.—Hornblende-Schiefer, *Oken*, b. i. s. 323. *Id. Hoff.* b. ii. s. 155. *Id. Haus.* Handb. b. ii. s. 700.

External Characters.

Its colour is intermediate between greenish-black and blackish-green.

It occurs massive, and in thin promiscuous prismatic concretions.

Internally it is glistening, passing into shining and pearly.

The

The fracture is straight slaty.

The fragments are thick tabular.

It is opaque.

It yields a greenish-grey coloured streak.

It is semi-hard, passing into soft.

It is rather difficultly frangible.

In other characters it agrees with the foregoing.

It is not always pure, being frequently intermixed with mica and felspar.

Geognostic Situation.

It occurs in beds, in granite, gneiss, mica-slate, quartz-rock, sometimes also in clay-slate, and frequently along with beds of primitive limestone. It occasionally accompanies metalliferous beds, that contain magnetic-ironstone, chlorite, and other minerals. It is frequently intermixed with mica; and sometimes with quartz or iron-pyrites.

Geographic Situation.

Europe.—In Scotland, it occurs in gneiss, in the districts of Braemar and Aberdeen, in Aberdeenshire; in Banffshire, as near Portsoy; in Argyleshire, as in the islands of Coll, Tiree, &c.; in Inverness-shire, as in the islands Rona, Lewis, &c.; and in many other parts in Scotland; and also in England and Ireland, as will be mentioned in the fourth volume of this work. On the Continent, it occurs in Norway, Sweden, Saxon Erzgebirge, Lusatia, Bohemia, Silesia, Franconia, Bavaria, Moravia, Switzerland, Stiria, the Tyrol, Hungary, France, and Spain.

Asia.—It occurs abundantly in many places in Siberia, as Nertschinsk, Kolywan, and Catharinenburg.

Third

Third Kind.

Basaltic Hornblende*.

Basaltische Hornblende, *Werner.*

Schorl opaque rhomboidal, *Romé de Lisle,* t. ii. p. 379.—Basaltische Hornblende, *Wid.* s. 417.—Basaltine, *Kirw.* vol. i. p. 219.—Basaltische Hornblende, *Estner,* b. ii. s. 719. *Id. Emm.* b. ii. s. 330. *Id.* b. iii. s. 269.—Orniblenda basaltica, *Nap.* p. 281.—Amphibole, *Lam.* t. ii. p. 330.—Amphibole crystallizée, *Haüy,* t. iii. p. 58.—Basaltische Hornblende, *Reuss,* b. ii. s. 159. *Id. Lud.* b. i. s. 120. *Id. Suck.* 1r th. s. 242. *Id. Bert.* s. 188. *Id. Mohs,* b. i. s. 500. *Id. Hab.* s. 32. *Id. Leonhard,* Tabel. s. 25.—Amphibole schorlique basaltique, *Brong.* t. i. p. 452.—Basaltische Hornblende, *Haus.* s. 91. *Id. Karsten,* Tabel. s. 38. *Id. Steffens,* b. i. s. 311. *Id. Lenz,* b. i. s. 322. *Id. Oken,* b. i. s. 324. *Id. Hoff.* b. ii. s. 157. *Id. Haus.* Handb. b. ii. s. 700.—Basaltic Hornblende, *Aikin,* p. 221.

External Characters.

Its colours are velvet-black or brownish-black.

It occurs crystallized, in the following figures:

1. Unequiangular six-sided prism, flatly acuminated with three planes, set on the alternate lateral edges of the prism †, Fig. 109. Pl. 6.
2. The preceding prism, flatly acuminated on one extremity by four planes, which are set on the four opposite

* It is named *Basaltic Hornblende,* because it occurs principally in basaltic rocks.

† Amphibole dodecaedre, Haüy.

opposite lateral planes, and on the other extremity bevelled, the bevelling planes set on the two opposite lateral edges *, Fig. 110. Pl. 6.

3. The six-sided prism flatly acuminated on one extremity by three planes, which are set on the alternate lateral edges; on the other bevelled, the bevelling planes set on the opposite lateral edges †, Fig. 110[3]. Pl. 6.

4. Six-sided prism, in which two opposite lateral planes are broader than the others, and doubly acuminated on the extremities; first, with four planes, which are set on those edges which one of the broader lateral planes always forms with an adjacent smaller one; and again acuminated with four planes, which are set on the first, under very obtuse angles ‡.

The crystals are small and middle-sized, seldom large, and are imbedded, and all around crystallized. Their surfaces are smooth.

The lustre of the cleavage is splendent and vitreous, approaching to pearly; that of the cross fracture is glistening.

It has a distinct double cleavage, in which the folia meet under angles of 55° 50′, and 124° 50′.

The fracture is small-grained uneven, approaching to conchoidal.

The fragments are indeterminate angular, and sometimes indistinctly rhomboidal.

It is always opaque.

It

* Amphibole equi-different, Haüy.

† Amphibole ondecimal, Haüy.

‡ Amphibole surcomposé, Haüy.

It is rather harder than common hornblende.

It is rather brittle.

It is more easily frangible than the preceding subspecies.

It affords a dark greyish-white streak.

Specific gravity, 3.158, 3.199, *Karsten*.—3.158, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it melts into a black glass, but is rather more refractory than common hornblende.

Constituent Parts.

	Basaltic Hornblende from Fulda.
Silica, - -	47.00
Alumina, - -	26.00
Lime, - -	8.00
Magnesia, - -	2.00
Oxide of Iron, -	15.00
Water, - -	0.50
	98.50

Klaproth, Beit. b. v. s. 154.

Geognostic Situation.

It occurs imbedded in basalt, along with olivine and augite; also in wacke and trap-tuff; in small quantity in some kinds of porphyry, and frequently in lava.

Geographic Situation.

Europe.—It occurs in the basalt of Arthur's Seat, and other similar hills around Edinburgh; in the basalt of Fifeshire, and that of the islands of Mull, Canna, Eig, and Skye.

Skye. It is also an inmate of the basaltic rocks in England and Ireland. Upon the Continent, it occurs in the secondary trap-rocks of Fulda, the Saxon Erzgebirge, Bohemia, Spain, and other countries.

America.—It is frequent in the basaltic rocks of Mexico.

Observations.

1. It is distinguished from the other kinds of *Hornblende* by its colour, crystallization, and splendent lustre; from *Augite* by its form, splendent lustre, and more oblique cleavage. It has been confounded with Schorl, by some authors; but it is distinguished from it by colour, form, lustre, foliated fracture, and inferior hardness.

2. It decomposes more slowly than basalt: hence we frequently find unaltered crystals dispersed through the clay formed by the decomposition of basaltic rocks.

3. Beyer describes a mineral under the name *Kohlenhornblende*, (Coal Hornblende), which appears to be nearly allied to hornblende; hence it deserves to be noticed in this part of the system. He describes it in the following terms:—Its colour is velvet-black, passing into brownish-black. It occurs massive and disseminated. The principal fracture is imperfect foliated, almost slaty, sometimes straight, sometimes curved, and inclining to fibrous; the cross fracture is small-grained uneven. The lustre of the principal fracture is shining and glistening, and pearly; the cross fracture glimmering, or dull. It is opaque. It affords a dark greenish grey-coloured streak. It is soft. It emits a clayey smell when breathed on. It occurs imbedded

bedded in pitchstone-porphyry, between Zwickau and Planitz *.

Third Subspecies.

Actynolite †.

Strahlstein, *Werner*.

THIS subspecies is divided into three kinds, viz. Asbestous Actynolite, Common Actynolite, and Glassy Actynolite.

First Kind.

Asbestous Actynolite.

Asbestartiger Strahlstein, *Werner*.

Asbestartiger Strahlstein, *Wid.* s. 479.—Amianthinite, *Kirw.* vol. i. p. 164.—Asbestartiger Strahlstein, *Emm.* b. i. s. 416.—Asbestoid, *Lam.* t. ii. p. 371.—Actinote aciculaire, *Haüy,* t. iii. p. 75.—La Rayonnante asbestiforme, *Broch.* t. i. p. 504.—Asbestartiger Strahlstein, *Reuss,* b. ii. 1. s. 174. *Id. Lud.* b. i. s. 140. *Id. Suck.* 1r th. s. 252. *Id. Bert.* s. 156. *Id. Mohs,* b. i. s. 581. *Id. Hab.* s. 61. *Id. Leonhard,* Tabel. s. 30. Amphibole actinote aciculaire, *Brong.* t. i. p. 455.—Asbestartiger Strahlstein, *Karst.* Tabel. s. 40. *Id. Haus.* s. 99.—Asbestinite, *Kid,* vol i. p. 116.—Amphibole, *Haüy,* Tabl. p. 40.—Asbestartiger Strahlstein, *Steffens,* b. i. s. 281. *Id. Lenz,* b. ii. s. 683.—Strahlige Hornblende, *Oken,* b. i. s. 322.—Asbestartiger Strahlstein, *Hoff.* b. ii. s. 293. *Id. Haus.* b. ii. s. 727.

External

* Vid. Beyer, in Crell's Chem. Annal. 2. 11. 381.—Lenz, Tabel. s. 33.—Leonhard, Tasch. b. i. s. 267.

† *Actynolite,* from the Greek words *ακτιν, ray,* and λιθος, *stone,* on account of its radiated or prismatic concretions.

External Characters.

Its colour is greenish-grey, which passes on the one side through mountain-green into a kind of sky-blue, on the other through olive-green into yellowish-brown, and liver-brown.

It occurs massive, in distinct concretions, which are fibrous, and sometimes collected into others which are promiscuous wedge-shaped, and granular. It rarely occurs crystallized, in delicate capillary, rigid, moss-like, superimposed crystals.

Internally the lustre is glistening and pearly.

The fracture, owing to the smallness of the concretions, is not visible.

The fragments are splintery and wedge-shaped.

It is opaque, or slightly translucent on the edges.

The fibres or concretions in groups are soft, but individually equally hard with the other varieties of actynolite.

Specific gravity, 2.809, *Karsten*.

Chemical Characters.

It melts with difficulty before the blowpipe, into a black or dark green coloured glass.

Constituent Parts.

Silica, - -	47.0
Lime, - -	11.3
Magnesia, -	7.3
Oxide of Iron, -	20.0
Oxide of Manganese,	10.0
Loss, - -	4.4
	100.0

Vauquelin, in Haüy, t. iv. p. 335.

This is an analysis of the variety of Asbestous Actynolite, named *Byssolite* by Saussure.

Geognostic Situation.

It occurs in beds in gneiss, mica-slate, and granular limestone, along with magnetic ironstone, iron-glance, iron-pyrites, copper-pyrites, variegated copper-ore, malachite, galena, blende, common actynolite, amethyst, garnet, and asbestus.

Geographic Situation.

Europe.—In Norway, it occurs at Arendal, Kongsberg, and Röraas; in Sweden, at Sala, and other places; in the Hartz, the Saxon Erzgebirge, Bohemia, Franconia, Silesia, Switzerland, Hungary, Italy, and France.

America.—Greenland; and the metalliferous mountains of Zacatecas in Mexico.

Observations.

1. It is distinguished from the other subspecies by its colour-suite, fibrous concretions, capillary crystallizations, pearly lustre, and inferior degree of hardness. It is distinguished from *Asbestus* by its fibrous, wedge-shaped and granular concretions.

2. Those varieties of asbestous actynolite which occur in very thin scopiformly aggregated acicular elastic-flexible crystals, have been considered as forming a distinct species, and named *Byssolite* by Saussure, *Amianthoid* by Haüy, and *Asbestoid* by some French mineralogists.

Second

Second Kind.

Common Actynolite.

Gemeiner Strahlstein, *Werner.*

Basaltes radiis minimis, fibrosis, nitidis, compositus; Basaltes fibrosus, *Wall.* gen. 22. sp. 152.—Gemeiner Strahlstein, *Wid.* s. 480.—Schorlaceous Actynolite, and Common Asbestoid, *Kirw.* vol. i. p. 166. & 168.—Gemeiner Strahlstein, *Estner,* b. ii. s. 887. *Id. Emm.* b. i. s. 418.—Stralite commune, *Nap.* p. 323.—Zillerthite, *Lam.* t. ii. p. 357.—Actinote etalé, *Haüy,* t. iii. p. 75.—La Rayonnante commune, *Broch.* t. i. p. 507.—Gemeiner Strahlstein, *Reuss,* b. i. s. 176. *Id. Lud.* b. i. s. 140. *Id. Suck.* 1r th. s. 140. *Id. Bert.* s. 185. *Id. Mohs,* b. i. s. 583. *Id. Hab.* s. 59. *Id. Leonhard,* Tabel. s. 31.—Amphibole Actinote hexaedre, *Brong.* t. i. p. 454.—Gemeiner Strahlstein, *Karst.* Tabel. s. 40. *Id. Haus.* s. 99.—Actynolite, *Kid,* vol. i. p. 116.—Amphibole comprimé, *Haüy,* Tabl. p. 40.—Gemeiner Strahlstein, *Steffens,* b. ii. s. 284. *Id. Lenz,* b. i. s. 681. *Oken,* b. i. s. 322. *Id. Hoff.* b. ii. s. 296. *Id. Haus.* Handb. b. ii. s. 725.

External Characters.

Its principal colour is leek-green, which passes on the one side into blackish-green, on the other into olive-green and grass-green.

It occurs massive and disseminated; also in wedge-shaped prismatic concretions, which are thin, thick, scopiform, stellular, and promiscuous; these sometimes pass into coarse, small, and long angulo-granular concretions. Frequently the prismatic concretions are collected into large granular concretions.

Internally

Internally it is shining, inclining to glistening, and is pearly inclining to vitreous.

It has a distinct double oblique angular cleavage, in which the angles are 124° 50′ and 55° 50′.

The fracture is uneven and conchoidal.

The fragments are splintery and wedge-shaped, seldom indeterminate angular.

It is generally translucent on the edges.

It is rather harder and more brittle than hornblende.

Specific gravity, 2.994, 3.293, *Kirwan*.

Chemical Characters.

Before the blowpipe, it melts into a greenish-grey or blackish glass.

Constituent Parts.

Silica,	64.00	
Magnesia,	20.00	
Alumina,	2.70	
Lime,	9.30	
Iron,	4.00	
	100	*Bergmann.*

Geognostic Situation.

It occurs in beds in gneiss, mica-slate, and talc-slate, sometimes alone, sometimes accompanied with ores of different kinds, as galena, magnetic ironstone, copper-pyrites, and blende. Small and irregular veins occasionally occur in transition-trap, and minute portions in secondary or flœtz-trap rocks.

Geographic

Geographic Situation.

It occurs at Eilan Reach in Glenelg, in Inverness-shire; near Fortrose in Cromarty; in the parish of Sleat, in the isle of Skye; different places in the isle of Lewis. In Cornwall, as in the neighbourhood of Redruth *. On the Continent, it is not uncommon in Saxony, Bohemia, Silesia, Sweden, and Norway.

Observations.

1. This is the most common kind of Actynolite. It never occurs regularly crystallized; the crystallized varieties of actynolite formerly included under this kind, being now referred by Werner to the Glassy Actynolite.

2. The mineral named *Pargasite* is now arranged with common actynolite.

Third Kind.

Glassy Actynolite.

Glasartiger Strahlstein, *Werner*.

Glasartiger Strahlstein, *Wid.* s. 438.—Glassy Actynolite, *Kirw.* vol. i. p. 168.—Glasartiger Strahlstein, *Estner,* b. ii. s. 893. *Id. Emm.* b. i. s. 422.—Stralite vetrosa, *Nap.* p. 326.—La Rayonnante vitreux, *Broch.* t. i. p. 510.—Glasartiger Strahlstein, *Reuss,* b. i. s. 182. *Id. Lud.* b. i. s. 141. *Id. Bert.* s. 155. *Id. Mohs,* b. i. s. 386. *Id. Leonhard,* Tabel. s. 31.—Amphibole actinote fibreux, *Brong.* t. i. p. 455.—Glasartiger Strahlstein, & Muschlicher Strahlstein, *Karst.* Tabel. s. 40.—Glasartiger Strahlstein, *Haus.* s. 99.—Amphibole etalé et fibreux, (in part), *Haüy,* Tabl. p. 40.—Glasartiger Strahlstein, *Steffens,*

* Greenough.

fens, b. i. s. 286. *Id. Lenz*, b. ii. s. 685. *Id. Oken*, b. i. s. 322. *Id. Hoff.* b. ii. s. 298. *Id. Haus.* b. ii. s. 726.

External Characters.

Its principal colour is mountain-green, which passes into grass-green, and leek-green, also into blackish-green, and greenish-grey.

It occurs massive; also in prismatic distinct concretions, which are very thin or fibrous, and thin or radiated, and are arranged in a scopiform, and rarely in a promiscuous manner; and these are again collected into thick and wedge-shaped prismatic, or large granular concretions. It sometimes occurs crystallized, and in the following figures:

1. Very oblique four-sided prism, which is long, thin, and often acicular, and truncated on the acute edges.
2. Rather flat six-sided prism, with two opposite acute lateral edges.

If the crystals are fully crystallized, and not broken, the edges of the obtuse lateral edges, and the angles of the acute lateral edges, are generally truncated; and sometimes the terminal edges are truncated.

The lateral planes are longitudinally streaked, seldom smooth and splendent.

Internally it is shining, sometimes splendent, and intermediate between vitreous and pearly.

It has a distinct double oblique angular cleavage.

The fracture is not visible, owing to the smallness of the concretions.

The fragments are splintery and wedge-shaped.

It is translucent, or semi-transparent.

It is brittle.

It is uncommonly easily frangible.

It is traversed by numerous parallel rents.

It is as hard as hornblende, but more brittle.

Specific gravity, 3.175, *Karsten*.

Chemical

Chemical Characters.

Before the blowpipe, it melts with difficulty into an opaque green-coloured glass.

Constituent Parts.

Glassy Actynolite from Zillerthal in the Tyrol.

Silica, -	50.00
Magnesia, -	19.25
Alumina, -	0.75
Lime, - -	9.75
Potash, - -	0.50
Oxide of Iron, -	11.00
Oxide of Manganese,	0.50
Oxide of Chrome, -	3.00
Carbonic Acid, and Water,	5.00
Loss, - -	0.25

Laugier, Annales du Mus. t. v. p. 79.

Geognostic and Geographic Situations.

Europe.—It occurs in primitive rocks in the isle of Skye: in veins, along with rock-crystal, axinite, and epidote, at Bourg d'Oisans in Dauphiny; in beds of indurated talc, with limestone and common talc, on St Gothard; also in a similar repository in the Zillerthal, in the Tyrol; and in Sweden.

Asia.—It appears to be associated with talc at Bialoyarsk, in the Uralian Mountains.

Observations.

1. It is distinguished from the preceding kind by its vitreous lustre, crystallizations, and parallel cross rents.

2. The fibrous varieties of glassy actynolite have been confounded with Amianthus; but they are distinguished from

from it by lustre, cross rents, and the rough feel of their powder.

Fourth Subspecies.

Tremolite *.

Tremolith, *Werner.*

THIS subspecies is divided into three kinds, viz. Asbestous Tremolite, Common Tremolite, and Glassy Tremolite.

First Kind.

Asbestous Tremolite.

Asbestartiger Tremolit, *Werner.*

Asbestartiger Tremolith, *Emm.* b. i. s. 425. *Id. Estner,* b. ii. s. 893.—Grammatite, *Haüy,* t. iii. p. 227.—La Tremolith asbestiforme, *Broch.* t. i. p. 514.—Asbestartiger Tremolith, *Reuss,* b. i. s. 136. *Id. Lud.* b. i. s. 142. *Id. Suck.* 1r th. s. 272. *Id. Bert.* s. 166. *Id. Mohs,* b. i. s. 589. *Id. Leonhard,* Tabel. s. 31.—Grammatite, *Brong.* t. i. p. 475. *Id. Lucas,* p. 77. *Id. Brard,* p. 188.—Asbestartiger Tremolith, *Karsten,* Tabel. s. 44.—Amphibole blanc et soyeux, *Haüy,* Tabl. p. 41.—Asbestartiger Tremolith, *Steffens,* b. i. s. 290. *Id. Lenz,* b. i. s. 689.—Asbestartiger Grammatite, *Oken,* b. i. s. 327.—Asbestartiger

* The name is derived from *Tremola,* a valley in the Alps, where it is said to have been first found. It would, however, appear, that it was first discovered in Transylvania by M. Von Fichtel, and described by him under the name *Saulen* and *Stern-spath:* it was afterwards, in the year 1788, found in the Valley of Tremola.

bestartiger Tremolit, *Hoff.* b. ii. s. 306. *Id. Haus.* Handb. b. ii. s. 732.

External Characters.

Its most common colour is greyish-white; it is found also yellowish-white, and greenish-white, rarely reddish-white, and pale violet blue *.

It occurs massive; also in fibrous or very thin prismatic distinct concretions; these are generally scopiform or stellular, and collected into thick and wedge-shaped prismatic, and into large granular concretions.

Internally it is shining, approaching to glistening, and is pearly †.

The fracture is not visible.

The fragments are wedge-shaped, or splintery.

It is translucent on the edges.

It is rather easily frangible.

It is soft, approaching to very soft, in the mass, but the individual concretions are as hard as the other kinds of this subspecies.

It is rather sectile.

Physical Characters.

When struck gently, or rubbed in the dark, it emits a pale reddish-coloured light; when pounded, and thrown on coals, a greenish-coloured light. It phosphoresces more than any of the other subspecies.

Chemical

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* The rare violet-blue variety has been hitherto found only at St Marcel in Piedmont.

† It has a lower lustre than any of the other subspecies.

Chemical Characters.

Before the blowpipe it melts into a white opaque mass.

Geognostic Situation.

It occurs most frequently in granular foliated limestone, or in dolomite; sometimes in chlorite; and more rarely in secondary trap-rocks.

Geographic Situation.

Europe.—It occurs in foliated granular limestone in Glen Tilt, in Perthshire, and in Glen Elg in Inverness-shire; in dolomite in Aberdeenshire and Icolmkill; and in basalt in the Castle Rock of Edinburgh. In Norway, it is an inmate of foliated granular limestone; in Bohemia, it is imbedded in limestone, along with calcareous-spar, slate-spar, brown-spar, fluor-spar, and quartz; at Dognatska in Hungary, with galena, copper-pyrites, iron-pyrites, compact and foliated magnetic ironstone, and garnet; Switzerland in dolomite; in granular limestone, along with augite, on Mount Vesuvius.

America.—It is found in foliated granular limestone in many places in the United States, and in Greenland.

Asia.—Patrin found it at Kadainsk, in Siberia.

Observations.

Its fibrous concretions, pearly lustre, and softness, characterize it as a particular kind of Tremolite. It is distinguished from *Amianthus*, by its concretions, comparative brittleness, and meagre feel; and its higher lustre, inferior translucency and hardness, distinguish it from *Fibrous Zeolite.*

Second

Second Kind.

Common Tremolite.

Gemeiner Tremolit, *Werner.*

Gemeiner Tremolith, *Estner*, b. ii. s. 901. *Id. Emm.* b. i. s. 426. —Grammatite, *Haüy*, t. iii. p. 227.—La Tremolithe commune, *Broch.* t. i. p. 515.—Gemeiner Tremolith, *Reuss*, b. i. s. 188. *Id. Lud.* b. i. s. 142. *Id. Suck.* 1 th. s. 274. *Id. Bert.* s. 164. *Id. Mohs*, b. i. s. 590.—Grammatite, *Lucas*, p. 77.—Tremolith, *Hab.* s. 61. *Id. Leonhard*, Tabel. s. 31.—Grammatite, *Brong.* t. i. p. 475. *Id. Brard*, p. 188.—Gemeiner Tremolith, *Karsten*, Tabel. s. 44.—Gemeiner Grammatite, *Haus.* s. 97. —Amphibole grammatite, *Haüy*, Tabl. p. 40.—Gemeiner Tremolith, *Steffens*, b. i. s. 291. *Id. Lenz*, b. ii. s. 691.—Gemeiner Grammatite, *Oken*, b. i. s. 327.—Gemeiner Tremolit, *Hoff.* b. ii. s. 308.—Gemeiner Grammatite, *Haus.* Handb. b. ii. s. 730.

External Characters.

Its most frequent colour is white, and principally greyish and yellowish white, seldom greenish and reddish white; the greyish-white passes into smoke-grey, and the greenish-white into pale asparagus-green.

It occurs massive; also in distinct concretions, which are prismatic, and these are collected into large and coarse longish granular concretions. It is sometimes crystallized, and in the following figures:

1. Very oblique-four-sided prism, truncated on the acute lateral edges.
2. Same prism, truncated on the obtuse lateral edges.
3. Same prism, truncated on all the lateral edges.

4. Same

4. Same prism, bevelled on the obtuse lateral edges. When these bevelling planes increase so much that the original ones disappear, there is formed
5. An extremely oblique four-sided prism.
6. Very oblique four-sided prism, very flatly bevelled on the extremities, the bevelling planes set on the acute lateral edges *.
7. The preceding figure †, truncated on the acute lateral edges.
8. N° 6. truncated on all the lateral edges ‡.
9. N° 6., in which all the lateral edges are rounded off ||.

The lateral planes are longitudinally streaked.

The crystals are middle-sized or small; sometimes singly imbedded, sometimes superimposed, or promiscuously aggregated.

The lustre is shining, and intermediate between vitreous and pearly ¶.

It has a double oblique angular cleavage §, the angles of which are 124° 50′, 55° 50′.

The

* Grammatite di-tetraedre, Haüy.

† Grammatite bis-unitaire, Haüy.

‡ Grammatite tri-unitaire, Haüy.

|| Grammatite cylindroide, Haüy.

¶ It has a higher degree of lustre than any of the other subspecies.

§ This mineral splits easily, not only in the direction of the planes of the prism, but also in that of its diagonals, particularly the longest diagonal. When we break across one of these prisms, we observe on the fracture-surface a line in the direction of the longer diagonal, which is so strongly marked, that at first sight we are apt to consider it as pointing out these as hemitrope or twin-crystals. The name *Grammatite*, formerly given to this mineral by Haüy, is derived from the character just stated. It is also worthy of remark, that in the fracture of tremolite, even in crystals, there is

The fracture is uneven, or conchoidal.

The fragments are splintery and wedge-shaped, or indeterminate angular.

It is translucent, or semi-transparent.

It is as hard as hornblende.

It is rather brittle.

It is easily frangible.

Its powder is rough to the feel.

Specific gravity, 2.9257, 3.2, *Haüy.*—2.832, *Karsten.*—3.000, *Wid.*

Chemical Character.

Before the blowpipe, it loses its colour and transparency, melts with great difficulty, often only on the edges, and with considerable ebullition, into an opaque glass.

Constituent Parts.

Silica,	27.0	Silica,	35.5	Silica,	52.0	Silica,	50
Magnesia,	18.5	Magnesia,	16.5	Magnesia,	12.0	Magnesia,	25
Lime,	21.0	Lime,	16.5	Lime,	20.0	Lime,	18
Alumina,	6.0	Carbonic acid		Carbon. acid,	12.0	Carbonic acid	
Carbon. acid,	26.0	and Water,	23.0	A trace of iron.		and Water,	5
	Chenevix.		*Buchols.*		*Lowitz.*		*Laugier.*

Geognostic Situation.

Like the asbestous subspecies, it occurs principally in granular limestone, or dolomite, and in metalliferous beds. These

is a tendency to the fibrous structure: the stroke of a hammer, or even the simple pressure of the finger in some cases, will separate folia or radia into fibres as delicate as those of amianthus, and which are somewhat elastic-flexible.

These beds contain, besides the tremolite, quartz, calcareous-spar, garnet, blende, galena, copper-pyrites, and vitreous copper-ore, or copper-glance. It sometimes occurs in indurated talc, along with rhomb-spar; or in common talc, with calcareous-spar and rutile. It occurs rarely in serpentine and granite.

Geographic Situation.

Europe.—It occurs in Glen Tilt and Glen Elg, and in Unst, one of the Shetland Islands; also at Clicker Tor in Cornwall. On the Continent, it occurs at Kongsberg in Norway, along with ores of silver; in the island of Senjen in Nordland, in thin beds, resting on limestone, and covered with a bed of massive garnet; in Sweden, Hessia, Bohemia, Silesia, Moravia, Switzerland, the Tyrol, Carinthia, Carniola, Hungary, Transylvania, Italy, and France.

Asia.—It is found on the borders of the Lake Baiakal.

America.—It occurs in several districts of the United States.

Africa.—Egypt.

Third Kind.

Glassy Tremolite.

Glasartiger Tremolith, *Werner.*

Glasartiger Tremolith, *Estner,* b. ii. s. 907. *Id. Emm.* b. i. s. 429.—Grammatite, *Haüy,* t. iii. p. 229.—La Tremolithe vitreuse, *Broch.* t. i. p. 516.—Glasartiger Tremolith, *Reuss,* b. i. th. 1. s. 193. *Id. Lud,* b. i. s. 145. *Id. Suck.* 1r th. s. 277. *Id. Bert.* s. 165. *Id. Mohs,* b. i. s. 392.—Grammatite, *Lucas,* p. 77.—Glasartiger Tremolith, *Leonhard,* Tabel. s. 31.—Tremolith, *Hab.* s. 61.—Grammatite, *Brong.* t. i. p. 475. *Id.* *Brard,*

Brard, p. 188.—Glasartiger Tremolith, *Karsten,* Tabel. s. 44. *Id. Haus.* s. 97.—Amphibole Grammatite, *Haüy,* Tabl. p. 40. Glasartiger Tremolith, *Steffens,* b. i. s. 294. *Id. Lenz,* b. ii. s. 694.—Glasartiger Grammatite, *Oken,* b. i. s. 327.—Glasiger Tremolit, *Hoff.* b. ii. s. 311.—Glasartiger Grammatite, *Haus.* Handb. b. ii. s. 729.

External Characters.

Its colours are greyish, greenish, yellowish, and reddish white.

It occurs massive; also in distinct concretions, which are thin, very thin, straight and scopiform prismatic, with numerous cross-rents, and these are again grouped into thick and wedge-shaped concretions.

It is frequently crystallized in long acicular crystals.

Its lustre is shining, but in a lower degree than the preceding subspecies, and intermediate between vitreous and pearly.

The fragments are splintery and wedge-shaped.

It is translucent.

It is nearly as hard as hornblende.

It is very easily frangible, and very brittle.

Specific gravity 2.863, *Karsten.*

Physical Character.

It is phosphorescent in a low degree.

Chemical Character.

It is said to be infusible before the blowpipe.

Constituent Parts.

		Tremolite from St Gothard.					
Silica,	65.00	Silica,	35.5	Silica,	28.4	Silica,	41.00
Magnesia,	10.33	Lime,	26.5	Lime,	30 6	Lime,	15.00
Lime,	18.00	Magnesia,	16.5	Magnesia,	18.0	Magnesia,	15 25
Iron,	0.16	Water, and		Water, and		Water, and	
Carbon. acid,		Carbon. acid,	23.0	Carbon. acid,	23.0	Carbon. acid,	23.00
and Water,	6.05					Loss,	5.75
			101.5		100.0		
							100.0
Klaproth.		*Laugier*, Annales du Museum, 34 cahier, t. vi. p. 232.					

Geognostic Situation.

It is the same as that of the preceding subspecies, occurring principally along with granular limestone.

Geographic Situation.

Europe.—In Scotland, it occurs along with the other kinds. It is found at Arendal in Norway; Sweden; in Bavaria, Salzburg, the Tyrol, Switzerland, and Hungary.

Asia.—In the island of Ceylon; in the Uralian Mountains.

America.—In the United States.

Observations.

1. On a general view, Tremolite is characterized by its white colours; Actynolite by its light green colours; and Hornblende by its dark green colours.

2. A mineral found in ironstone in Normark in Sweden, has been lately described by Werner, under the name *Calamite.* It appears to be a variety of tremolite. The following is the description of it, as given in Leonhard's Taschenbuch for 1816:—

Colour

Colour intermediate between asparagus and pistachio green, sometimes approaching to mountain-green. Occurs in reed-like prismatic crystals, in which the lateral planes are deeply longitudinally streaked. Is shining and splendent, and vitreous, inclining to metallic. Oblique double cleavage. Uneven fracture. As hard as actynolite. Easily frangible.

Another mineral, found in Pfitschthal in the Tyrol, has been described under the name *Rhatizit*, but which appears to be but a variety of Glassy Tremolite. The following description is given in Leonhard's Taschenbuch for 1816:

Colour milk-white, seldomer yellowish and greyish white, and isabella-yellow, and smoke-grey. Occurs massive. Fracture scopiform and stellular radiated. Fragments splintery. Distinct concretions large granular. Translucent on the edges. Semihard. Rather brittle. Rather easily frangible.

Fifth Subspecies.

Asbestus.

Asbest, *Werner.*

THIS subspecies is divided into four kinds, viz. Rock-Cork, Amianthus, Common Asbestus, and Rock-Wood.

First Kind.

Rock-Cork *.

Berg Cork, *Werner.*

Aluta montana, *Wall.* t. i. p. 414.; Suber montanum, Id. p. 415.—Berk Kork, *Wid.* s. 469.—Suber montanum, Corium montanum, *Kirw.* vol. i. p. 163.—Berg Kork, *Estner,* b. ii. s. 864. *Id. Emm.* b. i. s. 399.—Sughero montano, *Nap.* p. 319.—Varieté d'Amianthe, *Lam.* p. 367.—Le Siege de montagne, *Broch.* t. i. p. 492.—Asbeste tresse, *Haüy,* t. iii. p. 248.—Holz Asbest, *Reuss,* b. ii. 2. s. 253.—Kork Asbest, *Lud.* b. i. s. 137.—Berg Kork *Suck.* 1r th. s. 263. *Id. Bert.* s. 148. *Id. Mohs,* b. i. s. 567.—Asbeste tresse, *Lucas,* p. 81.—Berg Kork, *Leonhard,* Tabel. s. 29.—Asbeste suberiforme, *Brong.* t. i. p. 479.—Asbeste tresse, *Brard,* p. 194.—Schwimmender Asbest, *Karst.* Tabel. s. 42. *Id. Haus.* s. 99.—Compact spongy Amianthus, *Kid,* vol. i. p. 103.—Asbeste tresse, *Haüy,* Tabl. p. 55.—Berg Kork, *Steffens,* b. i. s. 278. *Id. Lenz,* b. ii. s. 670.—Korkichter Asbest, *Oken,* b. i. s. 326.—Berg Kork, *Hoff.* b. ii. s. 278.—Schwimmender Asbest, *Haus.* Handb. b. ii. s. 738.—Mountain Cork, *Aikin,* p. 232.

External Characters.

Its colours are yellowish and greyish white, also yellowish and ash grey, and pale ochre yellow.

It occurs massive, in plates that vary in thickness †, corroded,

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* This mineral is named *Rock Cork,* on account of its resembling cork in lightness, and its receiving impressions from the nail.

† The variety in plates has received the following names: *Mountain Flesh,* Bergfleish, Caro montana, Chaire de montagne, Chair fossile; *Mountain Paper,* Papiere fossile, Bergpapier; *Mountain Leather,* Bergleder, Corium montanum, Cuir de montagne.

roded, and with impressions; and these forms are composed of delicate and promiscuous fibrous concretions.

Internally it is feebly glimmering, or dull.

The fracture is fine-grained uneven, inclining to slaty in the large.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It is very soft.

It becomes shining in the streak.

It is sectile, almost like common cork.

It is slightly elastic flexible.

It is difficultly frangible.

It adheres slightly to the tongue.

It emits a grating sound when we handle it.

It feels meagre.

It is so light as to swim on water.

Specific gravity, 0.679, 0.991, *Brisson.*—0.991, *Haüy* *.

Chemical Characters.

It melts with great difficulty before the blowpipe into a milk-white nearly translucent glass.

Constituent Parts.

Silica, -	56.2	62.0
Magnesia, -	26.1	22.0
Alumina, -	2.0	2.8
Lime, -	12.7	10.0
Oxide of Iron,	3.0	3.2
	100	100

Bergmann, Opusc. t. iv. p. 170.

Geognostic

* This low specific gravity is owing to the loose texture of the mass.

Geognostic Situation.

It occurs in cotemporaneous veins in serpentine, and in red sandstone; also in metalliferous veins in primitive and transition rocks; and occasionally in mineral beds.

Geographic Situation.

It occurs in veins in the serpentine of Portsoy, and in the red sandstone of Kincardineshire; in plates, in the lead-veins at Lead Hills and Wanlockhead in Lanarkshire; and in small quantities at Kildrummie in Aberdeenshire. At Sala in Sweden, it occurs in a metalliferous bed, along with asbestus, steatite, calcareous-spar, rhomb-spar, and brown-spar: in veins along with ores of silver, calcareous spar, and heavy-spar, at Kongsberg in Norway; in the silver-mines of Johanngeorgenstadt in Saxony; at Valecas in Spain, in beds along with meer-schaum and talc: and in primitive rocks in Carinthia, Idria, France, Moravia, &c.

Second Kind.

Amianthus, or Flexible Asbestus *.

Amiant, *Werner.*

Αμιαντος of the Greeks.—Amiantus, *Plin.* Hist. Nat. xxxvi. 19. p. 31.—Asbestus maturus, *Wall.* t. i. p. 410.; Amianthus, Id. p. 408.—Amianth, *Wid.* s. 464.—Amianthus, *Kirw.* vol. i. p. 161.—Amianth, *Estner,* b. ii. s. 368. *Id. Emm.* b. i. s. 402. —Amiantho, *Nap.* p. 316.—L'Amianth, *Lam.* t. ii. p. 365.—*Id.*

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* *Amianthus*, from *αμιαντος, unstained, unsoiled*, which refers to the property this substance possesses, of remaining unsoiled in the fire. It is also named Rock-flax and Rock-wool.

Id. Broch. t. i. p. 494.—Asbest flexible, *Haüy*, t. iii. p. 245. Biegsamer Asbest, *Reuss*, b. 2. ii. s. 243.—Amianth, *Lud.* b. i. s. 137.—Amianth-asbest, *Suck.* 1r th. s. 265.—Amianth, *Bert.* s. 149. *Id. Mohs*, b. i. s. 569.—Amianth-asbest, *Hab.* s. 64.—Asbest flexible, *Lucas*, p. 81.—Biegsamer Asbest, *Leonhard*, Tabel. s. 30.—Asbest amianthe, *Brong.* t. i. p. 478.—Asbest flexible, *Brard*, p. 194.—Biegsamer Asbest, *Karst.* Tabel. s. 42.—Amianth, *Haus.* s. 99.—Loosely fibrous and flexible Amianthus, *Kid*, vol. i. p. 101.—Asbest flexible, *Haüy*, Tabl. p. 55.—Amiant, *Steffens*, b. i. s. 276. *Id. Lenz*, b. ii. s. 672. Biegsamer Asbest, *Oken*, b. i. s. 325.—Amianth, *Hoff.* b. ii. s. 281. *Id. Haus.* Handb. b. ii. s. 736.—Amianthus, *Aikin*, p. 232.

External Characters.

Its most common colour is greenish-white, of different degrees of intensity, which passes into greenish-grey, and rarely into light olive-green. It is sometimes blood-red, particularly when it occurs in veins in serpentine.

It occurs massive, and in small veins, also in fibrous distinct concretions, which are parallel, generally straight, and sometimes curved.

Internally its lustre is shining and pearly, occasionally approaching to semi-metallic.

The fracture is not visible.

The fragments are generally long splintery, or thread-like.

It is translucent on the edges, or opaque.

It is very soft.

It is sectile.

It is perfectly flexible.

It splits easily.

Specific gravity, 2.444, *Muschenbröck*. According to *Brisson*, it varies considerably in specific gravity: he found the

the long silky amianthus to vary from 0.9088 to 2.3134, before it had absorbed water; from 1.5662 to 2.3803, after it had absorbed water.

Chemical Characters.

Before the blowpipe, it phosphoresces, and melts with difficulty into a whitish or greenish slag.

Constituent Parts.

	Asbestus of Swartioick, in Sweden.	Asbestus of Tarentaise, in Savoy.	Asbestus of Torias, in Spain.	
Silica, - -	64.0	64.0	72.00	59.00
Carbonate of Magnesia,	17.2	18.6	12.19	25.00
Alumina, - -	2.7	3.3	3.03	3.00
Carbonate of Lime,	13.9	6.9	10.05	9.05
Barytes, - -		6.0		
Oxide of Iron, -	2.2	1.2	2.02	2.25
	Bergmann, Opusc. t. iv.	*Bergmann*, Id.	*Bergmann*, Id.	*Chenevix*.

Geognostic Situation.

It occurs frequently along with common asbestus, in cotemporaneous veins in serpentine; in similar veins in primitive and secondary greenstone, gneiss, and mica-slate; and it occasionally forms one of the constituent parts of metalliferous beds.

Geographic Situation.

Europe.—It occurs in serpentine in the islands of Mainland *, Unst and Fetlar in Shetland; and in the same rock at Portsoy; in veins in mica-slate, at Glenelg in Inverness-shire:

* Hibbert.

shire; in different parts of Aberdeenshire, and Argyleshire: in secondary greenstone in the middle division of Scotland, as in Fifeshire, particularly in Inchcolm, and other quarters. In England, it occurs in veins in serpentine, at St Kevern's in Cornwall *. On the Continent, it occurs in the Hartz, in veins in primitive greenstone; in Bohemia, in metalliferous beds, along with magnetic ironstone: in Upper Saxony, in veins in serpentine; and in a similar situation in Silesia and Switzerland. In Dauphiny, and in St Gothard, it is found in cotemporaneous veins in gneiss and mica-slate, along with felspar, earthy and common chlorite, and rock-crystal. Uncommonly beautiful white and long fibrous varieties are met with in the Val de Serre in Savoy, at Cogne in Piedmont, and in the island of Corsica †.

Asia.—It abounds in serpentine rocks in the Uralian and Altain mountains.

America.—In veins that traverse serpentine in Maryland, Delaware, New Jersey, Connecticut, and Massachusets ‡.

Uses.

This mineral, on account of its flexibility, and its resisting the action of considerable degrees of heat, was woven into those incombustible cloths in which the ancients sometimes wrapped the bodies of persons of distinction, before they were placed on the funeral-pile, that their ashes might be

* Greenough.

† It is so abundant in Corsica, that Dolomieu used it in place of hay and tow for packing his collections of minerals.

‡ Cleaveland's Mineralogy, p. 328.

be collected free from admixture *. After the body was consumed, the cloth was withdrawn from the fire, the ashes taken out of it, washed with milk and wine, and sprinkled with consecrated water, and inclosed in an urn, either with or without the fossile-cloth in which the body had been consumed †. The goodness of the amianthus for this purpose, depends on the length of its fibres, which vary from an inch to a foot in length, its whiteness and flexibility. In preparing the cloth, the amianthus is previously well washed, to free it of all impurities, then combed straight, and woven with flax. The cloth is placed on glowing coals, by which the flax and oil used in the operation of weaving are consumed, and the cloth is deprived of its stains ‡. In this manner are manufactured, not only large pieces of cloth, but also gloves, purses, belts, and napkins. All these articles have a shining appearance, and white colour; but various tints may be communicated to them by artificial means. At Nerwinski in Siberia, gloves, caps and purses are made of amianthus; and it is worked into girdles, ribbons, and other articles, in the Pyrenees. The finest girdles are made by weaving the most beautiful varieties of amianthus with silver-wire: they are much prized by the women, not only on account of their beauty, which is certainly

* Dioscorides says: "Amianthus lapis in Cypro nascitur, scissili alumini similis, quo elaborato utpote flexili, telas spectaculi gratia texunt, quæ ignibus injectæ ardent quidem sed flammis invectæ splendidiores exeunt."

† Dolomieu informs us, that he saw in the Library of the Vatican in Rome, a shroud, containing ashes and burnt bones, which had been found in a sarcophagus; and in Italy, asbestus-cloth, containing ashes, has been frequently found inclosed in urns.

‡ We are told that the Emperor Charlemagne had a table-cloth of amianthus, which he used to throw into the fire after dinner, that it might burn clean, by way of amusing his guests.

certainly very considerable, but from certain mysterious properties they are supposed to possess. When a number of fibres are placed together, we can use them as a wick for lamps; and it is remarked, that such a wick readily attracts the oil, and affords a pretty lively flame. It is said the Romans made use of this kind in the lamps placed in their temples and cemeteries; hence, it has been alleged that these lamps never required to be renewed *. It is well known, however, that the duration of amianthus wicks is not considerable; for Rozier found that they did not continue for more than twenty hours †. Paper has been made of this mineral, but it is too hard for use. It has been proposed to preserve valuable documents from fire, by writing them on paper of amianthus. Such a plan might deserve consideration, if we possessed fire-proof ink. Dolomieu informs us, that it is used by the Corsicans in the composition of a kind of pottery, which is thereby rendered very light, and less liable to be broken by sudden alternations of temperature, or even by falling, than other kinds of pottery. The Chinese pound and knead it with gum-tragacanth, and form it into a kind of furnace, which they affirm to be very durable. Ancient physicians prescribed it for different diseases. Thus, in the state of salve, it was considered as very useful in restoring vigour to enfeebled limbs: the itch was said to yield readily to its drying powers; and in affections of the stomach, it was not to be

* The incombustibility of bodies made of amianthus, gave rise among the antients to many fables. Thus, Pliny says, that the asbest (our amianthus) is obtained from an Indian plant, which grows in an arid region of the earth, never refreshed by the rain or dew of heaven, and hence it is able to resist the most violent degrees of heat.

† It is said that the natives of Greenland make use of amianthus for the wicks of their lamps.

be diregarded, as it restored the appetite when entirely lost.

Observations.

1. It is distinguished from *Common Asbestus* by its higher lustre, its fibres being more easily separated, and its flexibility.

2. It is said to be the *Lapis caristius* of Strabo.

Third Kind.

Common Asbestus *.

Gemeiner Asbest, *Werner*.

Asbestus immaturus, *Wall.* t. i. p. 411.—Gemeiner Abest, *Wid.* s. 471.—Asbestus, *Kirwan*, vol. i. p. 159.—Gemeiner Asbest, *Estner*, b. ii. s. 872. *Id. Emm.* b. i. s. 406.—Asbesto commune, *Nap.* p. 314.—Asbeste, *Lam.* t. ii. p. 369.—Asbeste dur, *Haüy*, t. iii. p. 247.—L'Asbeste commune, *Broch.* t. i. p. 497.—Gemeiner Asbest, *Reuss*, b. ii. 2. s. 248. *Id. Lud.* b. i. s. 138. *Id. Suck.* 1r th. s. 267. *Id. Bert.* s. 150. *Id. Mohs*, b. i. s. 571. *Id. Hab.* s. 63.—Asbeste dur, *Lucas*, p. 81. —Gemeiner Asbest, *Leonhard*, Tabel. s. 30.—Asbest dur, *Brong.* t. i. p. 479. *Id. Brard*, p. 194.—Gemeiner Asbest, *Karsten*, Tabel. s. 42. *Id. Haus.* s. 99.—Asbeste dur, *Haüy*, Tabl. p. 55.—Gemeiner Asbest, *Steffens*, b. i. s. 274. *Id. Lenz*, b. i. s. 679.—Steifer Asbest, *Oken*, b. i. s. 325.—Gemeiner Asbest, *Hoff.* b. ii. s. 288.—Talkartiger Asbest, *Haus.* Handb. b. ii. s. 736.—Common Asbest, *Aikin*, p. 233.

External

* The literal signification of this term is *unextinguishable*; but as the verb ἀποσβέννυμι is metaphorically used in the sense of *aboleo*, or *perdo*, it may be rendered *imperishable*; this explanation being more appropriate than the former to the peculiar character of this substance.—*Kid.*

External Characters.

Its colours are dark leek-green, and mountain-green; also greenish-grey and yellowish-grey.

It occurs massive; and in distinct concretions, which are parallel, slightly curved, and coarsely fibrous, and intimately aggregated together.

It is rarely crystallized in capillary crystals *.

Internally it is glistening and pearly.

The fracture is not visible.

The fragments are long splintery.

It is translucent, or only translucent on the edges.

It is soft, approaching to very soft.

It is rather brittle.

It is difficultly frangible.

It feels rather greasy.

Specific gravity, 2.000, *Karsten.*—2.542, *Kirwan.*—2.591, *Breithaupt.*

Chemical Characters.

It melts before the blowpipe into a blackish glass.

Constituent Parts.

According to Mr Chenevix, it contains nearly the same constituent parts as amianthus. Gehlen discovered chrome in the leek-green asbestus of Zöblitz, and manganese in a variety from Siberia.

Geognostic

* Count de Bournon found them to be tetrahedral rhomboidal prisms.—*Cat. Min.* p. 123.

Geognostic Situation.

Like amianthus, it occurs in veins in serpentine, and in primitive greenstone : it also occurs in metalliferous beds, along with magnetic ironstone, iron-pyrites, magnetic-pyrites, calcareous-spar, garnet, and indurated talc, and sometimes along with ores of copper, viz. copper-pyrites, copper-glance, and grey copper-ore.

Geographic Situation.

Europe.—It occurs in the serpentine of Shetland, Portsoy, Anglesey, and Cornwall; and on the Continent of Europe, it is found in all the serpentine districts, and in metalliferous beds in the Saxon Erzgebirge, Salzburg, &c.

Asia.—It is found at Sisertskoi and Sawod, and other parts in Siberia.

America.—In the United States.

Fourth Kind.

Rock-Wood or Ligneous Asbestus.

Bergholz, *Werner*.

Bergholz, *Wid.* s. 473.—Ligniform Asbestus, *Kirw.* vol. i. p. 161. —Bergholz, *Estner*, b. ii. s. 877. *Id. Emm.* b. i. s. 410.— Ligno Montano, *Nap.* p. 321.—Asbeste ligniforme, *Haüy*, t. iii. p. 240.—Le Bois de Montagne, *Broch.* t. i. p. 499.— Asbest ligniforme, *Brong.* t. i. p. 480.—Holzasbest, *Reuss*, b. ii. 2. s. 253. *Id. Leonhard*, Tabel. s. 30.—Asbeste ligniforme, *Lucas*, p. 81. *Id. Brong.* t. i. p. 48. *Id. Brard*, p. 195. —Holzasbest, *Karst.* Tabel. s. 42.—Holzartiger Asbest, *Haus.* s. 99.—Ligniform Asbestus, *Kid*, vol. i. p. 105.—Asbest ligniforme,

niforme, *Haüy,* Tabl. p. 55.—Bergholz, *Steffens,* b. i. s. 280. *Id. Lenz,* b. ii. s. 680.—Holzicher Asbest, *Oken,* b. i. s. 326. Bergholz, *Hoff.* b. ii. s. 291.—Holzasbest, *Haus.* Handb. b. ii. s. 737.—Mountain Wood, *Aikin,* p. 232.

External Characters.

Its colour is wood-brown, of various degrees of intensity.

It occurs massive, and in plates: also in delicate and promiscuous fibrous concretions.

Internally its lustre is glimmering.

The fracture is curved slaty.

The fragments are tabular.

It becomes shining in the streak.

It is soft, passing into very soft.

It is opaque.

It is sectile.

It is rather difficultly frangible.

It is slightly elastic-flexible.

It feels meagre, and adheres slightly to the tongue.

Specific gravity, before immersion, 1.534; after immersion, 2.225, *Breithaupt.*

Chemical Characters.

It is infusible before the blowpipe.

Geognostic and Geographic Situations.

It occurs at Sterzing in the Tyrol, along with many different fossils, as common asbestus, actynolite, quartz, garnet, blende, iron-pyrites, galena, and calamine; and its repository, as Mohs remarks, appears to be a bed, as it is accompanied with minerals that often occur in such situations.

tions. It is also found in Dauphiny, and in Stiria; and Steffens conjectures, from the descriptions of Georgi, that it occurs in different places in the mountains of Archangel and Olocnezk.

Observations.

It is distinguished from *Rock-Cork*, by its wood-brown colour, higher lustre, fracture, and greater specific gravity.

3. Prismatoidal Augite.

Prismatoidischer Augit, *Mohs.*

This Species contains two subspecies, viz. Epidote and Zoisite.

First Subspecies.

Epidote or Pistacite.

Epidote, *Haüy.*

Pistazit, *Werner.*

Schorl vert de Dauphiny, *Romé de Lisle,* t. ii. p. 401.—Thallite, *Daubenton,* Tabl. p. 9.—Thallite, *La Metherie,* Theor. de la Terre, 2d edit. t. ii. p. 319.—Delphinite, *Saussure,* Voyage dans les Alpes, n. 1918.—Acanticone, *Dandrada,* Journ. Chem. von Schœrer, t. iv. p. 19.—Thallite, *Karsten,* Mineral. Tabellen, p. 20.—Arendalite, *ib.* p. 34.—Thallite, *Reuss,* b. ii th. i. s. 117.—Epidote, *Haüy,* t. iii. p. 102.—Thallite, Arendalite, *Lud.* b. ii. s. 136, 137.—Epidot, *Suck.* 1r th. s. 256. —Thallite, Acanticone, *Bert.* s. 196. 173.—Epidote, *Mohs,*

b. i.

b. i. s. 57. *Id. Lucas,* p. 59. *Id. Brong.* t. i. p. 110. *Id. Brard,* p. 153.—Thallite, *Kid.* vol. i. p. 242.—Epidot, *Haüy,* Tabl. p. 43. *Id. Steffens,* b. i. s. 66.—Pistacit, *Hoff.* b. ii. s. 654.—Thallit, *Haus.* Handb. b. ii. s. 672.—Epidote, *Aikin,* p. 222.

External Characters.

Its principal colour is pistachio-green, which passes on the one side into blackish-green and greenish-black, on the other side into dark olive-green, oil-green, and siskin-green.

It occurs massive; also in distinct concretions, which are coarse and small granular, and stellular or scopiform fibrous, which latter are collected into wedge-shaped prismatic concretions.

It is frequently crystallized. The primitive figure is an oblique four-sided prism, in which the lateral planes meet under angles of 114° 37′, and 65° 23′. The following are the secondary figures.

1. Very oblique four-sided prism, bevelled on the extremities; the bevelling planes are set either on the obtuse or on the acute lateral edges, and in the latter case the bevelment is a little flatter than in the first *.
2. The preceding figure truncated on the acute edges, and flatly bevelled on the extremities; the bevelling planes set on the truncating planes; or we may describe it as a broad unequiangular six-sided prism, flatly bevelled on the extremities; the bevelling planes set on the opposite smaller lateral planes, fig. 119. Pl. 6.

* In the first variety, the angle of the bevelment is 110° 6′, in the latter 117° 14′.

3. The preceding six-sided prism acuminated on the extremities by four planes, which are set on the broader lateral planes, and the apex of the acumination, and the angles formed by the meeting of two acuminating planes, with a smaller lateral plane truncated, fig. 120. Pl. 6.
4. The same prism acuminated by six planes, and the apex of the acumination deeply truncated, fig. 121. Pl. 6.
5. The same prism truncated on the acute lateral edges, and flatly acuminated on the extremities by six planes, which are set on the lateral planes, and the apices of the acuminations, and the edges formed by the meeting of two opposite acuminating planes with the lateral planes, truncated, fig. 122. Pl. 6.
6. Very oblique four-sided prism, truncated on the obtuse lateral edges, and doubly acuminated on the extremities by four planes, the apex of the acumination truncated, and simply bevelled hy two planes, set on the acute lateral edges, fig. 123. Pl. 6.

Besides the crystallizations just described, others occur, which are to be viewed as varieties of the preceding, but are difficult of determination, on account of the multiplicity of truncations and bevelments they display, and the unequal increase of the different planes.

The crystals are sometimes reed-like, and are promiscuous, scopiform, and scalarwise aggregated; and are generally middle-sized.

The lateral planes of the crystals are more or less deeply longitudinally streaked, but the truncating, acuminating and bevelling planes are smooth, and the terminal planes diagonally streaked.

Externally, the lustre alternates from splendent to glistening.

tening, and is vitreous; internally, it is shining or glistening, and is resinous, inclining to pearly.

It has a twofold cleavage, and the cleavages are parallel with the lateral planes of the oblique four-sided prism. Of these cleavages one only in general is perfect.

The fracture is small and flat conchoidal, sometimes small-grained uneven, sometimes even or splintery.

The fragments are indeterminate angular, and sharp-edged.

It alternates from translucent to translucent on the edges, and to nearly transparent.

It is harder than felspar, but not so hard as quartz.

It is brittle, and easily frangible.

Specific gravity, 3.452, *Lucas*.—3.452, *Breithaupt*.—Variety named Acanticone, from Norway, 3.407, *Lowry*.

Chemical Characters.

Before the blowpipe it is converted into a brown-coloured scoria, which blackens by continuance of the heat.

Constituent Parts.

	Epidote from the Valais.	From Oisans.	From Arendal.
Silica,	37.0	37.0	37.0
Alumina,	26.0	27.0	21.0
Lime,	20.0	14.0	15.0
Oxide of iron,	13.0	17.0	24.0
Oxide of manganese,	0.6	1.5	1.5
Water, -	1.8	3.5	1.5
Loss, -	1.0	0	0
	100.0	100.0	100.0
		Descotils.	*Vauquelin.*

Laugier, Ann. du Mus. d'Hist. Nat. t. v. p. 149.

Geognostic Situation.

It occurs in beds and veins, and sometimes as an accidental constituent part of rocks. The beds in which it occurs are primitive, and contain augite, garnet, hornblende, quartz, calcareous-spar, and magnetic ironstone, as at Arendal in Norway; or, besides the epidote, they contain calcareous-spar, copper-pyrites, and variegated copper-ore, as in the Bannat and other places. The veins of which it forms a part are small, and of very old formation, usually traverse gneiss, and contain besides the epidote, felspar, rock-crystal, axinite, chlorite, asbestus, prehnite, octahedrite, and several other minerals. The varieties that occur in veins, are distinguished from those that occur in beds, by their lighter colours, and the more needle-shaped aspect of the crystals. The rocks in which it occurs are syenite, porphyry, and undefined granitous rocks.

Geographic Situation.

Europe.—In Arran it occurs in secondary syenite, and clay-slate: in Mainland in Shetland in syenite *. In the island of Icolmkill, in a rock composed of red felspar and quartz: in the island of Rona, also one of the Hebrides, in slender veins, traversing a rock composed of felspar and quartz, and felspar and hornblende: in the syenite of Glencoe and the neighbouring districts; in similar rocks among the Malvern Hills in Worcestershire; in quartz, at Wallow Crag near Keswick in Cumberland; near Marazion in Cornwall; and in granitous rocks in the islands of Guernsey and Jersey †. Upon the Continent of Europe it occurs in

* Hibbert.

† Geological Transactions, vol. i. p. 292.

in magnificent crystals at Arendal; and in porphyry near Christiania in Norway; also in Sweden; imbedded in rolled masses of a granitous rock in Mecklenburg; Bavaria, France, Italy, and Switzerland.

Asia.—Imbedded in granular limestone in Siberia; and in India along with corundum.

Africa.—Found imbedded in common quartz on the banks of the Orange River, by Dr Somerville.

America.—Upon the banks of Lake Champlaine, along with tremolite *; and in the mountains of South Carolina.

Observations.

1. *Distinctive Characters.*—*a.* Between epidote and *Actynolite.* The colour-suite of actynolite differs from that of epidote; in actynolite, the primitive figure has an angle of 124° 34′; but the primitive figure of epidote has an angle of 114° 37′; in actynolite, both the cleavages are distinctly seen; but, in epidote, frequently only one cleavage is to be seen; the crystals of actynolite are generally imbedded, and their terminal edges and angles truncated, whereas the crystals of epidote are frequently superimposed, and their extremities are bevelled or acuminated: actynolite is softer than epidote: and actynolite, before the blowpipe, melts into a greyish-white enamel; epidote into a black scoria.—*b.* Between epidote and *Asbestus.* Asbestus, when pounded, feels soft, whereas epidote feels rough; and asbestus fuses into an enamel, but epidote into a scoria.

2. Klaproth describes, under the title *Scorza*, a substance which probably belongs to this species. Its colour

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* Greenough.

lour is intermediate between pistachio and siskin green: it occurs in fine, roundish, dull, and meagre grains, that scratch glass, and have the specific gravity of 3.135. It contains silica, 43.; alumina, 21.; lime, 14.; oxide of iron, 16.5; oxide of manganese, 0.25. It is found in small nests, in a grey-coloured clayey stone, in a valley near the town of Muska, on the river Aranyos in Transylvania. The Wallachian name for this substance, viz. Scorza, has been retained by Klaproth. It might be arranged as a subspecies of epidote, under the title *Arenaceous Epidote*. Karsten names it *Arenaceous Thallite*.

3. Hausmann, according to Steffens, describes a mineral said to belong to this species, under the name *Earthy Epidote (erdiger Epidot)*. It has a pale siskin-green colour; occurs disseminated, and in membranes. Internally it is dull, and the fracture earthy; it is meagre to the feel, and soils. It occurs in granite, at Trolhatta in Sweden and, I believe, in the island of Rona, and other parts of the Highlands of Scotland.

4. Hausmann describes another mineral under the title *Capillary Epidote*. It is said to have a very dark pistachio-green colour, and to occur in very delicate capillary crystals, which have a lustre intermediate between silky and vitreous, and to incrust small drusy cavities, at Hackedal in Norway.

5. Karsten divides this species into three subspecies, viz. *Common*, *Splintery*, and *Arenaceous*. The arenaceous is the scorza already mentioned; the splintery includes all those varieties that have been described under the names Arendalite and Acanticone.

6. Epidote was first described by Romé de L'Isle as a variety of schorl, under the name Green Schorl. La Metherie afterwards gave an account of it, and describes it as

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a new species, which he named Thallite. Saussure, who found it in the Alps, names it Delphinite; and other varieties found in Norway, were described by Dandrada, by the names Acanticone and Arendalite. Haüy and Werner, nearly about the same time, particularly examined this mineral. Haüy named it Epidote, and Werner Pistacite.

Haüy published a description of the species, which Werner has not done; therefore the name Epidote, given to it by Haüy, has been very generally adopted.

Second Subspecies.

Zoisite *.

This subspecies is divided into two kinds, viz. Common Zoisite and Friable Zoisite.

First Kind.

Common Zoisite.

Zoisite, *Werner.*

Zoisit, *Karsten,* in Klaproth, Beit. b. iv. s. 180.—Epidot, *Haüy,* Journ. des Mines, n. 113. p. 465. *Id. Haüy,* Tabl. p. 44.—Zoisit, *Steffens,* b. i. s. 74. *Id. Hoff.* b. ii. s. 665. *Id. Haus.* Handb. b. ii. s. 676. *Id. Aikin,* p. 223.

External Characters.

Its colours are yellowish-grey, and light bluish-grey, which approaches to smoke-grey. Sometimes also of a colour

* *Zoisite,* in honour of the discoverer Baron von Zois, an Austrian gentleman.

lour intermediate between yellowish-brown and reddish-brown.

It occurs massive; also in large and longish granular and thin straight prismatic distinct concretions.

It occurs crystallized in very oblique four-sided prisms, in which the obtuse lateral edges are often rounded, so that the crystals have a reed-like form. Their surface is shining or glistening.

The crystals are middle-sized, and always imbedded.

Internally, it is shining on the cleavage, and glistening, on the fracture surface, and the lustre is resino-pearly.

The cleavage is double; but in general only one cleavage can be detected, which is parallel with the axis of the oblique prism.

The fracture is small-grained uneven.

The fragments are indeterminate angular, and sharp-edged.

It is feebly translucent, or only translucent on the edges.

It is as hard as epidote.

It is very easily frangible.

Specific gravity, 3.249, 3.290, *Breithaupt.*—3.315, *Klaproth.*

Chemical Characters.

Before the blowpipe it is affected nearly in the same manner as epidote.

Constituent Parts.

Silica,	-	-	43.
Alumina,	-	-	29.
Lime,	-	-	21.
Oxide of Iron,		-	3.

Klaproth, Beit. b. iv. s. 183.

Geognostic

Geognostic and Geographic Situations.

It was first observed in the Saualp in Carinthia, where it occurs imbedded in a bed of quartz along with kyanite, garnet, and augite; or it takes the place of felspar, in a granular rock, composed of quartz and mica. It also occurs imbedded in a coarse granular granite from Thiersheim near Wunsiedel, in Bareuth in Franconia; and in Bavaria, Salzburg, the Tyrol, Carniola, and Switzerland. I have it from Glen Elg in Inverness-shire, and from Shetland, I believe the island of Unst.

Second Kind.

Friable Zoisite.

Murber Zoisit, *Karsten.*

Murber Zoisit, *Karsten,* Magazin de Berlin, Geselch. 2. Jahrg. 3. quart. 1808, s. 187. *Id. Steffens,* b. i. s. 76. *Id. Klaproth,* Beit. b. v. s. 41.

External Characters.

Its colour is reddish-white, which is spotted with pale peach-blossom red.

It is massive, and in very fine loosely aggregated granular concretions.

It is very feebly glimmering.

The fracture is intermediate between earthy and splintery.

The fragments are not very sharp-edged.

It

It is translucent on the edges.
It is semi-hard.
It is brittle.
It is rather heavy.
Specific gravity 3.300, *Klaproth.*

Constituent Parts.

Silica, - -	44.
Alumina, - -	32.
Lime, - -	20.
Oxide of Iron, - -	2.50
	98.50

Klaproth, Beit. b. v. s. 43.

Geognostic and Geographic Situations.

It occurs imbedded in green talk at Radelgraben in Carinthia.

4. Prismatic Augite, or Tabular Spar.

Prismatischer Augitspath, *Mohs.*

Schaalstein, *Werner.*

Tafelspath, *Karsten.*

Tafelspath, *Reuss,* b. ii. s. 435. *Id. Lud.* b. ii. s. 144. *Id. Suck.* 1r th. s. 422.—Schaalstein, *Bert.* s. 166. *Id. Mohs,* b. ii. s. 1.—3. —Tafelspath, *Leonhard,* Tabel. s. 35. *Id. Karsten,* Tabel. s. 44.—Spath en tables, *Haüy,* Tabl. p. 66.—Schaalstein, *Lenz,* b. ii. s. 763.—Spathiger Conit, *Oken,* b. i. s. 392.—Schaalstein,

Schaalstein, *Hoff.* b. iii. s. 55.—Tafelspath, *Haus.* Handb. b. ii. s. 582.—Tabular Spar, *Aikin*, p. 183.

External Characters.

Its most common colour is greyish-white, which passes into greenish and yellowish white, and reddish-white.

It occurs massive, and coarsely disseminated; also in distinct concretions, which are coarse, long, and broad angulo-granular, and these are again composed of others which are thin and straight lamellar.

Internally the lustre varies from shining to glistening, and is pearly, inclining to vitreous.

The cleavage is double, and the folia are in the direction of an oblique prism of about 105°,—*Mohs.*

The fracture is splintery.

It is translucent.

It is harder than fluor-spar, but not so hard as apatite.

It is brittle, and easily frangible.

Specific gravity, 3.2—3.5, *Mohs.*

Constituent Parts.

Silica,	-	-	50
Lime,	-	-	45
Water,	-	-	5
			100

Klaproth, Beit. b. iii. s. 291.

Geognostic and Geographic Situations.

Europe.—It occurs in primitive rocks at Orawicza in the Bannat of Temeswar, where it is associated with brown garnets,

garnets, blue-coloured calcareous-spar, tremolite, actynolite, and variegated copper-ore.

Asia.—It has been lately discovered in the Island of Ceylon, associated with cinnamon-stone in gneiss.

Genus IX.—SCHILLER-SPAR.

Schiller Spath, *Mohs.*

This Genus contains four Species, viz. 1. Green Diallage, 2. Schiller-Spar, 3. Hyperstene, 4. Anthophyllite.

1. Green Diallage.

Prismatische Schiller Spath, *Mohs.*

Diallage Verte, *Haüy.*

Körniger Strahlstein, *Werner.*

External Characters.

Its colours are grass-green, which sometimes inclines to emerald-green, or to mountain-green.

It occurs massive and disseminated.

Internally it is shining, glistening and pearly.

It

It has an imperfect double cleavage; one only of the cleavages is visible.

Its fragments are indeterminate angular, and rather sharp-edged.

It is translucent on the edges, sometimes passing into translucent.

Some varieties are harder than fluor-spar, and others harder than apatite, but none so hard as felspar.

It is brittle.

Specific gravity 3.0, 3.2., *Mohs.*

Chemical Characters.

It melts before the blowpipe into a grey or greenish enamel.

Constituent Parts.

Silica, - -	50.0
Alumina, - -	11.0
Magnesia, - -	6.0
Lime, - -	13.0
Oxide of Iron, -	5.3
Oxide of Copper, -	1.5
Oxide of Chrome, -	7.5
	94.3

Vauquelin, An. d. Chimie, No. 88.

Geognostic and Geographic Situations.

Europe.—It occurs in the Island of Corsica, along with Saussurite; and with the same mineral in Mont Rosa in Switzerland, and at La Rivera, in the Valley of Susa in Piedmont.

Asia.—In India, along with quartz and rutile.

America.—In Labrador, associated with Saussurite.

Uses.

Uses.

The compound of green diallage and saussurite, named *Gabbro* by the Italians, *Euphotide*, by the French, and by artists *Verde di Corsica duro*, when cut and polished has a beautiful appearance, and is much prized as an ornamental stone. It is cut into snuff-boxes, ring-stones, for in-laid work, and other similar purposes.

Observations.

1. It has been confounded with Hornblende and Felspar; but it is distinguished from the first by its pearly lustre, single distinct cleavage, and inferior hardness; from the latter, by its inferior hardness, and by its cleavage; felspar having always a distinct double cleavage, whereas in this mineral there is but one distinct cleavage.

2. This mineral was first discovered by Saussure, who named it from its colour, Smaragdite, and Emeraudite, which other mineralogists changed into Emerald-Spar, and Prime d'Emeraude. It has been described as a felspar, and also as a variety of hornblende. Haüy remarks, that as the minerals with which this substance had been confounded, have at least two distinct cleavages, whereas it has but one, he chose a name which would recall this difference; hence the origin of the name Diallage, which signifies difference.

2. Schiller-Spar.

Schiefer Schiller-Spath, *Mohs.*

This Species contains two subspecies, viz. Bronzite and Common Schiller-spar.

First

First Subspecies.

Bronzite.

Blättriger Anthophyllit, *Werner.*

Diallage metalloide fibro-laminaire, *Haüy.*

Bronzit, *Leonhard,* Tabel. s. 29.—Diallage metalloide, *Brong.* t. ii. p. 443.—Bronzit, *Karsten,* Tabel. s. 40.—Diallage metalloide fibro-laminaire, *Haüy,* Tabl. p. 47.—Bronzit, *Steffens,* b. i. s. 325. *Id. Lenz,* b. ii. s. 663.—Blättriger Anthophyllit, *Hoff.* b. ii. s. 676.—Bronzit, *Haus.* Handb. b. ii. s. 717. Bronzite, *Aikin,* p. 230.

External Characters.

Its colour is intermediate between clove-brown, yellowish-brown and pinchbeck-brown; it occurs also yellowish-grey.

It occurs massive, and in coarse and small granular distinct concretions.

Internally it is shining, and the lustre is metallic-pearly.

It has a double slightly oblique cleavage: one of the cleavages is very distinct, the other indistinct: they belong to a prism, in which one of the angles appears to be about 100°. The folia are curved, and their surface streaked. Sometimes the folia appear fibrous.

The fragments are indeterminate angular and blunt-edged.

It is translucent on the edges, sometimes approaching to translucent.

It is harder than fluor-spar, but not so hard as apatite.

It affords a white streak.

It

It is difficultly frangible.

Specific gravity, 3.200, *Klaproth.*—3.213—3.281, *Blöde.* 3.271, *Breithaupt.*—3.0, 3.3, *Mohs.*

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

Silica, - -	60.00
Magnesia, - -	27.50
Iron, - - -	10.50
Water, - -	0.50
	98.50

Klaproth, Beit. b. v. s. 34.

Geognostic and Geographic Situations.

It occurs in greenstone in the Island of Skye: in large masses in a bed of serpentine near Kraubat in Upper Stiria; at Kupferberg in Bareuth, in small globular masses, sometimes associated with asbestus, and disseminated magnetic ironstone, in serpentine; in small masses in serpentine near Peinach, on the Pacher Alp in Lower Stiria; and in the vicinity of Hoff in Franconia.

America.—In the island of Cuba.

Observations.

1. Its dark-brown colours, metallic-pearly lustre, distinct single and curved fibro-laminar cleavage, and granular concretions, are its distinguishing characters.

2. It is distinguished from *Common Schiller-spar* by its curved and fibro-laminar cleavage, greater hardness, and brittleness.

Second

Second Subspecies.

Common Schiller-Spar.

Schillerstein, *Werner.*

Diallage metalloide laminaire, *Haüy.*

Schillerspath, ou Spath chatoyant, *Broch* t. i. p. 421.—Schillerende Hornblende, *Reuss,* b. ii. 1. s. 153.—Schillerstein, *Lud.* b. i. s. 134. *Id. Suck.* 1r th. s. 134. *Id. Bert.* s. 532. *Id. Mohs,* b. i. s. 557. *Id. Hab.* s. 30. *Id. Leonhard,* Tabel. s. 28.—Diallage chatoyant, *Brong.* t. i. p. 442.—Smaragdit, *Karsten,* Tabel. s. 40.—Schillerende Hornblende, *Haus.* Nordeutsche Beit. b. i. s. 1.—Diallage metalloide, *Haüy,* Tabl. p. 47.—Schillerstein, *Steffens,* b. i. s. 371. *Id. Lenz,* b. ii. s. 661. *Id. Hoff.* b. ii. s. 264. *Id. Haus.* Handb. b. ii. s. 715.

External Characters.

Its colours are olive-green, which passes on the one side into mountain-green and greenish-grey, on the other into yellowish-brown and pinchbeck-brown.

It seldom occurs massive, generally disseminated, and sometimes in granular distinct concretions.

Internally it is shining and splendent, and the lustre is pearly, or metallic-pearly.

It has a distinct straight single cleavage.

The fragments are indeterminate angular or tabular.

It is faintly translucent on the edges, or is opaque.

It is softer than bronzite.

The streak is greenish-grey, and dull.

It is easily frangible, and slightly inclining to sectile.

Specific gravity, 2.882 ?

Geognostic and Geographic Situations.

It occurs imbedded in serpentine in Fetlar and Unst in Shetland, and at Portsoy in Banffshire; in the greenstone rocks of the island of Skye; also in the greenstone rocks of Fifeshire; in the porphyritic rock of the Calton Hill, and the trap-rocks of Craig Lockhart, near Edinburgh; in similar rocks near Dunbarton; in serpentine at Cortachie in Forfarshire; and in the same rock between Ballantrae and Girvan in Ayrshire *. In Cornwall it occurs in serpentine and hornblende-slate. At Basta in the Hartz, it is found in primitive greenstone, which rests on granite, associated with compact felspar, pinchbeck-brown mica, amianthus, mountain-cork, precious serpentine, steatite, copper-pyrites, and iron-pyrites. Also disseminated in the serpentine of Zöblitz in Saxony, of Gastein in Salzburg, and of the Pinzgau in the Tyrol.

Observations.

It is distinguished from *Bronzite* by its green colours, straight cleavage, and inferior hardness.

3. Hyperstene, or Labrador Schiller-Spar.

Labradorische Schiller-Spath, *Mohs.*

Hyperstene, *Haüy.*

Labrador Hornblende, *Kirw.* vol. i. p. 221.—Diallage metalloide, *Haüy*, t. iii. p. 127.—Labradorische Hornblende, *Leonhard*, Tabel. s. 25.—Hyperstene, *Brong.* t. i. p. 444. *Id. Karsten*, Tabel.

* Allan.

Tabel. s. 40. *Id. Haus.* s. 98. *Id. Haüy*, Tabl. p. 44. *Id. Steffens*, b. i. s. 322. *Id. Lenz*, b. ii. s. 664. *Id. Oken*, b. i. s. 328.—Paulit, *Hoff.* b. ii. s. 143.—Hypersthen, *Haus.* Handb. b. ii. s. 718. *Id. Aikin*, p. 230.

External Characters.

Its colour is intermediate between greyish and greenish black, but it is nearly copper-red on the cleavage, and brownish-black, or blackish-brown on the fracture surface.

It occurs massive, disseminated, also in thin curved lamellar concretions, which are collected into coarse granular.

On the cleavage the lustre is shining and glistening, and is metallic-pearly, but on the fracture it is glimmering and pearly.

It has a double oblique angular cleavage, the folia meeting under angles of about 100°, and 80°; but of these cleavages one only is distinct; there is a third, but indistinct cleavage, in the direction of the shorter diagonal of the terminal plane of an oblique four-sided prism; and all the cleavages are frequently more or less curved.

The fragments are indeterminate angular or rhomboidal.

It is opaque, or feebly translucent on the edges.

It is greenish-grey in the streak.

It is as hard as felspar.

It is brittle, and rather easily frangible.

Specific gravity, 3.390, *Klaproth.*—3.376, *Karsten.*—3.3, 3.4, *Mohs.*

Chemical Character.

It is infusible before the blowpipe.

Constituent Parts.

Silica, - -	54.25
Magnesia, - -	14.00
Alumina, - -	2.25
Lime, - -	1.50
Oxide of Iron, -	24.50
Water, - -	1.00
Oxide of Manganese, a trace.	
	97.50

Klaproth, Beit. b. v. s. 40.

Geognostic and Geographic Situations.

It was first discovered on the coast of Labrador, where it occurs as a constituent part of a rock composed of Labrador felspar, and sometimes also of common hornblende and magnetic ironstone. Giesecké found it in granitous rocks in Greenland; MacCulloch detected it forming a constituent part of a mountain rock at Loch Scavig in the island of Skye; and in greenstone, near Portsoy.

Uses.

When cut and polished, it has a beautiful copper-red colour, and metallic pearly lustre, and is made into ring-stones and brooches.

Observations.

Observations.

1. Hyperstene was originally described as a variety of hornblende, under the name Labrador Hornblende; but it is distinguished from *Hornblende* by its metallic-pearly luster and cleavage.

2. This mineral, although nearly allied to Anthophyllite, differs from it in being harder, heavier, its cleavage less distinct, and its lustre more metallic.

4. Anthophyllite *.

Gerader Schiller-Spath, *Mohs.*

Anthophyllith, *Schumacher.*

Strahliger Anthophyllit, *Werner.*

Anthophyllith, *Schumacher,* Verzeichniss, s. 96. *Id. Leonhard,* Tabel. s. 42. *Id. Brong.* t. i. p. 444. *Id. Karst.* Tabel. s. 32. *Id. Haus.* s. 92. *Id. Haüy,* Tabl. p. 58. *Id. Steffens,* b. i. s. 324. *Id. Lenz,* b. i. s. 527.—Strahliger Anthophyllit, *Hoff.* b. i. s. 673.—Anthophyllit, *Haus.* Handb. b. ii. s. 720. *Id. Aikin,* p. 223.

External Characters.

Its colour is intermediate between dark yellowish-grey and clove-brown.

It generally occurs massive; also in narrow or broad prismatic distinct concretions, which are scopiform or promiscuous, and in which the surface is streaked.

It

* This mineral is named *Anthophyllite,* on account of the similarity of its colour with that of the anthophyllum.

It is rarely crystallized in reed-like very oblique four-sided prisms.

The surface of the crystals is longitudinally streaked.

The lustre is shining and glistening, and metallic-pearly.

It has a fourfold cleavage; two of the cleavages, and these are the most distinct, are parallel with the sides of an oblique four-sided prism, in which one of the angles is about 100°; the other two cleavages are parallel with the diagonals of the prism.

The fragments are wedge-shaped and splintery; and sometimes rhomboidal.

It is translucent on the edges, or translucent.

It is as hard as felspar.

Specific gravity, 3.3, 3.4, *Mohs*.—3.285, *Haüy*.

Chemical Characters.

It becomes dark greenish-black before the blowpipe, but is infusible.

Constituent Parts.

Silica,	56.00
Alumina,	13.30
Magnesia,	14.00
Lime,	3.33
Iron,	6.00
Oxide of Manganese,	3.00
Water,	1.43

John, Chem. Untersuchungen, 1. s. 200, 201.

Geognostic

Geognostic and Geographic Situations.

Europe.—It occurs in beds in mica-slate, at Kongsberg in Norway, along with common hornblende, mica, and asbestous-tremolite; at Modum cobalt mines, also in Norway, along with common hornblende, cobalt-glance, and copper-pyrites.

America.—In mica-slate, and along with garnets in Greenland.

Observations.

It is named *Anthophyllite*, from the resemblance of its colour to that of the Anthophyllum. This name was given to it by Schumacher, the naturalist who first described it.

ORDER *III.*

ORDER III. MICA.

THIS order contains seven genera, viz. 1. Copper-mica, 2. Uranite, 3. Red Cobalt, 4. White Antimony, 5. Blue Iron, 6. Graphite, 7. Mica.

GENUS I. COPPER-MICA.

This genus contains one species, viz. Prismatic Copper Mica.

1. Prismatic Copper-Mica.

Prismatischer Kupferglimmer, *Mohs.*

Kupferglimmer, *Werner.*

Blättriges Olivenerz, *Karsten,* Journ. de Phys. an 10. p. 348.—Arseniate of Copper in hexaedral laminæ, with inclined sides, *Bournon,* Phil. Trans. part i. 1801.—Blättriches Olivenerz, *Reuss,* b. iii. s. 504.—Kupferglimmer, *Mohs,* b. iii. s. 294.—Cuivre arseniaté lamelliforme, *Brong.* t. ii. p. 230.—Kupferglimmer, *Karsten,* Tabel. s. 64.—Cuivre arseniaté lamelliforme, *Haüy,* Tabl. p. 90.—Kupferglimmer, *Hoff.* b. iii. s. 162. *Id. Haus.* Handb. b. iii. s. 1043.—Hexahedral Arseniate of Copper, *Aikin,* p. 93.

External Characters.

Its colour is emerald-green, which in some varieties inclines to verdigris-green.

It

It occurs massive, disseminated, and in granular distinct concretions; seldom crystallized in very thin equiangular six-sided tables, in which the alternate terminal planes are set on obliquely.

Externally it is smooth and splendent.

Internally it is splendent, and the lustre is pearly.

It has a distinct single cleavage, which is parallel with the sides of the table, or with the sides of a prism, when the table is viewed as a short prism.

The fracture is small-grained uneven, inclining to conchoidal.

The fragments are indeterminate angular and tabular.

The massive varieties are translucent; the crystallized transparent.

It scratches gypsum slightly, but does not affect calcareous-spar.

Its streak is green.

It is sectile.

It is rather brittle.

Specific gravity, 2.548, *Bournon*.—2.5, 2.6, *Mohs*.

Chemical Characters.

It decrepitates before the blowpipe; and passes, first, to the state of a black spongy scoria, after which it melts into a black globule, of a slightly vitreous appearance.

Constituent Parts.

Oxide of Copper, -	39	58
Arsenic Acid, -	43	21
Water, - -	17	21
	99	100
	Vauquelin, Journ. des Mines, N. 55. p. 562.	*Chenevix*, Phil. Tr. for 1801, p. 201.

Geognostic

Geognostic and Geographic Situations.

It has been hitherto found only in veins in the copper-mines in Cornwall, where it is accompanied with red copper-ore, copper-pyrites, copper-glance or vitreous copper-ore, variegated copper-ore, copper-black or black oxide of copper, compact and fibrous malachite, ironshot copper-green, azure copper-ore, indurated tile-ore, oliven-ore, and brown iron-ochre.

Observations.

1. This mineral is distinguished by its colour, crystallization, cleavage, softness, and sectility.

2. It is distinguished from *Foliated Talc* by its colour, cleavage, want of flexibility, and its greasy feel. It is also nearly allied to *Mica* in external appearance, but is readily distinguished from it by colour, and want of flexibility; and its cleavage and form distinguish it from *Malachite.*

GENUS II. URANITE OR URAN-MICA.

This genus contains one species, viz. Pyramidal Uranite.

1. Pyramidal

1. Pyramidal Uranite.

Pyramidaler Uran-Glimmer, *Mohs.*

Uran-Glimmer, *Werner.*

Chalkolith, *Wern.* Pabst. b. i. s. 290.—Grün Uranerz, *Wid.* s. 990.—Micaceous uranitic Ore, *Kirw.* vol. i. p. 304.—Grün Uranerz, *Emm.* b. ii. s. 584.—Oxide d'Uranit avec Cuivre, *Lam.* t. i. p. 410.—Urane oxidé, *Haüy,* t. iv. p. 283.—L'Urane micacé, *Broch.* t. ii. p. 463.—Uranglimmer, *Reuss,* b. iv. s. 556. *Id. Lud.* b. i. s. 308. *Id. Suck.* 2ter th. s. 469. *Id. Bert.* s. 511. *Id. Mohs,* b. iii. s. 721.—Uran oxydé, *Lucas,* p. 177.—Uranglimmer, *Leonhard,* Tabel. s. 81.—Uran oxidé micacé, *Brong.* t. ii. p. 103. *Id. Brard,* p. 379.—Uranglimmer, *Karsten,* Tabel. s. 74.—Uran oxydé, *Haüy,* Tabl. p. 115.—Micaceous Uranite, *Kid,* vol. ii. p. 221.—Uran-oxyd, *Haus.* Handb. b. i. s. 327. Uranglimmer, *Hoff.* b. iv. s. 275.—Uranite, *Aikin,* p. 138.

External Characters.

Its chief colour is grass-green, which passes on the one side into apple-green and emerald-green, and on the other into siskin-green and sulphur-yellow.

It is very seldom massive, sometimes in flakes; the massive varieties are disposed in angulo-granular concretions. It is frequently crystallized.

Its primitive form is a pyramid, in which the angles are 95° 13′, and 144° 56′. The secondary forms are the following:

1. Rectangular four-sided table, or short prism. This is sometimes elongated.
2. The four-sided table bevelled on the terminal planes, and the bevelling planes set on the lateral planes.

3. The

3. The terminal edges of the table truncated, thus forming an eight-sided table. This table is sometimes elongated.
4. The terminal planes of the four-sided table bevelled; and sometimes the edges of the bevelment truncated.
5. When the bevelling planes of N° 4. increase very much in size, there is formed a very acute double four-sided pyramid, in which the apices are more or less deeply truncated.
6. Sometimes the figure N° 4. is acuminated on both extremities with four planes, which are set on the lateral planes, and the apices of the acuminations deeply truncated.

The crystals are small and very small, superimposed, and form druses.

The terminal planes of the table are streaked, but the lateral planes are smooth.

Externally it is usually shining, and sometimes splendent.

Internally it is shining, approaching to glistening, and the lustre is pearly.

Its cleavage is fourfold and rectangular; of these one only is very distinct, and is that parallel with the base of the prism, or lateral planes of the table.

It is transparent and translucent.

It scratches gypsum, but not calcareous-spar.

Its streak is green.

It is sectile.

It is not flexible.

It is easily frangible.

Specific gravity, 3.121, *Champeaux*.—3.3, *Gregor*.—3.1, 3.2, *Mohs*.

Chemical

Chemical Characters.

It decrepitates violently before the blowpipe on charcoal; loses about 33 *per cent.* by ignition, and acquires a brass-yellow colour; with borax it yields a yellowish-green glass; it dissolves in nitric acid without effervescence, and communicates to it a lemon-yellow colour.

Constituent Parts.

	Cornwall.
Oxide of Uranium, with a trace of Oxide of Lead, - -	74.4
Oxide of Copper, - -	8.2
Water, - - -	15.4
Loss, - - -	2.
	100

Gregor, in Annals of Phil. vol. v. p. 284.

Geognostic and Geographic Situations.

It occurs in veins in primitive rocks. In Cornwall in tinstone and copper veins that traverse granite and clay-slate. In Saxony, partly in silver-veins, along with pitch-ore, and partly in red ironstone, and tin veins. It is also found in the district of Autun in France; at Welsendorf in Bavaria, with fluor-spar; and at Bodenmais, also in Bavaria, along with beryl and felspar *.

Observations.

1. This mineral is nearly allied to copper-mica; but is distinguished from it by its pyramidal crystallization, and the

* Heuland.

the same character distinguishes it from *Chlorite*, *Talc*, and *Mica*.

2. When first discovered, it was described under the name *Green* Mica; afterwards it was named *Chalcolite*, on account of its supposed cupreous nature; and some authors have named it *Uranium Spar*, and *Torberit*, in Honour of Sir Torbern Bergmann.

Werner describes a soft mineral, found along with Uranite, under the name Uran-Ochre. It does not appear to form a distinct species, nor can it be considered as a subspecies of Uranite. It is here placed immediately after Uranite.

* Uran-Ochre.

Uran-Ocker, *Werner*.

There are two kinds of this mineral, viz. Friable and Indurated.

1. Friable Uran-Ochre.

Zerreibliche Uranocker, *Werner*.

Uran oxydé pulverulent, *Haüy*, t. iv. p. 285.—Uranocher, *Reuss*, b. iv. s. 561. *Id. Leonhard*, Tabel. s. 81. *Id. Karsten*, Tabel. s. 74.—Zerreibliche Uranocker, *Hoff.* b. iv. s. 280.

External Characters.

Its colour is lemon-yellow, which passes into straw-yellow and sulphur-yellow, and also into orange yellow.

It

It occurs usually as a coating or efflorescence on pitch-ore, sometimes small reniform.

It is friable, and composed of dull, dusty, and weakly cohering particles.

It feels meagre.

Geognostic Situation.

It occurs always on pitch-ore.

2. Indurated Uran-Ochre.

Feste Uranocker, *Werner.*

Verhärtete Uranocher, *Karsten,* Tabel. s. 74.—Feste Uran-ocker, *Hoff.* b. iv. s. 279.

External Characters.

Its colours are straw-yellow, lemon-yellow, and orange-yellow; and this latter passes into aurora-red and hyacinth-red, and into reddish and yellowish brown.

It occurs massive, disseminated, and superimposed; and sometimes there is a tendency to fibrous concretions.

Internally it is glimmering, and glistening and resinous.

The fracture is imperfect conchoidal.

It is opaque.

It is soft and very soft.

It is rather sectile.

Specific gravity, 3.1500, *La Metherie.*—3.2438, *Haüy.*

Chemical Characters.

According to Klaproth, the yellow varieties are pure oxide of uranium, but the brownish and reddish contain also a little iron.

Geognostic

Geognostic and Geographic Situations.

It is found at Joachimsthal, and Gottesgab in Bohemia, and at Johanngeorgenstadt in Saxony.

Genus III.—RED COBALT.

Kobalt Glimmer, *Mohs.*

This Genus contains one Species, viz. Prismatic Red Cobalt.

1. Prismatic Red Cobalt.

Prismatischer Kobalt Glimmer, *Mohs.*

This Species is divided into three Subspecies, viz. Radiated Red Cobalt, Earthy Red Cobalt, and Slaggy Red Cobalt.

First Subspecies.

Radiated Red Cobalt, or Cobalt-Bloom.

Kobaltblüthe, *Werner.*

Flos Cobalti, *Wall.* Syst. Min. t. ii. p. 181.—Koboldblüthe, *Wern.* Pabst. b. i. s. 206. *Id. Wid.* s. 939.—Cobaltic Germinations, Flowers of Cobalt, of some, *Kirw.* vol. ii. p. 278.—Koboldblüthe, *Emm.* b. ii. s. 507.—Le Fleurs de Cobalt, ou Cobalt terreux rayonné rouge, *Broch.* t. ii. p. 403.—Cobalt arseniaté

arseniaté aciculaire, *Haüy*, t. iv. p. 217.—Strahlicher rother Erdkobold, *Reuss*, b. iv. s. 420.—Kobaltblüthe, *Lud.* b. i. s. 288. *Id. Mohs*, b. iii. s. 672.—Strahliger rother Erdkobold, *Leonhard*, Tabel. s. 77.—Cobalt arseniaté aciculaire, *Brong.* t. ii. p. 119.—Strahlige Kobaltblüthe, *Karsten*, Tabel. s. 72. —Cobalt arseniaté aciculaire, *Haüy*, Tabl. p. 108.—Strahlige Kobaltblüthe, *Haus.* Handb. b. iii. s. 1125. *Id. Hoff.* b. iv. s. 203.—Red Cobalt, *Aikin*, p. 130.

External Characters.

Its principal colour is crimson-red, which passes on the one side into peach-blossom, on the other into columbine-red; it is rarely greenish-grey, and olive-green.

It occurs massive disseminated, often in membranes, small reniform, small botryoidal; also in stellular and scopiform radiated or fibrous concretions, which are sometimes collected into granular concretions.

It also occurs crystallized. Its primitive form is not known. The following are the only crystallizations hitherto met with.

1. Rectangular four-sided prism.
2. Compressed acute double six-sided pyramid?

The crystals are generally acicular or capillary, and are scopiformly or stellularly aggregated.

Externally it is shining, passing into splendent.

Internally it is shining and glistening, and the lustre is pearly.

A single cleavage is observable, and in the direction of the axis of the prism.

The fragments are splintery and wedge-shaped.

It is more or less translucent; sometimes translucent on the edges.

Its colour is not changed in the streak.

It is harder than gypsum, but softer than calcareous spar.

It is rather sectile.

It is easily frangible.

Specific gravity 4.0, 4.3, *Mohs*.

Chemical Characters.

Before the blowpipe it becomes grey, and emits an arsenical odour, and tinges borax glass blue.

Constituent Parts.

Cobalt, - -	39
Arsenic Acid, - -	38
Water, -	23
	100

Buckholz. in J. d. Min. t. 25. p. 158.

Geognostic Situation.

It occurs in veins, in primitive, transition, and secondary rocks, along with silver-white cobalt, tin-white cobalt, grey cobalt, and other cobaltic minerals; also with copper-nickel, nickel-ochre, copper-pyrites, grey copper-ore, blue copper-ore, iron-shot copper-green, native bismuth, brown ironstone, galena or lead-glance, and blende; the vein-stones are heavy-spar, calcareous-spar, brown-spar, ironstone, and quartz.

Geographic Situation.

It occurs in veins in secondary rocks at Alva, in Stirlingshire; in limestone of the coal formation in Linlithgowshire; formerly in small veins in sandstone of the coal formation,

mation, along with galena and blende, at Broughton, in Edinburgh; in the Clifton lead-mines near Tyndrum, already described; and at Dolcoath in Cornwall. On the Continent, it is met with at Modum in Norway, Riegelsdorf in Hessia; Schneeberg, Annaberg, and Saalfeldt in Saxony; Kupferberg in Silesia; Wittichen in Furstemberg, and Alpersbach in Wurtemberg; Allemont in France; and in Salzburg and Hungary.

Observations.

A mixture of red cobalt, black cobalt, with ochre of nickel and native silver, occurs in the mines of Allemont, and of Schemnitz in Hungary, and is known to the miners by the name of *Goose-Dung Ore.* It is the *minera argenti mollior diversicolor*, Wall. t. 2. p. 346.; *Mine d'argent merde d'oie*, Delisle, t. 3. p. 150.; *Cobalt merde d'oie*, Brong.; *Cobalt arseniaté terreux argentifere*, Lucas; and the *Gansekothigsilber* and *Ganiskothigererz* of the Germans. Some other mixtures of silver-ores have received the same name. This is the case with a mixture of native arsenic, red silver-ore, and earthy silver-glance; and slaggy yellow orpiment, is named *Goose-Dung Ore* in the Hartz.

Second Subspecies.

Earthy Red Cobalt, or Cobalt-Crust.

Koboldbeschlag, *Werner.*

Ochra Cobalti rubra, *Wall.* Syst. Min. t. ii. p. 181.—Koboldbeschlag, *Wid.* s. 938.—Cobalt Incrustations, *Kirw.* vol. ii. p. 279.—Koboldbeschlag, *Emm.* b. ii. s. 509.—Le Cobalt terreux rouge, pulverulent, *Broch.* t. ii. p. 405.—Cobalt arseniaté

niaté pulverulent, *Haüy*, t. iv. p. 218.—Erdiger rother Erdkobold, *Reuss*, b. iv. s. 419.—Koboldbeschlag, *Lud.* b. i. s. 287. *Id. Mohs*, b. iii. s. 671.—Cobalt arseniaté, *Lucas*, p. 161.—Erdiger rother Erdkobold, *Leonhard*, Tabel. s. 77.—Cobalt arseniaté pulverulent, *Brong.* t. ii. p. 119. *Id. Brard*, p. 357. Gemeine Koboldblüthe, *Karsten*, Tabel. s. 72.—Arseniate of Cobalt, *Kid*, vol. ii. p. 211.—Cobalt arseniaté pulverulent, *Haüy*, Tabl. p. 108.—Erdige Kobaltblüthe, *Haus.* Handb. b. iii. s. 1125.—Koboldbeschlag, *Hoff.* b. iv. s. 201.

External Characters.

Its colour is peach-blossom red, of different degrees of intensity, which sometimes inclines to crimson-red, sometimes verges on cochineal-red, and also passes into reddish-white.

It seldom occurs massive or disseminated, generally in velvety crusts, and also small reniform and botryoidal.

It is generally friable, and is composed of scaly and dusty particles, which are feebly glimmering or dull.

The massive varieties have a fine earthy fracture.

The fragments are indeterminate angular, and blunt-edged.

It is very easily frangible.

It is very soft, or friable.

It is sectile.

The streak is shining.

It does not soil.

Third

Third Subspecies.

Slaggy Red Cobalt.

Schlackige Kobaltblüthe, *Hausmann.*

Id. Haus. Syst. d. Unorgan. Natk. s. 140. *Id. Haus.* Handb. b. iii. s. 1126.

External Characters.

Its colours are muddy crimson-red, and dark hyacinth-red, which passes into chesnut-brown.

It occurs in thin crusts, and sometimes reniform.

Externally it is smooth.

The lustre is shining and resinous.

The fracture is conchoidal.

It is translucent.

It is soft, and brittle.

Geognostic and Geographic Situations.

It occurs in veins along with other cobaltic minerals, in the mine of Sophia at Wittichen in Furstemberg.

Cobalt-Ochre.

The Black, Brown and Yellow Cobalt Ochres, and other similar minerals, ought to be arranged together, and form a particular Order by themselves. In the mean time, I place them beside the Red Cobalt, on account of their being often associated with that mineral.

1. Black

*

1. Black Cobalt Ochre.

Schwarz Erdkobold, *Werner.*

It is distinguished into Earthy Black Cobalt-ochre, and Indurated Black Cobalt-ochre.

a. Earthy Black Cobalt-Ochre.

Schwarzer Kobold Mulm, *Werner.*

Cobalt oxide noire terreux, *Haüy.*

Wern. Pabst. b. i. s. 205.—Zerreiblicher schwarzer Erdkobold, *Wid.* s. 933.—Loose Black Cobalt-ochre, *Kirw.* vol. ii. p. 275.—Schwarzer Kobold Mulm, *Emm.* b. ii. s. 498.—Le Cobalt terreux noire friable, *Broch.* t. ii. p. 397.—Cobalt oxydé noire terreux, *Haüy,* t. iv. p. 215.—Zerreiblicher schwarzer Erdkobold, *Reuss,* b. iv. s. 411.—Schwarzer Kobaltmulm, *Lud.* b. i. s. 285.—Zerreiblicher schwarzer Erdkobold, *Leonhard,* Tabel. s. 76.—Cobalt oxydé terreux, *Brong.* t. ii. p. 118. —Lockere Kobaltschwärze, *Haus.* Handb. b. i. s. 332.—Koboldmulm, *Hoff.* b. iv. s. 192.

External Characters.

Its colour is intermediate between brownish and blackish brown.

It is friable, and composed of dull coarse particles, which soil very little.

The streak is shining.

It is meagre to the feel.

It is light.

Chemical

Chemical Characters.

Before the blowpipe, it yields a white arsenical vapour; and it colours borax blue.

b. Indurated Black Cobalt-Ochre.

Fester Schwarz Erdkobold, *Werner*.

Minera Cobalti scoriformis, *Wall.* Syst. Min. t. ii. p. 180.—Verhärteter schwarzer Erdkobold, *Wid.* s. 933.—Indurated Black Cobalt-ochre, *Kirw.* vol. ii. p. 275.—Verhärteter schwarzer Erdkobold, *Emm.* b. ii. s. 499.—Le Cobalt terreux noire endurci, *Broch.* t. ii. p. 397.—Cobalt oxydé noire, var. 1.–3. *Haüy*, t. iv. p. 215.—Verhärteter schwarzer Erd-cobalt, *Reuss*, b. iv. s. 413. *Id. Lud.* b. i. s. 286. *Id. Mohs*, b. iii. s. 665. *Id. Leonhard*, Tabel. s. 76.—Cobalt oxidé vitreux, *Brong.* t. ii. p. 118.—Feste Kobaltschwärze, *Haus.* Handb. b. i. s. 333. *Id. Hoff.* b. iv. s. 193.

External Characters.

Its colour is distinct bluish-black.

It occurs massive, disseminated, in crusts, small botryoidal, small reniform, fruticose, moss-like, stalactitic, corroded, specular, and with pyramidal impressions. Sometimes it occurs in thin and curved lamellar concretions.

The surface is feebly glimmering.

Internally it is dull, or very feebly glimmering.

The fracture is fine earthy, sometimes passing into conchoidal.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

The

The streak is shining and resinous.

It is very soft, approaching to soft.

It [illegible].

It is [illegible].

It is very easily frangible.

Specific gravity, 2.019 to 2.425 *Gellert.*—2.200 *Breithaupt.*

Chemical Characters.

Before the blowpipe it yields an arsenical odour, and colours [illegible] smalt-blue.

Constituent Parts.

It [illegible] black oxide of cobalt, with arsenic [illegible].

Geognostic Situation.

[illegible] usually occur together, and in the same [illegible] the first subspecies is the rarest. [illegible] in primitive mountains, but [illegible] mountains, where they are [illegible], red, brown, and [illegible] other ores of silver [illegible] calcareous-spar, and [illegible] *filled* with the [illegible] *compact kind* forms the [illegible] *middle part of the veins.*

Geographic Situation.

[illegible] *Upper Silesia* [illegible] *in the principality* [illegible] at [illegible]

emu

Reigelsdorf in Hessia, and in many other countries on the Continent.

Uses.

It is used in the making of smalt, and affords a good blue colour, but not so fine as that obtained from grey cobalt. Of the two kinds of black cobalt, the compact is that which affords the most esteemed blue colour.

2. Brown Cobalt-Ochre.

Brauner Erdkobold, *Werner.*

Ochra Cobalti lutea, *Waller.* Syst. Min. t. ii. p. 183.—Brauner Erdkobold, *Wern.* Pabst. b. i. s. 206. *Id. Wid.* s. 935.—Brown Cobalt-ochre, *Kirw.* vol. ii. p. 276.—Brauner Erdkobold, *Emm.* b. ii. s. 503.—Le Cobalt terreux brun, *Broch.* t. ii. p. 400.—Brauner Erdkobalt, *Reuss,* b. iv. s. 415. *Id. Lud.* b. i. s. 287. *Id. Suck.* 2ter th. s. 406. *Id. Bert.* s. 488. *Id. Mohs,* b. iii. s. 667. *Id. Leonhard,* Tabel. s. 76.—Cobalt oxidé brun, *Brong.* t. ii. p. 118.—Erdkobalt, *Haus.* Handb. b. i. s. 334. (in part).—Brauner Erdkobalt, *Hoff.* b. iv. s. 197.

External Characters.

Its principal colour is liver-brown, which sometimes passes into yellowish-grey, and sometimes inclines to brownish-black.

The yellowish-grey makes the transition into the yellow cobalt-ochre, and the black into the black cobalt-ochre.

It occurs massive, disseminated, and sometimes very much cracked.

Internally it is dull.

The

The fracture is fine earthy, approaching to conchoidal in the large.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

The streak is shining and resinous.

It is very soft.

It is sectile.

It is very easily frangible.

It is light.

Chemical Characters.

Before the blowpipe it emits an arsenical odour, and communicates a blue colour to borax.

Constituent Parts.

It is considered to be a compound of Brown Ochre of Cobalt, Arsenic, and Oxide of Iron.

Geognostic Situation.

It appears to occur principally in secondary mountains, and is generally accompanied with red and black cobalt-ochre, ochry-brown ironstone, and lamellar heavy-spar.

Geographic Situation.

It is found at Kamsdorf and Saalfeld in Saxony; Alpirsbach in Wurtemberg; and in the valley of Gistain in Spain.

Use.

It is used for making smalt, but is not so valuable as the black cobalt.

Observations.

Observations.

It is distinguished from *Umber*, *Bole*, and other minerals of the same description, by its streak and softness.

3. Yellow Cobalt-Ochre.

Gelber Erdkobold, *Werner*.

Cobalt arseniaté terreux argentifere (?) *Haüy*.

Ochra Cobalti lutea et alba, *Wall.* t. ii. p. 183.—Gelber Erdkobold, *Wid.* s. 936.—Yellow Cobalt-ochre, *Kirw.* vol. ii. p. 277. Gelber Erdkobold, *Emm.* b. ii. s. 504.—Le Cobalt terreux jaune, *Broch.* t. ii. p. 401.—Gelber Erdkobold, *Reuss*, b. iv. s. 417. *Id. Lud.* b. i. s. 287. *Id. Suck.* 2ter th. s. 407. *Id. Bert.* s. 488. *Id. Leonhard,* Tabel. s. 76.—Cobalt oxidé jaune, *Brong.* t. ii. p. 118.—Erdkobalt, *Haus.* Handb. b. i. s. 334. (in part.)—Gelber Erdkobold, *Hoff.* b. iv. s. 199.

External Characters.

The colour is muddy straw-yellow, which in some varieties passes through light yellowish-grey into yellowish-white.

It occurs massive, disseminated, corroded, and incrusting.

It frequently appears rent in different directions.

Internally it is dull.

The fracture is fine earthy, in the small; conchoidal in the large.

The fragments are indeterminate angular, and blunt-edged.

The streak is shining.

It

It is soft, passing into friable.

It is sectile.

It is very easily frangible.

Specific gravity, 2.677, *Kirwan*, after having absorbed water.

Chemical Characters.

It emits an arsenical odour before the blowpipe, and colours borax blue. It appears to be the purest of the cobalt ochres. It generally contains a portion of silver.

Geognostic Situation.

It occurs in the same geognostic situation as the preceding, and is almost always associated with earthy red cobalt, and sometimes with radiated red cobalt, nickel-ochre, iron-shot copper-green, and azure copper-ore.

Geographic Situation.

It occurs at Saalfeld in Thuringia; Kupferberg in Silesia; Wittichen in Furstenberg, and Alpirsbach in Wurtemberg in Swabia; and Allemont in France.

Use.

It affords a better smalt than the preceding, and, owing to the silver it contains, in the countries where it occurs, is also valued as an ore of silver.

GENUS IV.

Genus IV. WHITE ANTIMONY.

Spiessglass-glimmer, *Mohs.*

This genus contains one species, viz. Prismatic White Antimony.

1. Prismatic White Antimony.

Prismatischer Spiessglass-glimmer, *Mohs.*

Weiss-spiesglaserz. *Werner.*

Id. Wern. Pabst. b. ii. s. 203. *Id. Wid.* s. 920.—Muriated Antimony, *Kirw.* vol. ii. p. 251.—Muriate d'Antimoine, *De Born,* t. ii. p. 147.—Weiss-spiesglaserz, *Emm.* b. ii. s. 480.—Antimoine muriatique, *Lam.* t. i. p. 348.—Antimoine oxydé, *Haüy,* t. iv. p. 273.—Antimoine blanc, *Broch.* t. ii. p. 381.—Weiss-spiesglanzerz, *Reuss,* b. iv. s. 382. *Id. Lud.* b. i. s. 281. *Id. Suck.* 2ter th. s. 392. *Id. Bert.* s. 470. *Id. Mohs,* b. iii. s. 710.—Antimoine oxydé, *Lucas,* p. 173.—Weiss-spiesglanzerz, *Leonhard,* Tabel. s. 70.—Antimoine oxydé, *Brong.* t. ii. p. 128. *Id. Brard,* p. 374.—Weiss-spiesglanz, *Karsten,* Tabel. s. 72.—Antimoine oxydé, *Haüy,* Tabl. p. 113.—Spiessglanzweiss, *Haus.* Handb. b. i. s. 341.—Weiss-spiessglanzerz, *Hoff.* b. iv. s. 119.—White Antimony, *Aikin,* p. 125.

External Characters.

Its colours are snow-white, greyish-white, light ash-grey, and yellowish-white, which latter colour is the most common.

It

It seldom occurs massive, more frequently disseminated, and in membranes; also in distinct concretions, which are coarse and small granular, and scopiform and stellular radiated. Is often crystallized. Its primitive form is a prism, but its dimensions are unknown. The following figures have been observed.

1. Rectangular four-sided prism, bevelled on the extremities.
2. Oblique four-sided prism.
3. Rectangular four-sided table.
4. Six-sided prism.
5. Acicular and capillary crystals.

The tables are small and very small, usually adhering by their lateral planes, and sometimes, although seldom, manipularly aggregated, and often intersecting each other, in such a manner as to form cellular groups.

The crystals are sometimes smooth, sometimes feebly longitudinally streaked, and splendent.

Internally it is shining, and the lustre is intermediate between pearly and adamantine.

It has a cleavage in the direction of the lateral planes of the prism.

The fragments are indeterminate angular, or wedge-shaped.

It is translucent.

Its hardness is indeterminate, between that of talc and gypsum.

It is rather sectile.

Specific gravity, 5.0, 5.6, *Mohs.*

Chemical Characters.

Before the blowpipe it melts very easily, and is volatilised in the form of a white vapour.

Constituent

Constituent Parts.

	Allemont.
Oxide of Antimony, -	86
Oxides of Antimony and Iron,	3
Silica, - -	8
	98

Vauquelin, Haüy, t. iv. p. 274.

Geognostic and Geographic Situations.

It occurs in veins in primitive rocks, and is usually accompanied with the other ores of antimony.

At Prizbram in Bohemia, it occurs along with crystallized galena or lead-glance; and at Allemont, with native antimony, and grey and red antimony. It has also been found in Malaxa in Hungary.

Observations.

1. It is distinguished from *Calamine* by its inferior hardness; from *White Lead-spar* by its inferior hardness and crsytallization; from *Strontianite* and *Arragonite* by inferior hardness, and superior weight.

2. The foliated varieties are found only at Prizbram, the radiated chiefly in Hungary.

* Antimony-Ochre.

Spiesglanzocker, *Werner*.

Spiesglanzocher, *Reuss*, b. iv. s. 388. *Id. Lud.* b. i. s. 282. *Id. Suck.* 2ter th. s. 394. *Id. Bert.* s. 478. *Id. Mohs*, b. iii. s. 713. *Id. Leonhard*, Tabel. s. 79. *Id. Karsten*, Tabel. s. 72.—Antimoine

timoine oxydé terreux, *Haüy*, Tabl. p. 113.—Spiessglanz-ocher, *Haus.* Handb. b. i. s. 339. *Id. Hoff.* b. iv. s. 124.—Antimonial Ochre, *Aikin*, p. 125.

External Characters.

Its colour is straw-yellow, of different degrees of intensity, which inclines on the one side into yellowish-grey, on the other into yellowish-brown.

It scarcely occurs massive, and disseminated, generally incrusting crystals of grey antimony.

It is dull.

The fracture is earthy, and sometimes inclines to radiated.

It is opaque.

It is soft, passing into very soft.

It is brittle, and easily frangible.

Chemical Characters.

Before the blowpipe, on charcoal, it becomes white, and evaporates without melting. With borax, it intumesces, and is partly reduced to the metallic state.

Geognostic and Geographic Situations.

It occurs always in veins, and accompanied with grey antimony, and sometimes with red antimony.

It is found at Huel Boys in Endellion in Cornwall. At Dublowitz, near Saltschaw in Bohemia; Telkebanya in Hungary; Toplitz in Transylvania; Braunsdorf, in the kingdom of Saxony; on the Sonnenberg, near Mittersill in Salzburg; and in Siberia.

GENUS V.

GENUS V. BLUE IRON.

Eisen Glimmer, *Mohs.*

THIS genus contains one species, viz. Prismatic Blue Iron.

1. Prismatic Blue Iron.

This species is divided into three subspecies, viz. Foliated Blue Iron, Fibrous Blue Iron, and Earthy Blue Iron.

First Subspecies.

Foliated Blue Iron.

Blättriches Eisenblau, *Hausmann.*

Blättriches Eisenblau, *Uttinger,* Moll's Eph. b. iv. s. 71.—Fer phosphaté crystallisé, *Haüy,* Tabl. p. 99.—Fer phosphaté crystallisé ou laminaire, *Lucas,* t. ii. p. 413.—Blättriches Eisenblau, *Haus.* Hand. b. iii. s. 1075.—Kristallisirte Blaueisenerde, *Hoff.* b. iv. s. 144.

External Characters.

Its colour is dark indigo-blue, and sometimes bluish-grey; also leek-green, and inclining to sky-blue.

Its primitive form is an oblique four-sided prism, the dimensions of which are not known. The secondary forms are the following:

1. Broad rectangular four-sided prism, in which the lateral edges are truncated, (the truncating planes are set obliquely on the smaller lateral planes, and are the

original planes of the oblique four-sided prism), flatly bevelled on the extremities; the bevelling planes set obliquely on the broader lateral planes.

2. Eight-sided prism, acuminated with four planes.

The crystals are sometimes acicular, and deeply longitudinally streaked. They are small, or middle-sized, and superimposed.

Externally it is shining or splendent.

Internally shining, passing into splendent, and pearly inclining to adamantine.

It has a perfect and straight single cleavage, which is parallel with the broader lateral planes of the prism.

The fragments are long tabular, or splintery.

It is translucent on the edges, or strongly translucent.

It is as hard as gypsum.

The colour is paler blue in the streak.

It is sectile, and easily frangible.

It is flexible in thin pieces.

Specific gravity, 2.70, *Breithaupt.*—2.80, 3.0, *Mohs.*

Constituent Parts.

	From the Isle of France.
Oxide of Iron, -	41.25
Phosphoric Acid, -	19.25
Water, - -	31.25
Ironshot Silica, -	1.25
Alumina, - -	5.00
	98

Fourcroy and *Laugier*, in Ann. du Mus. t. iii. p. 405.

Geognostic

Geognostic and Geographic Situations.

Europe.—It occurs in Whealkind Mine, in St Agnes's in Cornwall; along with iron-pyrites, and magnetic-pyrites, in gneiss, in the Silberberg, at Bodenmais, in Bavaria; and in the department of Allier in France.

Africa.—In the Isle of France.

America.—It is said to occur in drusy cavities in bog-iron-ore in New Jersey, United States; and it is mentioned as a Brazilian mineral.

Observations.

1. This mineral is described by Reuss as Kyanite *; and by Brauner as Foliated Gypsum †. Its true nature was first ascertained by Uttinger of Sonthofen, in a paper in Von Moll's Ephemeriden, already quoted.

2. In the fourth volume of Hoffman's Mineralogy, there is a description by Werner of a new mineral, under the name *Vivianite*, in compliment to Mr Vivian of Cornwall, and which appears to be but a variety of this species.

* Reuss, Lehrbuch der Mineralogie.

† Annalen der Berg und Hüttenkunde, b. iii. lif. 2. s. 296.

Second Subspecies.

Fibrous Blue Iron.

Fasriges Eisenblau, *Hausmann*.

Fasriges Eisenblau, *Haus.* Handb. b. iii. s. 1076.

External Characters.

Its colour is indigo-blue.

It occurs massive, and sometimes intimately connected with hornblende, and in roundish blunt angular pieces; also in delicate fibrous concretions, which are scopiform or promiscuous.

Internally it is glimmering and silky.

It is opaque.

It is soft.

Geognostic and Geographic Situations.

Europe.—It occurs in transition syenite at Stavern in Norway *.

America.—In West Greenland †.

Third

* Hausmann's Reise durch Scandinavien, b. ii. s. 109.

† Schumacher, Verz. s. 139.

Third Subspecies.

Earthy Blue Iron.

Blau Eisenerde, *Werner.*

Erdiges Eisenblau, *Hausmann.*

Cœruleum berolinense naturale, *Wall.* t. ii. p. 260.—Ocre martiale bleu; Bleu de Prusse natif, *Romé de Lisle,* t. iii. p. 295. —Prussiate de Fer natif, *De Born,* t. ii. p. 275.—Blaue Eisenerde, *Werner,* Pabst. b. i. s. 169. *Id. Wid.* s. 835.—Blue Martial Earth, *Kirw.* vol. ii. p. 185.—Blaue Eisenerde, *Emm.* b. ii. s. 359.—Prussiate de Fer natif, *Lam.* t. i. p. 247.—Fer azure, *Haüy,* t. iv. p. 119,–122.—Le Fer terreux bleu, *Broch.* t. ii. p. 288.—Blaue Eisenerde, *Reuss,* b. iv. s. 146. *Id. Lud.* b. i. s. 257. *Id. Mohs,* b. iii. s. 433. *Id. Leonhard,* Tabel. s. 68.—Fer phosphaté azure, *Brong.* t. ii. p. 179.—Blau Eisenerde, *Karsten,* Tabel. s. 66.—Erdiges Eisenblau, *Haus.* s. 138.—Phosphate of Iron; Native Prussian Blue, *Kid,* vol. ii. p. 189.—Fer phosphaté terreux, *Haüy,* Tabl. p. 99. —Blaue-eisenerde, *Hoff.* b. iv. s. 302.—Erdiges Eisenblau, *Haus.* Handb. b. iii. s. 1077.—Earthy Blue Iron-ore, *Aikin,* p. 105.

External Characters.

In its original repository it is said to be white, but afterwards becomes indigo-blue, of different degrees of intensity, which sometimes passes into smalt-blue.

It is usually friable, sometimes loose, and sometimes cohering.

It occurs massive, disseminated, and thinly coating.

Its particles are dull and dusty.

It soils slightly.

It

It feels fine and meagre.
It is rather light.

Chemical Characters.

Before the blowpipe, it immediately loses its blue colour, and becomes reddish-brown, and, lastly, melts into a brownish-black coloured slag, attractable by the magnet.

It communicates to glass of borax a brown colour, which at length becomes dark yellow. It dissolves rapidly in acids.

Constituent Parts.

		From Eckartsberg.
Oxide of Iron,	-	47.50
Phosphoric Acid,	-	32.00
Water,	- -	20.00
		99.50

Klaproth, Beit. b. iv. s. 122.

Geognostic Situation.

It occurs in nests and beds in clay-beds, also disseminated in bog iron-ore, or incrusting turf and peat.

Geographic Situation.

Europe.—On the surface of peat-mosses in several of the Shetland Islands; and in river-mud at Toxteth, near Liverpool; Iceland; Helsingor on the Island of Seeland; Schonen in Sweden; Russia; Maschen in Hanover; Steinbach, Oberlichtenau, and Weissig in Upper Lusatia; Silesia; Suabia; Upper Palatinate; Bavaria; Carniola *; France.

Asia.

* Dr Clarke, upon the subject of this mineral, in a letter to Dr Bruce, remarks, " That it occurs in the mouth of the Cimmerian Bosphorus, now called

Asia.—Borders of the Lake Baikal in Siberia.

America.—Along with bog iron-ore in alluvial soil in New Jersey *.

Uses.

It is sometimes used as a pigment. It is principally employed in water-colours, because, when mixed with oil, the colour is said to change into black †. Beautiful green and olive colours have been formed, by mixing it with other colours. It would appear that this mineral was known to the ancients; for a substance answering to blue iron-earth is mentioned by Pliny, as being collected in the marshes of Egypt, and ground and washed, and used as a pigment.

GENUS VI.

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called the Straits of Taman, between the Sea of Azoph and the Black Sea. It lies there associated with extraneous fossil remains of animals, whose decomposition, it is conjectured, afforded phosphoric acid to the metal."—Bruce's Journal, p. 123.

* Cutbush, in Bruce's American Mineralogical Journal, p. 86.

† Mr Cutbush was informed, that a piece of this mineral, by grinding with oil, afforded a beautiful blue colour, which shows that the American variety is different from that used by painters in Europe.—Vid. Cutbush, in Bruce's Journal, p. 87, 88.

GENUS VI. GRAPHITE *.

Kohlen Glimmer, *Mohs*.

THIS genus contains one species, viz. Rhomboidal Graphite.

1. Rhomboidal Graphite.

Graphit, *Werner*.

Ferrum molybdena, *Wall.* t. ii. p. 249.—Plombagine, *Romé de Lisle*, t. ii. p. 500. *Id. De Born*, t. ii. p. 295.—Graphites plumbago, *Lin.* Syst. Nat. edit. 13. cura Jo. Frid. Gmelin, t. iii. p. 284.—Plumbago, *Kirw.* vol. ii. p. 58.—Graphit, *Emm.* b. ii. s. 97. *Id. Wid.* s. 651.—Graphite, *Broch.* t. ii. p. 76.—Fer carburé, *Haüy*, t. iv. p. 98.—Graphite, *Reuss*, b. iii. 3. s. 176. *Id. Lud.* b. i. s. 196. *Id. Suck.* 2ter th. s. 73. *Id. Bert.* s. 335. *Id. Mohs*, b. ii. s. 327. *Id. Leonhard*, Tabel. s. 50.—Plumbago, *Kid*, vol. ii. p. 58.—Plumbago, *Aikin*, p. 59.

This species is divided into two subspecies, viz. Scaly Graphite, and Compact Graphite.

First

* *Graphite*, from γραφω, *I write*, on account of its writing quality.

First Subspecies.

Scaly Graphite.

Schuppiger Graphit, *Werner.*

Graphite lamellaire, *Brong.* t. ii. p. 53.—Schuppiger Graphit, *Karst.* Tabel. s. 58. *Id. Haus.* s. 115.—Graphite granulaire, *Haüy,* Tabl. p. 70.—Schuppiger Graphit, *Lenz,* b. ii. s. 1084.—Blättriger Graphit, *Haus.* Handb. b. i. s. 67.—Schuppiger Graphit, *Hoff.* b. iii. s. 312.

External Characters.

Its colour is dark steel-grey, which approaches to light iron-black.

It occurs massive, disseminated; in coarse, small, and fine granular concretions; and crystallized.

Its primitive form appears to be a rhomboid, the dimensions of which are unknown. The only secondary form hitherto met with, is the equiangular six-sided table.

Internally it is shining, passing into splendent, and the lustre is metallic.

It has a distinct single cleavage, which is parallel with the terminal planes of the prism.

The fracture is scaly foliated.

The fragments are indeterminate angular, and blunt-edged.

The streak is shining, even splendent, and its lustre is metallic.

Its hardness is sometimes equal to that of gypsum.

It is perfectly sectile.

It is rather difficultly frangible.

It

It writes and soils.

Its streak is black.

It feels very greasy.

Specific gravity, (but uncertain whether of scaly or compact graphite),

Kirwan,	1.987	2.267
Brisson,	2.1500	2.456
Haüy,	2.0891	2.245
Mohs,	1.9	2.1

Second Subspecies.

Compact Graphite.

Dichter Graphit, *Werner*.

Graphite granuleux, *Brong*. t. ii. p. 54.—Dichter Graphit, *Karsten*, Tabel. s. 58. *Id. Haus*. s. 115. *Id. Lenz*, b. ii. s. 1085.

External Characters.

The colour is nearly the same with the preceding, only rather blacker.

It occurs massive, and disseminated; also in columnar concretions.

Internally it is glimmering, sometimes glistening, and the lustre is metallic.

The fracture is small and fine-grained uneven, which passes into even, and also into large and flat conchoidal; in the large it is sometimes slaty longitudinal.

The fragments are indeterminate angular, and blunt-edged, and sometimes also tabular.

In other characters it agrees with the preceding subspecies.

Chemical

Chemical Characters.

When heated in a furnace, it burns without flame or smoke, and during combustion emits carbonic acid, and leaves a residuum of red oxide of iron.

Constituent Parts.

				Graphite of Pluffier.	
Carbon,	90.9	Carbon,	81	Carbon,	23
Iron,	9.1	Oxygen,	9	Iron,	2
	———	Iron,	10	Alumina,	37
	100.00		——	Silica,	38
	Berthollet.		100		——
			Scheele.		100
				Journal des Mines, N. 12. p. 16.	

According to John, it sometimes contains Chrome, Nickel, and Manganese; and Schrader mentions Oxide of Titanium as one of its ingredients.

Geognostic Situation.

It occurs usually in beds, sometimes disseminated, and in imbedded masses, in granite, gneiss, mica-slate, clay-slate, foliated granular limestone, coal and trap formations.

Geographic Situation.

Europe.—It occurs in imbedded masses, and disseminated in gneiss in Glen Strath Farrar in Inverness-shire; in the coal formation near Cumnock in Ayrshire, where it is imbedded in greenstone, and in columnar glance-coal *. At Borrodale in Cumberland, it occurs in a

* Jameson's Mineralogical Description of Dumfriesshire, p. 161.

a bed or beds of very varying thickness, included in a bed of trap, which is subordinate to clay-slate. This trap varies in its nature, being sometimes greenstone, or trap-tuff, in other instances amygdaloid, which is occasionally slaty, and contains agates. On the Continent it is met with in the granite of Langsdorf in Bavaria. At Geffrees in Bareuth, imbedded in foliated granular limestone; at Arendal and Friedrschwärn, in Norway; in mica-slate, near Monte-Rosso in Calabria; in gneiss in Piedmont; in serpentine in the mountain of Mora, near to Marbella in Andalusia: and in Iceland, in trap, along with green-earth and zeolite. It is also enumerated amongst the mineral productions of France, Savoy, Bohemia, Austria, Stiria, Salzburg, Hungary and Transylvania.

America.—In the United States it is found at Sparta in New Jersey, imbedded in foliated granular limestone; in syenite near New York; in marble in the county of Ulster; at Freeport in Maine in granite; at Bath in granite; in transition rocks in Rhode Island; and in several other places in foliated granular limestone *. Also in granite in Greenland.

Asia.—At Thutskoi Noss.

Africa.—It is said to occur in rocks near the Cape of Good Hope.

Uses.

The finer kinds are first boiled in oil, and then cut into tables or pencils: the coarser parts, and the refuse of the sawings, are melted with sulphur, and then cast into coarse pencils for carpenters; they are easily distinguished by their sulphureous

* Cleaveland's Mineralogy, and Bruce's Mineralogical Journal.

sulphureous smell. It is also used for brightening and preserving grates and ovens from rust; and, on account of its greasy quality, for diminishing the friction in machines. Crucibles are made with it, which resist great degrees of heat, and have more tenacity and expansibility than those manufactured with the usual clay mixtures.

GENUS VII. MICA.

Talk-glimmer, *Mohs.*

THIS genus contains one species, viz. Rhomboidal Mica.

1. Rhomboidal Mica.

Rhomboedrischer Talk-glimmer, *Mohs.*

This species is subdivided into ten subspecies, viz. 1. Mica, 2. Pinite, 3. Lepidolite, 4. Chlorite, 5. Green Earth, 6. Talc, 7. Nacrite, 8. Potstone, 9. Steatite, 10. Figure-Stone. * Clay-slate, Whet-Slate, Black Chalk, Alum-Slate.

First

First Subspecies.

Mica *.

Glimmer, *Werner*.

Mica, *Wall.* t. i. p. 383.—Glimmer, *Wid.* s. 403.—Mica, *Kirw.* vol. i. p. 210.—Glimmer, *Estner,* b. ii. s. 673. *Id. Emm.* b. i. s. 31.—Mica, *Lam.* t. ii. p. 337. *Id. Nap.* p. 272. *Id. Broch.* t. i. p. 402. *Id. Haüy,* t. iii. p. 208.—Glimmer, *Reuss,* b. ii. s. 72. *Id. Lud.* b. i. s. 114. *Id. Suck.* 1r th. s. 474. *Id. Bert.* s. 202. *Id. Hab.* s. 41.—Mica, *Lucas,* p. 75.—Glimmer, *Leonhard,* Tabel. s. 23.—Mica, *Brong.* t. i. p. 508. *Id. Brard,* p. 182. —Glimmer, *Haus.* s. 89. *Id. Karsten,* Tabel. s. 30.—Mica, *Kid,* vol. i. p. 183. *Id. Haüy,* Tabl. p. 53.—Glimmer, *Steffens,* b. i. s. 215. *Id. Lenz,* b. ii. s. 585. *Id. Oken,* b. i. s. 387. *Id. Hoff.* b. ii. s. 115. *Id. Haus.* Handb. b. ii. s. 487.—Mica, *Aikin,* p. 199.

External Characters.

Its most common colours are yellowish and greenish grey, seldomer smoke and ash grey. The yellowish-grey passes into pinchbeck-brown, and brownish-black, and also into yellowish and silver white. The greenish-grey passes through leek-green and blackish-green into greenish-black, and the ash-grey into velvet-black. It is very rarely peach-blossom red.

It occurs massive, and disseminated ; also in distinct concretions, which are large, coarse, and small granular, and wedge-shaped prismatic. Sometimes regularly crystallized. Its primitive figure is a rhomboid, the dimensions of which are

* *Mica,* from the Latin word *mico,* to shine, given to it on account of its lustre.

are not accurately known; and the following are the secondary forms:

1. Equiangular six-sided prism, fig. 104. Pl. 5.
2. Equiangular six-sided table, fig. 105. Pl. 5.
3. Equiangular six-sided table, truncated on four of the terminal edges, fig. 106. Pl. 5.
4. Equiangular six-sided table, bevelled on the terminal planes, and the edges of the bevelment truncated, fig. 107. Pl. 5.
5. Rectangular four-sided table.
6. Rectangular four-sided prism.
7. Six-sided pyramid, with alternate broader and narrower lateral planes, fig. 108. Pl. 5.

The crystals are middle-sized and small, seldom large.

The tables generally adhere by their terminal planes, seldom by their lateral planes, and form druses. They are sometimes arranged in rows, rarely in the rose-form, and seldom intersecting each other.

The lateral planes of the tables, and the terminal planes of the prism, are smooth and splendent: the terminal planes of the table are longitudinally streaked, and the lateral planes of the prism are transversely streaked.

Internally it is generally splendent, seldom shining, generally pearly, sometimes semimetallic, and in the silver-white variety passing into metallic.

It has a perfect single cleavage, which is parallel with the terminal planes of the prism, or with the lateral planes of the table. The folia of the cleavage are sometimes spherical * and undulating curved, or are floriform.

The fracture is not discernible.

The fragments are tabular and splintery.

I

* This is the Mica hæmispherica of Wallerius and Linnæus, which occurs at Skogboll in Sweden.

It is translucent or transparent in thin plates, but rarely in crystals of considerable thickness or length *.

It is sectile.

It affords a grey-coloured dull streak.

It is harder than gypsum, but not so hard as calcareous spar.

It feels fine and meagre, or smooth.

It is elastic-flexible.

Specific gravity, 2.654, 2.034, *Haüy*.—2.726, *Karsten*.

Chemical Characters.

Before the blowpipe, it melts into a greyish-white enamel.

Constituent Parts.

Common Mica of Zinnwald.		Large foliated Mica from Siberia.		Black Mica from Siberia.	
Silica,	47.00	Silica, -	48.00	Silica,	42.50
Alumina,	22.00	Alumina,	34.25	Alumina,	11.50
Oxide of Iron,	15.50	Oxide of Iron,	4.50	Oxide of Iron,	22.00
Oxide of Manganese,	1.75	Oxide of Manganese,	0.50	Oxide of Manganese,	2.00
Potash,	14.50	Potash,	8.75	Potash,	10.00
		Loss by heating,	1.25	Magnesia,	9.00
	98.75			Loss by heating,	1.00
			97.25		
					98.00
Klaproth, Beit. b. v. s. 69.		*Klaproth*, Ib. s. 73.		*Klaproth*, Ib. s. 78.	

Geognostic

* Count de Bournon mentions crystals of mica in his valuable collection, of considerable thickness, which are transparent in the direction of their axes. He also notices particularly the difference of colour observed as we look in the direction of the axis or across the crystal: thus, he observed in a transparent crystal from Pegu, that the colour in the direction of the axis was yellowish-green; but at right angles to the axis, was beautiful *vert d'herbe*. In other crystals, the colour in the line of the axis was of a beautiful green, whilst in the opposite direction it was orange; and in some other crystals, the colour parallel with the axis was white; but perpendicular to it flesh-red.

Geognostic Situation.

This mineral occurs as an essential constituent part of several primitive rocks, and accidentally intermixed with others, both of the primitive, transition, secondary or flœtz, and alluvial classes. Thus, along with felspar and quartz, it forms granite and gneiss, and with quartz mica-slate: it is occasionally intermixed with clay-slate, quartz-rock, primitive limestone, sienite, porphyry, greenstone, hornblende-slate and hornblende-rock, whitestone, greywacke, greywacke-slate, sandstone, wacke, amygdaloid, basalt, and various alluvial deposites. It sometimes forms short beds in granite, and other primitive rocks; or it appears in globular, oval, tuberose, or irregular-shaped cotemporaneous masses, in granite or gneiss. It also occurs in veins, as in those formed of granite or quartz, or in such as contain ores of different kinds, as tinstone and copper-pyrites *.

Geographic Situation.

The rocks in which mica occurs, are so universally distributed, that it is not necessary to enter into any detail of localities: we may merely mention, that most of the mica of commerce is brought from Siberia, and the borders of the Caspian Sea, where it occurs in large plates or crystals, in granite.

Uses.

In some countries, as in Siberia, mica is an article of commerce, and is regularly mined. In Siberia, the principal mica mines are those on the banks of the Wettin, the Aldan,

* At Zinnwald in Bohemia, it occurs in veins, in a variety of granite, which contains little or no mica, and is known under the name *Greisen*.

Aldan, and other rivers that fall into the Lena. It occurs in nests, often of considerable magnitude, imbedded in granite *. The mica is extracted by means of hammers and chisels, is then washed of the adhering earth, and assorted into different kinds, according to goodness, purity, and size. The plates or tables intended for sale, must be clear, well coloured, and as free as possible from spots. The greenish-coloured and imperfectly transparent, or the spotted varieties, are laid aside, and sold at a low rate. It is exported in considerable quantity from Russia. In 1781, 200 puds were sent from St Petersburgh to Lubec, and a very considerable quantity to England and Ireland.

In Siberia, where window-glass is scarce, it is used for windows; also for a similar purpose in Peru, and, I believe, also in New Spain, as it appears that the mineral named *Teculi* by Ulloa, and which is used for that purpose, is a variety of mica. It is also used in lanterns, in place of glass, as it resists the alternations of heat and cold better than that substance. In Russia, it is employed in different kinds of inlaid work. It is sometimes intermixed with the glaze in particular kinds of earthen-ware: the heat which melts the glaze has no effect on the mica; hence it appears dispersed throughout the glaze, like plates or scales of silver or gold, and thus gives to the surface of the ware a very agreeable appearance. Some artists use it in the making of artificial aventurines.

Observations.

1. Mica is distinguished from *Talc* by lustre, elastic flexibility, superior hardness, and different colours; from Foliated *Chlorite*, by colour, streak, superior hardness, elastic

* The plates are sometimes three or four feet square.

tic flexibility, and crystallizations; and from *Common Hornblende*, by form, single distinct cleavage, streak, and inferior hardness.

2. The following works contain information in regard to the situation, mode of mining, and uses of Russian mica.

1. Georgi's Geograph. Physikal. u. Naturhist, od Beschreib. Russischen. Reichs. b. 3. s. 236.
2. Gmelin's Reise, b. 2. s. 322.
3. Nov. Comment. Acad. Petrop. 1766, p. 549.
4. Hanover'sches Magazin. 9. s. 79.
5. Neue Nordische Beiträge, b. ii. s. 356.
6. Beckmann's Vorbereitung zur Waarenkunde, b. ii. s. 233.

3. The yellow and brown varieties are by the vulgar named *Cat-gold*, the white varieties *Cat-Silver*. The Russian *Sliuda*, is mica, and their *Frauen-glass* or Muscovy glass is the same mineral.

Second Subspecies.

Pinite *.

Pinit, *Werner*.

Micarelle, *Kirwan*.

Pinit, *Reuss*, b. ii. s. 69. *Id. Lud.* b. ii. s. 149. *Id. Suck.* 1r th. 469. *Id. Bert.* s. 298. *Id. Mohs*, b. i. s. 480. *Id. Lucas*, p. 280. *Id. Leonhard*, Tabel. s. 24. *Id. Brong.* t. i. p. 507. *Id. Brard*, p. 185. *Id. Karsten*, Tabel. s. 48. *Id. Haüy*, Tabl. p. 53. *Id. Steffens*, b. i. s. 219. *Id. Lenz*, b. ii. s. 592. *Id.* Oken,

* It is named *Pinite*, from the Pini mine gallery, where it was first found.

Oken, b. i. s. 389. *Id. Hoff.* b. ii. s. 127. *Id. Haus.* Handb. b. ii. s. 507. *Id. Aikin,* p. 190.

External Characters.

Its colour is blackish-green, altered on the surface by brown or red iron-ochre into brownish-red. It is sometimes iron-shot.

It occurs massive, also in distinct concretions, which are thick and thin lamellar, collected into large and coarse granular, and crystallized in the following figures:

1. Equiangular six-sided prism.
2. The preceding figure truncated or bevelled on all the lateral edges. Owing to the number of planes, figures of this description have a cylindrical form. The terminal angles are sometimes truncated.
3. Rectangular four-sided prism.

The crystals are seldom middle-sized, generally small. They are imbedded, and frequently intersect each other.

The cleavage is shining; the fracture is glistening and glimmering, and the lustre is resinous.

The cleavage is imperfect and single, the folia being parallel with the terminal planes of the prism.

The fracture is small-grained uneven.

The fragments are blunt-angular, seldom tabular.

It is opaque, or faintly translucent on the edges.

It is soft, passing into very soft.

It is sectile, and easily frangible.

It is not flexible.

It feels somewhat greasy.

Specific gravity, 2.914, *Haüy.*—2.974, *Kirwan.*

Chemical Character.

It is infusible before the blowpipe.

Constituent

Constituent Parts.

Silica, -	29.50	Silica, -	46.0
Alumina, -	63.75	Alumina, -	42.0
Oxide of Iron,	6.75	Oxide of Iron,	2.5
		Loss by calcination,	7.0
	100.00	Loss, -	2.5
			100.0
Klaproth, Jour. des Mines, N. 100. p. 311.		*Drappier*, Jour. des Mines, N. 100. p. 311.	

Geognostic and Geographic Situations.

It is found imbedded in the granite of St Michael's Mount in Cornwall: in porphyry in Ben Gloe and Blair-Gowrie; in granite at Schneeberg in Saxony, and in the porcelain-earth of Aue, also in Saxony; in a greyish porous felspar-porphyry in the Puy de Dome, in Auvergne; in Dauphiny, along with epidote, axinite, rock-crystal, chlorite, and iron-ochre; in Regenbei near Bodenmais in Bavaria, and in the Lisenz-Alp in the Tyrol, where it is very rare *.

Observations.

1. It is distinguished from *Mica*, with which it has been confounded, by its circumscribed series of colour, its peculiar truncations, its never inclining to the tabular form, and its lustre, fracture, and want of flexibility.

2. It was first established as a distinct mineral by Werner,

* Heuland.

ner, and named *Pinite*, from the Pini Gallery in the mines of Schneeberg, where it was first found.

3. According to Bernhardi, in Von Moll's Ephemerid. b. iii. st. 1. pinite is nearly allied to Schorl; and Hausmann is of opinion, that it is a mixture of mica and andalusite. In opposition to these conjectures, and in confirmation of its close affinity to mica, we have its form, cleavage, softness and specific gravity.

Third Subspecies.

Lepidolite *.

Lepidolith, *Werner*.

Lepidolith, *Wid.* s. 378. *Id. Kirw.* vol. i. p. 208. *Id. Emm.* b. iii. s. 324. *Id. Estner,* b. ii. s. 228. *Id. Nap.* p. 167. *Id. Lam.* t. ii. p. 315. *Id. Broch.* t. i. p. 399. *Id. Haüy,* t. iv. p. 375. *Id. Reuss,* b. ii. s. 402. *Id. Lud.* b. i. s. 114. *Id. Suck.* 1r th. s. 397. *Id. Bert.* s. 17. *Id. Mohs,* b. i. s. 465. *Id. Hab.* s. 40. *Id. Lucas,* p. 199. *Id. Leonhard,* Tabel. s. 23. *Id. Brong.* t. i. p. 506. *Id. Brard,* p. 411. *Id. Haus.* s. 91. *Id. Karsten,* Tabel. s. 30. *Id. Kid,* vol. ii. p. 246. *Id. Haüy,* Tabl. p. 64. *Id. Steffens,* b. i. s. 213. *Id. Lenz,* b. ii. s. 582. *Id. Oken,* b. i. s. 390. *Id. Hoff.* b. ii. s. 111. *Id. Haus.* Handb. b. ii. s. 500. —Mica, *Aikin,* p. 200.

External Characters.

Its colour is peach-blossom-red, inclining sometimes to rose-red, sometimes to lilac-blue; it also passes into pearl-grey, yellowish-grey, and greenish-grey.

It

* *Lepidolite*, from the Greek word λεπις, *a scale*, given it on account of its foliated appearance.

It occurs massive, and in small granular distinct concretions.

Internally its lustre is glistening, passing into shining, and pearly.

It has a distinct single cleavage.

The fracture is coarse splintery.

The fragments are indeterminate angular and blunt-edged.

It is feebly translucent.

It is soft.

It is rather sectile.

It is rather easily frangible.

Specific gravity, 2.816, *Klaproth*.—2.58, *Karsten*.

Chemical Characters.

Before the blowpipe it intumesces, and melts very easily into a milk-white nearly translucent globule.

Constituent Parts.

Silica, - -	54.50	Silica, -	54.00
Alumina, -	38.25	Alumina,	20.00
Potash, -	4.00	Potash, -	18.00
Manganese & Iron,	0.75	Fluat of Lime,	4.00
Loss, partly Water,	2.50	Manganese,	3.00
		Iron, -	1.00
	100		100
	Klaproth, Beit. b. ii. s. 195.		*Vauquelin*, Jour. de Min. t. ix. p. 235.

Geognostic

Geognostic and Geographic Situations.

It occurs disseminated, in foliated and granular limestone, at Dalmally; in primitive limestone in a quarry on the north side of Loch Fyne, opposite the Inn of Cairndow, situated on the south side; and in primitive limestone, from a quarry on the east side of Loch Leven, nearly opposite to the Inn at Balachulish, situated on the west side *.

It occurs imbedded in granite, in the mountain of Hradisko, near to Rosena in Moravia; in quartz in granite, in the Riesengebirge in Silesia; also in beds of ironstone subordinate to gneiss, along with apophyllite, in Utön in Sweden; in Norway; in the vicinity of Limoges in France; and in the Isle of Elba †; and associated with rubellite and common felspar, at Perm, in the government of Catharineburg, in Siberia.

Uses.

It is sometimes cut into snuff-boxes, which are admired for their colour; but, owing to the softness of the mineral, they have rather a dull greasy-like surface.

Observations.

1. It is nearly allied to Mica, from which, however, it is distinguished by colour and fracture.

2. The first account published of this mineral, was by M.

* The above localities are on the authority of Mr Holme of Peterhouse, Cambridge, who found this mineral in the places above mentioned.

† Haüy and Tondi received, through Mr Schultz, a mineral from Bavaria, which they consider as a variety of lepidolite.—Von Moll's Neue Jahrbuch d. Berg & Hüttenkunde, 3. B. 1. Lif. s. 111.

M. Von Born, in the Chem. Annalen for 1791, who considered it as zeolite.

3. The grey variety from Utön, has been described as a distinct species, under the name *Petalite*.

Fourth Subspecies.

Chlorite *.

Chlorit, *Werner*.

This subspecies is divided into four kinds, viz. Earthy Chlorite, Common Chlorite, Slaty Chlorite, and Foliated Chlorite.

First Kind.

Earthy Chlorite.

Erdiger Chlorit, *Karsten*.

Chlorite in a loose form; Peach of the Cornish Miners, *Kirw.* vol. i. p. 147.—Erdiger Chlorite, *Reuss*, b. ii. s. 81. *Id. Lud.* b. i. s. 116. *Id. Suck.* 1r th. s. 479. *Id. Bert.* s. 426. *Id. Mohs*, b. i. s. 484. *Id. Leonhard*, Tabel. s. 24. *Id. Haus.* s. 90. *Id. Karst.* Tabel. s. 12.—Talc Chlorit terreux, *Haüy*, Tabl. p. 56.—Erdiger Chlorit, *Steffens*, b. i. s. 221. *Id. Lenz*, b. ii. s. 600. *Id. Oken*, b. i. s. 382. *Id. Hoff.* b. ii. s. 134.—Schuppiger Chlorit, *Haus.* Handb. b. ii. s. 491.

External

* *Chlorite*, from the Greek word χλωρος, *green*, on account of its green colour.

External Characters.

Its colours are dark mountain and leek green, and sometimes olive-green.

It occurs massive, disseminated, in crusts, and moss-like, inclosed in adularia and rock-crystal.

It is glimmering or glistening, and the lustre is pearly.

It consists of fine scaly particles, which are more or less cohering, and feels rather greasy.

It does not soil.

Its streak is of a mountain-green colour.

Specific gravity 2.612, 2.699.

Chemical Characters.

It melts before the blowpipe into a blackish slag.

Constituent Parts.

Silica, - -	26.00
Alumina, - -	18.50
Magnesia, - -	8.00
Muriate of Soda, or Potash,	2.00
Oxide of Iron, -	43.00
Loss, - -	2.50
	99.00

Vauquelin, Journ. des Mines, N. 39. p. 167.

Geognostic and Geographic Situations.

It occurs in veins along with common chlorite at Forneth Cottage in Perthshire. In felspar and Adularia veins in St Gothard; also in Dauphiny, where it encrusts rock-crystal, axinite, and sphene; and in veins intersecting serpentine at Waldheim near Freyberg.

Observations.

Observations.

1. It is characterized by its green colour, scaly glimmering particles, slightly greasy feel, and its not soiling.

2. The great quantity of iron it contains, is by Karsten considered more as an accidental than as a regular constituent part.

3. The scaly parts, according to Haüy, when viewed by the microscope, appear to be regular six-sided tables.

Second Kind.

Common Chlorite.

Gemeiner Chlorit, *Werner.*

Indurated Chlorite, *Kirwan*, vol. i. p. 148.—Gemeiner Chlorit, *Reuss*, b. ii. s. 84. *Id. Lud.* b. i. s. 117. *Id. Suck.* 1r th. s. 483. *Id. Bert.* s. 426. *Id. Mohs*, b. i. s. 485. *Id. Hab.* s. 59. *Id. Leonhard*, Tabel. s. 24.—Chlorite commune, *Brong.* t. i. p. 500. —Blättricher Chlorit, *Haus.* s. 90. *Id. Karsten*, Tabel. s. 42. *Id. Steffens*, b. i. s. 222. *Id. Lenz*, b. ii. s. 60. *Id. Oken*, b. i. s. 382.—Gemeiner Chlorit, *Hoff.* b. ii. s. 137. *Id. Haus.* Handb. b. ii. s. 492.

External Characters.

Its colour is intermediate between dark blackish-green and leek-green.

It occurs massive and disseminated.

Its lustre is glimmering, or glistening, and is pearly, inclining to resinous.

The fracture is fine earthy, and fine scaly foliated.

The

The fragments are blunt-edged.

It is opaque.

It becomes light mountain-green in the streak, with a feeble lustre.

It is soft, passing into very soft.

It is sectile.

It does not adhere to the tongue.

It feels somewhat greasy.

Specific gravity 2.832, *Wid.*

Geognostic and Geographic Situations.

It occurs not only disseminated through rocks of different kinds, as granite and mica-slate, but also in beds and veins. The granite of Mont Blanc contains common chlorite in veins, or disseminated through it: in Saxony, Salzburg, and other countries, it occurs in beds, which contain magnetic ironstone, copper-pyrites, iron-pyrites, arsenical pyrites, hornblende, actynolite, and calcareous-spar. In the Island of Arran, it occurs in quartz veins that traverse clay-slate; in similar repositories in the Island of Bute, and in several other districts in Scotland, in granite and other rocks. In England, it occurs in the Wherry Mine, Penzance, and other places in Cornwall *.

Third

* Greenough.

Third Kind.

Slaty Chlorite or Chlorite-Slate.

Chlorit-Schiefer, *Werner.*

Schiefriger Chlorit, *Karsten.*

Chlorit Schiefer, *Reuss,* b. ii. s. 88. *Id. Lud.* b. i. s. 117. *Id. Suck.* 1r th. s. 484. *Id. Bert.* s. 427. *Id. Mohs,* b. i. s. 487. *Id. Hab.* s. 59. *Id. Leonhard,* Tabel. s. 24.—Chlorit schisteuse, *Brong.* t. i. p. 501.—Schiefriger Chlorit, *Haus.* s. 90. *Id. Karst.* Tabel. s. 42.—Talc Chlorite fissile, *Haüy,* Tabl. p. 56. —Schiefriger Chlorit, *Steffens,* b. i. s. 223.—Chlorit Schiefer, *Lenz,* b. ii. s. 605. *Id. Oken,* b. i. s. 383. *Id. Hoff.* b. ii. s. 139. *Id. Haus.* Handb. b. ii. s. 493.

External Characters.

Its colour is intermediate between dark mountain and leek green, and sometimes passes into blackish-green and greenish-black.

It occurs massive, and in whole beds.

The lustre is glistening, sometimes inclining to shining, and is intermediate between pearly and resinous.

The fracture is more or less perfect slaty, seldom straight, generally waved slaty, and sometimes scaly foliated.

The fragments are tabular.

It is opaque.

It affords a pale mountain-green streak.

It is soft.

It is sectile; and rather easily frangible.

It does not adhere to the tongue.

It feels slightly greasy.

Specific

Specific gravity, 2.905, *Saussure.*—2.822, *Karsten.*—2.794, *Grüner.*

Constituent Parts.

Silica, - - -	29.50
Alumina, - - -	15.62
Magnesia, - - -	21.39
Lime, - - -	1.50
Iron, - - -	23.3
Water, - - -	7.38
	Grüner.

Geognostic Situation.

It occurs principally in beds, subordinate to clay-slate, and is occasionally associated with potstone and talc-slate. It also occurs in beds in gneiss, mica-slate, and quartz rock. It frequently contains octahedral crystals of magnetic iron-stone; also garnets, schorl, and rhomb-spar.

Geographic Situation.

It occurs in beds, in the clay-slate districts of the Grampians, and other parts of Scotland. On the Continent, it is found in Norway, Sweden, Saxony, Switzerland, Corsica, and other countries.

Observations.

It passes into Clay-slate, and also into Potstone.

Fourth

Fourth Kind.

Foliated Chlorite.

Blättriger Chlorit, *Werner.*

Blättriger Chlorit, *Reuss*, b. ii. s. 86. *Id. Lud.* b. i. s. 118. *Id. Suck.* 1r th. s. 481. *Id. Mohs*, b. i. s. 486. *Id. Leonhard*, Tabel. s. 24. *Id. Haus.* s. 90. *Id. Karsten*, Tabel. s. 62.—Talc Chlorit, *Haüy*, Tabl. p. 56.—Blättriger Chlorit, *Steffens*, b. i. s. 224. *Id. Lenz*, b. ii. s. 603. *Id. Oken*, b. i. s. 383. *Id. Hoff.* b. ii. s. 140. *Id. Haus.* Handb. b. ii. s. 490.

External Characters.

Its colour is dark blackish-green, which in some rare varieties is dark olive-green.

It occurs massive, disseminated, in granular concretions, and crystallized in four-sided prisms, and in six-sided tables. These tables are aggregated together, in such a manner as to form the two following figures:

A. Cylinder terminated by two cones.

B. Two truncated cones, joined base to base.

If we suppose the six-sided table N° 1. to revolve around an axis which passes through its two opposite angles, the figure A will be formed; but if it revolves around an axis which passes through two opposite sides, the figure B will be formed. The streaking on the surfaces shows the mode of aggregation of the tables.

The crystals are generally longitudinally streaked, and are small or middle-sized.

Externally

Externally it is glistening, approaching to shining, and is resinous; internally it is shining and pearly.

It has a single imperfect cleavage, in which the folia are often curved.

The fragments are indeterminate angular, or tabular.

It is opaque, or translucent on the edges.

It is soft, passing into very soft.

It is sectile, and rather difficultly frangible.

It feels rather greasy.

Its colour is lighter in the streak.

Specific gravity 2.823, *Karsten*.

Constituent Parts.

Silica, - - -	35.00
Alumina, - - -	18.00
Magnesia, - - -	29.90
Iron, - - -	9.70
Water, - - -	2.70

Lampadius, Handbuch zur Chem. Analyse der Mineral Körper, s. 229.

Geognostic and Geographic Situations.

Europe.—It occurs in the island of Jura, one of the Hebrides, in quartz rock. On the Continent of Europe, it is found in St Gothard, where it is associated with adularia, rock-crystal, and rutile; also in the valley of Fusch in Salzburg, where it occurs along with amethyst and adularia, and seldom with prehnite; and in Sweden, Saxony, and Corsica.

Asia.—It occurs in Siberia, along with slaty chlorite.

OBSERVATIONS

OBSERVATIONS ON CHLORITE.

1. It was Saussure the Father, who first directed the attention of mineralogists to this mineral; and Werner was the first who ascertained its oryctognostic relations.

2. It is nearly allied to Talc and Mica, and also to Potstone. The foliated kind approaches the nearest to Mica, the common and slaty to Potstone.

3. Hausmann, in his "Entwurf eines Systems der Unorganisirten Naturkörper," describes a substance under the name *Conchoidal Chlorite*, which deserves to be more particularly examined. The following is his account of it:

"*Conchoidal Chlorite*. Colour leek-green; internally dull; but shining and resinous on the surface of the fissures. Fracture flat conchoidal, inclining to splintery and earthy, even sometimes approaching to slaty. Becomes resinous and shining in the streak. Translucent on the edges. Soft. It occurs in the Hartz, disseminated in amygdaloid and greenstone."

Fifth Subspecies.

Green Earth.

Grünerde, *Werner*.

Green Earth, *Kirwan*, vol. i. p. 196.—Grünerde, *Emm.* b. i. s. 353.—La Terre verte, *Broch.* t. i. p. 445.—Grünerde, *Reuss*, b. ii. s. 157. *Id. Lud.* b. i. s. 126. *Id. Suck.* 1r th. s. 522. *Id. Bert.* s. 214. *Id. Mohs*, b. i. s. 515. *Id. Hab.* s. 39.—Talc Chlorite zographique, *Lucas*, p. 84.—Grünerde, *Leonhard*, Tabel. s. 26.—Chlorite Baldogée, *Brong.* t. i. p. 501.—

Talc Chlorite zographique, *Brard*, p. 198.—Erdiger Chlorit, *Haus.* s. 90.—Grünerde, *Karsten*, Tabel. s. 26.—Talc Chlorite zographique, *Haüy*, Tabl. p. 56.—Grünerde, *Steffens*, b. i. s. 257. *Id. Lenz*, b. ii. s. 621. *Id. Oken*, b. i. s. 277. *Id. Hoff.* b. ii. s. 195.—Green Earth, *Aikin*, p. 201.

External Characters.

Its colour is celandine-green, of various degrees of intensity, which passes into blackish-green, and olive-green.

It occurs massive, seldomer disseminated, more frequently in globular and amygdaloidal-shaped pieces, which are sometimes hollow, in crusts lining the vesicular cavities in amygdaloid, or on the surface of agate balls *.

Internally it is dull.

The fracture is earthy, sometimes small grained uneven.

It is opaque.

It is feebly glistening in the streak, but without any change of colour.

It is very soft, and sectile.

It feels rather greasy.

It adheres slightly to the tongue.

Specific gravity, 2.598, *Karsten.*—2.632, *Kirwan.*—2.606, *Breithaupt.*

Chemical Characters.

Before the blowpipe, it is converted into a black vesicular slag.

Constituent

* It is said to occur crystallized in the valley of Fassa in the Tyrol.—Vid. Brocchi's Description of the Valley of Fassa.

Constituent Parts.

	From Cyprus.	From the Veronese.
Silica, - -	51.50	53.0
Oxide of Iron,	20.50	28.0
Magnesia, -	1.50	2.0
Potash, - -	18.00	10.0
Water, - -	8.00	6.0
Loss, - -	0.50	——
		99.0
	100.00	
	Klaproth, Beit. b. iv. p. 244.	*Klaproth*, Id. s. 241.

Geognostic Situation.

It occurs principally in the amygdaloidal cavities of amygdaloid, and incrusting the agates found in that rock. It also occasionally colours sandstone, and is disseminated in porphyry.

Geographic Situation.

It is a frequent mineral in the amygdaloid of Scotland; it occurs also in that of England and Ireland. It is found in the amygdaloid of Iceland and the Faroe Islands; and on the Continent of Europe, it occurs in Saxony, Bohemia, near Verona, the Tyrol, and Hungary.

Uses.

It is used as a pigment in water-painting, and is the *mountain-green* of painters. It is very durable in the air, but rarely affords tints equal to those obtained from copper. Before using, it must be ground, and well washed, to free it from impurities. When exposed to a moderate heat, the green changes into a beautiful reddish-brown colour, which is very durable, and it is then used as a water-colour. Of all the known varieties, that of Verona is the most highly esteemed, and is known in trade under the name *Green Earth of Verona*. That of Cyprus is also an article of commerce. It is brought to Holland as ballast, wrapped up in palm-leaves, in hampers. The green earth of Bohemia is also known in trade, but is not so highly esteemed as the Veronese and Cyprian. A colouring matter of this description appears to have been known to the Romans.

Observations.

1. This mineral was first established as a distinct mineral by Werner. It is distinguished by its colour, shape, fracture, streak, hardness, and geognostic situation.

2. The intimate combination of this mineral and calcedony forms Heliotrope, and also the greater number of the pretended specimens of Plasma.

Sixth Subspecies.

Talc *.

Talk, *Werner*.

This species is divided into two kinds, viz. Common Talc and Indurated Talc.

First

* The origin of the name *Talc* is not well known: some derive it from the German *talg*, tallow, as it has a greasy feel, or from the Swedish word *talgа*, as it cuts very easily; while others maintain that it is of Asiatic origin.

First Kind.

Common Talc.

Gemeiner Talk, *Werner*.

Talcum albicans, lamellis subpellucidis flexis, *Waller*. gen. 27. spec. 180.—Gemeiner Talk, *Wid.* s. 441.—Common Talc, or Venetian Talc, *Kirw.* vol. i. p. 150.—Gemeiner Talk, *Estner*, b. ii. s. 824. *Id. Emm.* b. i. s. 391.—Talco compatto, *Nap.* p. 293.—Talc cailleux, *Lam.* t. ii. p. 342.—Talc laminaire, *Haüy*, t. iii. p. 252.—Le Talc commun, *Broch.* t. i. p. 487.—Gemeiner Talc, *Reuss*, b. ii. 2. s. 229. *Id. Lud.* b. i. s. 136. *Id. Suck.* 1r th. s. 571. *Id. Bert.* s. 139. *Id. Hab.* s. 64.—Talc laminaire, *Lucas*, p. 83.—Gemeiner Talk, *Leonhard*, Tabel. s. 29.—Talc laminaire, *Brong.* t. i. p. 503. *Id. Brard*, p. 197.—Blättricher Talk, *Haus.* s. 91.—Gemeiner Talk, *Karst.* Tabel. s. 42.—Laminated and Venetian Talk, *Kid*, vol. i. p. 107. & 108.—Talc hexagonal, laminaire, ecailleux, *Haüy*, Tabl. p. 56.—Gemeiner Talk, *Steffens*, b. i. s. 228. *Id. Lenz*, b. ii. s. 665. *Id. Oken*, b. i. s. 389. *Id. Hoff.* b. ii. s. 270.—Blättricher Talk, *Haus.* Handb. b. ii. s. 498.

External Characters.

Its most common colour is greenish-white; it also occurs silver-white, apple-green, asparagus-green, and leek-green, which latter colour passes into duck-blue. The apple-green, sometimes passes into emerald-green.

It occurs massive, disseminated, in plates, reniform, and botryoidal: in distinct concretions, which are large, coarse and small granular; also narrow or broad and stellular or promiscuous radiated, which are again collected into other concretions, having a wedge-shaped prismatic form. It is sometimes

sometimes crystallized in small six-sided tables, which are in druses.

It is generally splendent, or shining, and is pearly, or semi-metallic.

It has a distinct single cleavage, in which the folia are generally curved.

The fragments are wedge-shaped, seldom splintery.

It is translucent; in thin folia transparent.

It is flexible, but not elastic.

It is very soft, or yields easily to the nail.

It is perfectly sectile.

It feels very greasy.

Specific gravity, 2.695, 2.795, *Kirwan.*—2.770, *Karsten.*—2.771, *Breithaupt.*

Chemical Characters.

It becomes white before the blowpipe, and at length, with difficulty, affords a small globule of enamel.

Constituent Parts.

Silica, -	62.00	Silica, -	61.75
Magnesia,	27.00	Magnesia,	30.50
Alumina,	1.50	Potash, -	2.75
Oxide of Iron,	3.50	Oxide of Iron,	2.50
Water, -	6.00	Water, -	0.25
		Loss, -	2.25
Vauquelin, Jour. d. Min. N. 88. p. 243.		*Klaproth*, Karst. Tab. s. 48.	

Geognostic Situation.

It occurs in beds in mica-slate and clay-slate, and in a similar situation in granular limestone and dolomite; also in

cotemporaneous

cotemporaneous veins, in beds of indurated talc, serpentine, and porphyry; and in the reniform external shape, in tin-stone veins.

Geographic Situation.

Europe.—It is found in Aberdeenshire, Banffshire, and Perthshire; and on the Continent of Europe, in Norway, Sweden, Saxony, Bohemia, Switzerland, the Tyrol, and Salzburg. The finest specimens of common talc are found in Salzburg, the Tyrol, and in St Gothard in Switzerland. The beautiful duck-blue variety is brought from the Taberg in Wermeland in Sweden.

Asia.—Persia, China, India.

America.—Maryland, Pennsylvania, Connecticut, Massachusets, and Maine *.

Uses.

It enters into the composition of the cosmetic named *rouge*. This substance is prepared by rubbing together in a warm mortar, generally of serpentine, certain proportions of carmine and finely powdered talc, with a small portion of oil of benzoin. This cosmetic communicates a remarkable degree of softness to the skin, and is not pernicious. The Romans prepared a beautiful blue or purple colour, by combining this substance with the colouring fluid of particular kinds of testaceous animals †; and the flesh polish is given to gypsum figures, by rubbing them with talc. The Persians, according to Tavernier, whiten the walls of their houses and gardens by means of lime-water,

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* Cleaveland's Mineralogy.

† The Buccinum reticulatum and Buccinum lapillus, that abound on the coasts of the Mediterranean.

water, and then powder them with silver-white coloured talc, which is said to give them a beautiful appearance. The Chinese burn talc, mix it with wine, and use it internally, as a cordial for curing diseases, and procuring long life: even European physicians, at one period, prescribed the powder of talc in dysenteric and hæmorrhoidal affections. It was known in the Materia Medica under the name *Talcum Venetum.*

Observations.

1. The light green colours, distinct concretions, strong lustre, fracture, considerable translucency, softness, perfect sectility, want of elasticity, and very greasy feel, are the principal characters of Common Talc.

2. Common Talc is often confounded with *Mica*, but is distinguished from it by its sectility, greasy feel, inferior hardness, want of elasticity, and colour. It is distinguished from *Chlorite* by its colours.

Second Kind.

Indurated Talc, or Talc-Slate.

Verhärteter Talk, *Werner.*

Verhærteter Talk, *Estner,* b. ii. s. 828. *Id. Emm.* b. iii. s. 280. —Le Talc endurcie, *Broch.* t. i. p. 489.—Verhärteter Talk, *Reuss,* b. ii. 2. s. 233. *Id. Lud.* b. i. s. 136. *Id. Suck.* 1r th. s. 573. *Id. Bert.* s. 140. *Id. Mohs,* b. i. s. 565. *Id. Leonhard,* Tabel. s. 29.—Talc endurcie, *Brong.* t. i. p. 504.—Verhärteter Talc, *Karsten,* Tabel. s. 42.—Indurated Talc, *Kid,* vol. i. p. 109.—Verhärteter Talc, *Steffens,* b. i. s. 230. *Id. Lenz,* b. ii. s. 669. *Id. Oken,* b. i. s. 390. *Id. Hoff.* b. ii. s. 275.—Schiefriger Talk, *Haus.* Handb. b. ii. s. 497.

External

External Characters.

Its colour is greenish-grey, of various degrees of intensity, which sometimes passes into greenish-white and yellowish-white: it very rarely inclines to olive-green.

It occurs massive, and rarely in fibrous distinct concretions.

Its lustre is shining, passing to glistening, and is pearly.

The fracture is curved slaty, passing into imperfect foliated.

The fragments are tabular.

It is strongly translucent on the edges, and sometimes feebly translucent.

It is soft, and the streak is white.

It is rather sectile.

It is rather easily frangible.

It is not flexible.

It feels greasy.

Specific gravity, 2.700, 2.800, *Kirwan*.—2.780, 2.793, *Breithaupt*.

Geognostic Situation.

It occurs in primitive mountains, where it forms beds in clay-slate and serpentine, and is associated with amianthus, chlorite, rhomb-spar, garnet, actynolite, quartz, kyanite and grenatite.

Geographic Situation.

It occurs in Perthshire, Banffshire, the Shetland islands; and on the Continent of Europe, in Sweden, Saxony, Silesia, the Tyrol, Austria, and Switzerland.

Uses.

Uses.

It is employed for drawing lines by carpenters, tailors, hat-makers, and glaziers. The lines are not so easily effaced as those made by chalk, and besides remain unaltered under water. Dr Kid remarks: "If lines be traced on glass by means of a piece of indurated talc, they remain invisible, or are scarcely perceptible by the naked eye, till breathed on. I have not met with an explanation of the effect produced in this instance; but it may perhaps in part depend on the comparative softness of the substance with which the impression is made: the condensation of the breath taking place more readily on the glass, than on the talc covering the glass, and the impression of the talc becoming more apparent by the simple contrast *." It is sometimes made into culinary vessels; and when reduced to powder, may be employed for the purpose of removing from silk stains occasioned by grease.

Observations.

1. It is distinguished from *Common Talc* by its inferior lustre, slaty fracture, inferior translucency, and rather greater hardness and weight; from *Potstone* by its colour-suite, superior lustre, more perfect slaty fracture, and greater translucency; and from *Axe-Stone* by inferior hardness and weight.

2. It passes into potstone, axestone, and steatite.

Seventh

* Kid's Mineralogy, vol. i. p. 109.

Seventh Subspecies.

Nacrite.

Nacrite, *Brongniart.*

Erdiger Talk, *Werner.*

Erdiger Talk, *Wid.* s. 439.—Talcite, *Kirw.* vol. i. p. 149.—Erdiger Talk, *Estner,* b. ii. s. 821. *Id. Emm.* b. i. s. 389.—Talco terroso, *Nap.* p. 293.—Le Talc terreux, *Broch.* t. i. p. 486.—Erdiger Talk, *Reuss,* b. ii. s. 227. *Id. Lud.* b. i. s. 135. *Id. Suck.* 1r th. s. 570. *Id. Bert.* s. 299. *Id. Mohs,* b. i. s. 560. *Id. Leonhard,* Tabel. s. 29.—Nacrite, *Brong.* t. i. p. 505.—Schuppiger Thon, *Karsten,* Tabel. s. 28. *Id. Haus.* s. 85.—Talc granuleux, *Haüy,* Tabl. p. 67.—Schuppiger Thon, *Steffens,* b. i. s. 202.—Erdiger Talc, *Hoff.* b. ii. s. 267.—Schuppiger Talc, *Haus.* Handb. b. ii. s. 498.

External Characters.

Its colours are greenish-white, and greenish-grey.

It consists of scaly parts, which are more or less compacted; the most compact varieties have a thick or curved slaty fracture.

It is strongly glimmering, and is pearly, inclining to resinous.

It is friable.

It feels very greasy.

It soils.

Chemical Characters.

It melts easily before the blowpipe.

Constituent Parts.

Alumina,	-	81.75
Magnesia,	-	0.75
Lime,	- -	4.00
Potash,	- -	0.50
Water,	-	13.50
		100.50 *John.*

Geognostic and Geographic Situations.

This is a very rare mineral; it occurs in veins with sparry ironstone, galena, iron-pyrites and quartz, in the mining district of Freyberg in Saxony; Gieren, in Silesia; and Sylva in Piedmont.

Observations.

This rare mineral is named *Nacrite* by Brongniart, which name is here adopted, in preference to that of Earthy Talc, the name given to it by Werner.

Eighth Subspecies.

Potstone, or Lapis ollaris *.

Topfstein, *Werner.*

Lapis comensis, *Plin.* Hist. Nat. xxxvi. 22. p. 44.—Steatites, Lapis ollaris, *Wall.* Syst. Min. i. 387.—Potstone, *Kirw.* vol. i. p. 155.

* So named, on account of the facility with which it can be cut into vessels or pots of different kinds.

p. 155.—Topfstein, *Reuss*, b. ii. 2. s. 236. *Id. Lud.* b. i. s. 115. *Id. Suck.* 1r th. s. 576. *Id. Hab.* s. 30. *Id. Leonhard*, Tabel. s. 26.—Serpentine ollaire, *Brong.* t. i. p. 486.—Topfstein, *Karsten*, Tabel. s. 42.—Talc ollaire, *Haüy*, Tabl. p. 56.—Topfstein, *Steffens*, b. i. s. 231. *Id. Lenz*, b. ii. s. 598. *Id. Oken*, b. i. s. 381. *Id. Hoff.* b. ii. s. 131. *Id. Haus.* Handb. b. ii. s. 496.—Potstone, *Aikin*, p. 234.

External Characters.

Its colour is greenish-grey, of different degrees of intensity; the darker varieties incline to leek-green, and blackish-green.

It occurs massive, and in granular concretions, which are indistinct.

Internally it is glistening, inclining to shining, and is pearly, inclining to resinous.

The fracture is curved, and imperfect foliated, which passes into slaty.

The fragments are indeterminate angular, or slaty.

It is translucent on the edges.

It affords a white-coloured streak.

It is soft, passing into very soft.

It is perfectly sectile.

It feels greasy.

It is rather difficultly frangible.

Specific gravity, 2.800, *Saussure* and *Karsten*.

Chemical Character.

It is infusible before the blowpipe.

Constituent

Constituent Parts.

			Potstone of Chiavenne.	
Silica, - -	39		Silica, -	38.12
Magnesia, -	16		Magnesia,	38.54
Oxide of Iron,	10		Alumina,	6.66
Carbonic Acid,	20		Lime, -	0.41
Water, -	10		Iron, -	16.62
	——		Fluoric Acid,	0.41
	95			——
	Tromsdorf.		*Wiegleb.*	99.76

Geognostic Situation.

It occurs in thick beds, in primitive clay-slate.

Geographic Situation.

Europe.—It occurs abundantly on the shores of the Lake Como in Lombardy, and at Chiavenna in the Valteline: also in different parts in Norway, Sweden, and Finland.

Africa.—It is said to occur in Upper Egypt.

America.—It is found in the country around Hudson's Bay; and in Greenland.

Uses.

When newly extracted from the quarry, it is very soft and tenacious, so that it is frequently fashioned into various kinds of culinary vessels, which harden in drying, and are very refractory in the fire. These vessels do not communicate any taste to the food boiled in them, and have been used for culinary purposes for ages. Pliny mentions them, and describes the mode of making them, and the changes they experience

ence by using. In those times, potstone was named *Lapis Comensis*, and *Lapis Siphnius*, from the island of Siphnus, (the present Siphanto), where it was found. In Upper Egypt, this mineral is named *Pierre de Baram*, and is used for culinary vessels. Quarries of potstone were worked on the banks of the Lake Como, from the beginning of the Christian era to the 25th of August 1618, when they fell in and destroyed the neighbouring town of Pleurs. It was there used for culinary vessels and oven-soles, both of which were uncommonly durable. In proof of this, it is mentioned, that an oven at Liddus, in the Valais, stood unimpaired for several hundred years. The town of Pleurs drew annually from those quarries, stone to the value of 60,000 ducats. In Greenland and Hudson's Bay, culinary vessels and lamps are made of potstone; and in Norway and Sweden it is used for lining stoves, ovens, and furnaces.

Observations.

It is very nearly allied to Indurated Talc, from which it is distinguished by its deeper grey colour, higher lustre, kind of fracture, distinct concretions, and lower degree of translucency.

Ninth Subspecies.

Steatite, or Soapstone.

Speckstein, *Werner*.

Creta Hispanica, *Wall.* t. i. p. 396.; Creta Briansonia, *Wall.* t. i. p. 390.—Speckstein, *Wid.* s. 451.—Semi-indurated Steatites, *Kirw.*

Kirw. vol. i. p. 151.—Speckstein, *Estner,* b. ii. s. 791. *Id. Emm.* b. i. s. 363.—Steatite compatta, *Nap.* p. 296.—Steatite, *Lam.* t. ii. p. 343.—La Steatite commune, *Broch.* t. i. p. 474. —Talc Steatite, *Haüy,* t. iii. p. 252.—Speckstein, *Reuss,* b. ii. s. 176. *Id. Lud.* b. i. s. 132. *Id. Suck.* 1r th. s. 544. *Id. Bert.* s. 141. *Id. Mohs,* b. i. s. 541. *Id. Hab.* s. 66. *Id. Leonhard,* Tabel. s. 27.—Talc Steatite, *Lucas,* p. 84.—Steatite commune, *Brong.* t. i. p. 496.—Talc Steatite, *Brard,* p. 198.—Dichter Speckstein, *Haus.* s. 100.—Speckstein, *Karst.* Tabel. s. 44.—Steatite, *Kid,* vol. i. p. 96.—Speckstein, *Steffens,* b. i. s. 233. *Id. Lenz,* b. ii. s. 644. *Id. Oken,* b. i. s. 380. *Id. Hoff.* b. ii. s. 236. *Id. Haus.* Handb. b. ii. s. 749.—Soapstone, *Aikin,* p. 235.

External Characters.

Its principal colour is white, of which it presents the following varieties: greyish, greenish, seldom yellowish, and reddish-white; the reddish-white borders on flesh-red; the greenish-white passes into mountain, oil, and, lastly, into siskin-green; and the yellowish-grey into pale isabella-yellow. It is sometimes marked with spotted, and dendritic greyish-black delineations.

It occurs massive, disseminated, in crusts, reniform; and also in the following figures:

1. Equiangular six-sided prism, acutely acuminated on both extremities with six planes.
2. Acute double six-sided pyramid.
3. Rhomboid.

The six-sided prism, and six-sided pyramid, are from rock-crystal, and the rhomboid from calcareous-spar. Both appear to be supposititious.

They

They are small or middle sized, and generally imbedded in massive steatite.

The lateral planes are transversely streaked, and the acuminating planes are smooth and shining.

Internally it is dull, and, when glimmering, it is owing to its being intermixed with foreign parts.

The fracture is coarse splintery, passing into coarse and fine grained uneven.

Internally it is dull, seldom feebly glimmering.

The fragments are indeterminate angular, and blunt-edged.

It is translucent on the edges.

It becomes shining in the streak.

It writes but feebly.

It is soft, passing into very soft.

It is very sectile.

It is rather difficultly frangible.

It does not adhere to the tongue.

It feels very greasy.

Specific gravity, 2.382, *Karsten*.—2.608, *Brisson*.—2.604, 2.665, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it loses its colour, but is infusible without addition.

Constituent Parts.

Steatite of Baireuth.		Steatite of Cornwall.		Steatite of Monte Ramazo.	
Silica, -	59.50	Silica, -	45.00	Silica, . -	44.00
Magnesia,	30.50	Magnesia,	24.75	Magnesia,	44.00
Alumina,		Alumina,	9.25	Alumina,	2.00
Iron, -	2.50	Iron, -	1.00	Iron, -	7.30
Potash, -		Potash, -	0.75	Manganese,	1.50
Water, -	5.50	Water,	18.00	Chrome,	2.00
				Trace of Lime & Muriatic Acid.	
	98.00		98.75		100.80
Klaproth, Beit. b. ii. s. 179.		*Klaproth*, Beit. b. v. s. 24.		*Vauquelin.*	

Geognostic Situation.

It occurs frequently in small cotemporaneous veins, that traverse serpentine in all directions; and in angular and other shaped pieces in secondary or flœtz-trap rocks. It also occurs in metalliferous veins that traverse primitive rocks, accompanying different formations of galena, blende, copper and silver ores; in tinstone veins and beds: And veins in grey-wacke, filled with galena, sparry-ironstone, and other metalliferous substances, occasionally contain steatite.

Geographic Situation.

Europe.—It occurs in the serpentine of Portsoy and Shetland; in the limestone of Icolmkill; and in the trap-rocks of Fifeshire, the Lothians, Arran, Skye, Canna, and other parts in Scotland. In England, in the serpentine of Cornwall, and at Amlwch in Anglesey. On the Continent of Europe, it is found in Norway, Sweden, Saxony, Bohemia, Baireuth, Salzburg, Switzerland, and Spain.

Asia.—In differents parts of Siberia, and China.

Uses.

Uses.

The Cornish steatite is used at Worcester, in the manufacture of porcelain. Like fullers earth and indurated talc, it readily absorbs oily and greasy matter, and hence it is used for extracting spots of grease from silk and woollen stuffs. It is also employed in polishing gypsum, serpentine and marble. When pounded and slightly burnt, it forms the basis of certain cosmetics. It writes readily on glass, in which character it differs from common chalk, which leaves no trace; hence it is used by glaziers, in marking plates of glass before they are cut with diamond. Tailors and others use it in preference to common chalk, for marking with, because the trace it leaves is not readily effaced. When finely ground and mixed with a pigment, it forms a kind of pastel colour, used for painting on glass. The Arabs use it in their baths instead of soap, to soften the skin. Certain savage tribes eat it, either alone, or mix it with their food, to deceive hunger. M. Labillardiere informs us, that the inhabitants of New Caledonia eat considerable quantities of a soft steatite, in which Vauquelin found 0.37 magnesia, 0.36 silica, 0.17 oxide of iron, and which contains no nourishing ingredient. Humboldt assures us, that the Otomacks, a savage race on the banks of the Orinoco, live for nearly three months of the year principally on a kind of potters-clay. Mr Goldberry says, that the Negroes near the mouth of the Senegal mix their rice with a white steatite, and eat it without inconvenience; and it is well known that Negroes in general eat earthy substances with great avidity.

As steatite becomes hard in the fire, and does not alter its shape, it has been successfully employed in imitating engraved gems by M. Vilcot, an artist of Leuttich, in the county of Liege. The subjects intended to be represented, are engraved on it with great ease; it is then exposed to a strong heat, when it acquires a considerable degree of hardness. It is afterwards polished, and may be coloured by means of metallic solutions.

Observations.

1. The yellowish-white variety approaches to Lithomarge, the flesh-red to Bole, and the siskin-green and greenish-grey to Fullers-Earth.

2. It is distinguished from *Talc* and *Chlorite* by fracture, and from *Serpentine* by softness.

3. In trade it is known under the names, Spanish-Chalk, Chalk of Briançon, and Soapstone.

4. Weiss and Steffens are of opinion, that steatite is not an original substance, but has been formed from other minerals, particularly felspar and mica, by a process somewhat resembling that which takes place with flesh, when it is converted into a fatty substance. This opinion will be fully considered in the geognostic part of the system.

5. The *Pimelite* of Karsten, which occurs along with chrysoprase at Kosemütz in Silesia, and contains 15.12 of Nickel, is arranged by Werner as a variety of Steatite.

Tenth

Tenth Subspecies.

Figurestone, or Agalmatolite *.

Bildstein, *Werner.*

Agalmatolith, *Klaproth.*

Steatites, particulis impalpabilibus, mollis, semi-pellucidus, lardites, colore flavescente, *Wall.* gen. 28. spec. 186. t. i. p. 399.—Indurated Steatites, *Kirw.* vol. i. p. 153.—La Pierre à Sculpture, *Broch.* t. i. p. 451.—Agalmatolite, *Lud.* b. ii. s. 151. *Id. Suck.* 1r th. s. 503. *Id. Bert.* s. 205. *Id. Leonhard,* Tabel. s. 27. *Id. Haus.* s. 86. *Id. Karst.* Tabel. s. 28. *Id. Kid,* vol. i. p. 181.—Talc graphique, *Haüy,* Tabl. p. 68.—Agalmatolith, *Steffens,* b. i. s. 240.—Bildstein, *Lenz,* b. ii. s. 594. *Id. Oken,* b. i. s. 379. *Id. Hoff.* b. ii. s. 244. *Id. Haus.* Handb. b. ii. s. 440.—Agalmatolite, *Aikin,* p. 202.

External Characters.

Its most common colour is greenish-grey, which on the one side passes into mountain-green, asparagus-green, and ore-green, and sometimes greenish-white; on the other into yellowish-grey, pearl-grey, flesh-red, and a colour intermediate between ochre-yellow and yellowish-brown. These colours are generally pale, and sometimes disposed in flamed delineations.

It occurs massive.

Internally it is dull or feebly glimmering.

The

* *Agalmatolite,* from the Greek words αγαλμα and λιθος, which signifies *figure-stone,* because it is cut into figures of different kinds in the countries where it is principally found.

The fracture is large and flat conchoidal in the large, and splintery in the small, and sometimes is imperfect slaty.

The fragments are indeterminate angular, and rather sharp-edged, or imperfect tabular.

It is translucent, sometimes only on the edges.

It becomes feebly resinous in the streak.

It is soft.

It is intermediate between sectile and brittle.

It feels rather greasy.

Specific gravity, 2.785, *Kirwan*.—2.815, *Klaproth*.—2.800, 2.827, *Breithaupt*.

Chemical Characters.

It is infusible before the blowpipe.

Constituent Parts.

Chinese Figurestone.			Figurestone of Nagyag.
Silica,	35.00	54.50	55.00
Alumina,	29.00	34.00	33.00
Lime,	2.00		
Potash,	7.00	6.25	7.00
Iron,	1.00	0.75	0.50
Water,	5.00	4.00	3.00
	99.00	99.50	98.50
	Vauquelin.	*Klaproth*, Beit. b. v. s. 21.	*Klaproth*, Id. s. 21.

Geographic Situation.

It occurs in China, and at Nagyag in Transylvania, but the geognostic situations are unknown.

Uses.

This mineral, owing to its softness, can easily be fashioned

shioned into various shapes with the knife: hence, in China, where it frequently occurs, it is cut into figures, generally of men, also into pagodas, cups, snuff-boxes, &c. Baron Veltheim is of opinion, that the celebrated Roman *Vasa murrhina*, brought from the most distant parts of India, were made of figurestone, whilst other antiquaries maintain that they were of porcelain. Data are wanting for enabling us to decide in regard to these *vasa murrhina*.

Observations.

1. This substance was formerly confounded with Steatite, from which it is distinguished by lustre and fracture. It appears to be intermediate between Steatite and Nephrite.

2. Lenz, in the second volume of his Mineralogy, describes what he considers as a distinct subspecies of figurestone, from Ochsenkopf, near Schneeberg in Saxony, where it occurs along with talc, corundum, and magnetic-ironstone. The following analysis of it has been published by Dr John: Silica, 51.50. Alumina, 32.50. Oxide of Iron, 1.75. Oxide of Manganese, 12.00. Potash, 6.00. Lime, 3.00. Water, 5.15.

* Clay-Slate.

Thonschiefer, *Werner.*

Schistus ardesia tegularis, *Wall.* t. i. p. 351.—Thonschiefer, *Wid.* s. 391.—Argillite, *Kirw.* vol. i. p. 234.—Killas, *Id.* p. 237.

* Clay-slate, Whet-slate, Black Chalk, and Alum-slate, are placed immediately after the subspecies of Rhomboidal Mica, on account of their affinity with it.

p. 237. *Id. Emm.* b. i. s. 284. *Id. Estner,* b. ii. s. 667.—Ardoise, *Lam.* t. i. p. 110.—Le Schiste argilleux, *Broch.* t. i. p. 395.—Argile schisteuse tegulaire tabulaire, *Haüy,* t. iv, p. 447.—Thonschiefer, *Reuss,* b. ii. s. 151. *Id. Lud.* b. i. s. 113. *Id. Suck.* 1r th. s. 508. *Id. Bert.* s. 215. *Id. Mohs,* b. i. s. 462. *Id. Hab.* s. 42. *Id. Leonhard,* Tabel. s. 23.—Schiste argilleux, *Brong.* t. i. p. 557.—Thonschiefer, *Haus.* s. 87. *Id. Karst.* Tabel. s. 38.—Schistus, or Slate, *Kid,* vol. i. p. 186.—Thonschiefer, *Steffens,* b. i. s. 210. *Id. Lenz,* b. ii. s. 578. *Id. Oken,* b. i. s. 359. *Id. Hoff.* b. ii. s. 98. *Id. Haus.* Handb. b. ii. s. 478.—Clay-Slate, *Aikin,* p. 243.

External Characters.

Its colours are yellowish, ash, smoke, bluish, pearl, and greenish-grey; from greenish-grey it passes into a colour intermediate between leek-green and blackish-green; from dark smoke-grey into greyish-black and bluish-black; and from pearl-grey into brownish-red * and cherry-red.

It is sometimes spotted, striped, or flamed.

It occurs massive.

Its lustre is pearly, and is glistening, or glimmering.

The fracture is more or less perfect slaty; and some varieties approach to foliated, and others to compact. The slaty is either straight, or undulating curved, and the latter has a twofold obliquely intersecting cleavage.

The fragments are generally tabular, seldom long splintery or trapezoidal.

It is opaque.

It affords a greyish-white dull streak.

It is soft.

It is sectile, and easily split.

It

* Houses roofed with the red variety of clay-slate, appear as if covered with copper.

It feels rather greasy.

Specific gravity, 2.661, *Kirwan*.—2.786, *Karsten*.

Chemical Characters.

It is fusible into a slag before the blowpipe.

Constituent Parts.

Silica, -	48.6
Alumina, -	23.5
Magnesia, -	1.6
Peroxide of Iron,	11.3
Oxide of Manganese,	0.5
Potash, -	4.7
Carbon, -	0.3
Sulphur, -	0.1
Water, and Volatile Matter, -	7.6
Loss, -	1.8
	100 *Daubuisson*.

Silica, -	38.0
Alumina, -	26.0
Magnesia, -	8.0
Lime, -	4.0
Peroxide of Iron,	14.0
	Kirwan.

Geognostic Situation.

It occurs in primitive and transition mountains: in primitive mountains it often rests on mica-slate, and alternates with it; when the mica-slate is awanting, it rests on gneiss, and alternates with it in the same manner as it does with mica-slate; when the gneiss is awanting, it rests on granite, and also alternates with it. These facts show, that clay-slate is sometimes of cotemporaneous formation with mica-slate, sometimes with gneiss, and even with granite: In transition mountains, it rests on and alternates with

grey

grey-wacke, grey-wacke-slate, transition trap, transition limestone, and other rocks of the transition class.

Transition clay-slate is sometimes scarcely to be distinguished from the primitive varieties of this rock, otherwise than by its geognostic characters: Transition clay-slate alternates with, and passes into grey-wacke-slate; Primitive clay-slate alternates with, and passes into mica-slate; and these are some of the geognostic characters by which we are enabled to distinguish the one from the other.

Geographic Situation.

It is a very generally distributed rock throughout the mountainous regions in the different quarters of the globe. It abounds in many of the highland districts in Great Britain and Ireland, and in several of the smaller islands that lie near their coasts. On the Continent of Europe, it forms a considerable portion of the Hartz, the Erzgebirge, the Fichtelgebirge, the Thuringerwaldgebirge, and of many other great groups of mountains.

Uses.

It is principally used for roofing of houses. Those varieties of clay-slate used for roofing houses, are named *Roofing-Slate*, and should possess the following properties.

1. They must split easily and regularly into thin and straight plates of the requisite magnitude. This is only the case, however, with such varieties of clay-slate as possess a regular and perfect slaty fracture, without rents, or intermixed foreign parts. A clay-slate which contains grains, crystals,

crystals, or veins of quartz, garnet, schorl, hornblende, or iron-pyrites, will not split into regular plates or *slates*, because these hard bodies do not yield on splitting the mass, and hence the slate generally breaks at such places. If the clay-slate is very thick-slaty, it cannot be split into slates of sufficient thinness, and hence it is of but little use, because when the slates are beyond a certain thickness they are too heavy for roofs. When the clay-slate is curved-slaty, it does not split into useful slates. It may be noticed, that care must be taken to keep the slate in a damp place, previous to splitting, otherwise, if it becomes dry, it will not split without difficulty. It is therefore advisable to split the masses as soon as possible after separating them from the rock.

2. A good roof-slate must be sufficiently compact, and not porous, so that the rain and snow water may not percolate through and destroy the wooden work of the roof. Some varieties of clay-slate are so porous that they imbibe much water, do not dry easily, and hence afford opportunity for the growth of mosses and lichens, which in time cover the surface of the slate. These plants retain moisture long, and keep the surface, and even the interior of the slate moist, so that during the winter season, by the freezing of the moisture, the slate splits and falls into pieces. In order to ascertain whether or not the slate has the requisite compactness, we have only to dry it completely, then weigh it, afterwards plunge it into water, and allow it to remain for some time. If, after wiping it with a cloth, it has not acquired any considerable increase of weight, it is a proof of its being sufficiently compact; on the contrary, if it absorbs much water, and becomes considerably heavier by immersion, it shews that it is of a porous and loose texture.

It

It is remarked, that the slates in the upper strata in quarries are generally porous and loose in their texture, and hence these are generally thrown away as useless.

3. A good slate must be sufficiently solid, and not brittle and shattery; for such slates break in pieces on the application of but a weak force, and do not form a firm roof. When the slate is too brittle, it flies into pieces during the dressing and boring; if it emits a pretty clear sound when struck with a hammer, it is a proof that it is not over brittle; and if it emits a dull sound, it shows that it is soft and shattery. Lastly, if a slate of inconsiderable thickness breaks easily with the hands, it is a proof of its being too soft.

4. No slate can be used with advantage for roofing houses, which readily decomposes by the action of the weather. The decomposition observed to take place in roof slates is of two kinds: the one is mechanical the other is chemical. The mechanical decomposition is principally caused by the freezing of water in the porous and softer varieties, by which they are split in pieces: the chemical decomposition is caused by the decay of disseminated iron-pyrites, or the increased oxidation of intermixed iron.

5. Lastly, a good slate ought to resist the action of a considerable degree of heat.

The best roof-slates found in Scotland, are those of Easdale, and some neighbouring islands off the coast of Lorn in Argyle, and of Ballihulish in Appin, also in Argyle. The quantity manufactured annually at Easdale and its vicinity, is about five millions, which gives employment to 300 men; and at Ballihulish, it is estimated that about half a million of slates are prepared every year. There are also considerable slate-quarries in the parish of Luss in Dunbartonshire, in Monteath, Strathearn, Strathmore, the Garioch,

Garioch, and other places. The slate principally in use in London, is brought from Wales, from quarries which are worked at Bangor in Caernarvonshire. There are also extensive slate-quarries near Kendal in Westmoreland, and the slates from that quarter, which are of a bluish-green colour, are more highly esteemed by the London builders than those from Wales. They are not of a large size, but they possess great durability, and are well calculated to give a neat appearance to the roof on which they may be placed. French slates were very much in use in London, about seventy years ago; they are of small size, very thin, and consequently light, and therefore much less calculated for the climate of this island than the heavier and more durable slates of England and Scotland.

We shall next mention some other uses of clay-slate.

The dark-coloured, most compact, and solid varieties, named *Table-slate*, are used for writing on, but are previously prepared in the following manner. The plate or slate is first smoothed by means of an iron instrument; it is afterwards ground with sandstone, and slightly polished with tripoli, and, lastly, rubbed with charcoal-powder. It is cut into the required shape, set in a wooden-frame, and is then ready for use. When these table-slates are first taken from the quarry, they are rather soft, hence are easily worked; but they become hard by drying.

The small pieces of slate used for writing with, are obtained from a particular variety of clay-slate, named *Writing-slate*, which, on splitting, falls into prismatic or splintery fragments. In order to form a good writing material, it must be more sectile and softer than table-slate, so that it may leave a coloured streak on its surface, without scratching it. This variety of slate does not occur either frequently or abundantly; and it is remarked, that the strata

strata in which it is contained are generally traversed by vertical rents, and that the best kinds are found between them. When the slate is separated from the stratum in which it is contained, and laid in heaps, it soon falls into long splintery pieces, which are from a quarter to half an inch thick, and from a few inches to upwards of a foot in length. It is said, that if these pieces are exposed for some time to the action of the sun or frost, they are rendered useless: hence workmen are careful to cover them up, and sprinkle them with water as soon as extracted from the quarry, and preserve them in damp cellars. The pieces are afterwards split, by means of a particular instrument, and then made into the required shape.

In some places in Wales, and also in Germany, clay-slate is used for grave-stones; and it is sometimes turned into vases, and other similar articles. The masses used for grave-stones, are cut smooth with sandstone, polished with tripoli, and, lastly, rubbed with charcoal-powder, or lamp-black, or graphite, in order to deepen the black colour. On account of its softness, it receives but an imperfect polish: hence, in order to give it a higher degree of lustre, it is a practice to dip it into oil, after polishing, by which process its lustre is improved, and it is also rendered more durable. It is remarked, that if a window or door is opened in the apartment where the workmen are turning the clay-slate into any particular form, it very frequently flies in pieces, although after the work is finished, it may be exposed to the usual alternations of temperature without risk of injury.

Pounded or ground clay-slate is used for cleaning the surface of iron, and other kinds of metallic ware. It scarcely acts on the metal, but unites with the adventitious soiling-matter on its surface. Clay-slate, when well ground, and

and mixed in certain proportions with loam, forms a compound excellently fitted for moulds, as it receives the most delicate impressions, and with the greatest accuracy: hence it is very advantageously employed in cast-iron works. When it is burnt, and afterwards coarsely ground, it may be used in place of sand, in the making of mortar: mortar of this kind is said to become very solid and impermeable under water.

In smelting-houses, it is sometimes employed as a flux, with ores that contain much calcareous earth.

Observations.

It passes into Mica-slate, Chlorite-slate, Talc-slate, Whet-slate, Alum-slate, Drawing-slate, and probably into Compact Felspar.

* Whet-Slate.

Wetzschiefer, *Werner*.

Schistus coticula, *Wall.* t. ii. p. 353.—Wetzschiefer, *Wid.* s. 402. —Novaculite, *Kirw.* vol. i. p. 238.—Wetzschiefer, *Estner*, b. ii. s. 664. *Id. Emm.* b. ii. s. 305.—Pietra cote, *Nap.* p. 270. —Cos, *Lam.* t. ii. p. 105.—Le Schiste à aiguiser, *Broch.* t. i. p. 393.—Argile schisteuse novaculaire, *Haüy*, t. iv. p. 448.—Wetzschiefer, *Reuss*, b. ii. s. 149. *Id. Lud.* b. i. s. 112. *Id. Suck.* 1r th. s. 506. *Id. Bert.* s. 216. *Id. Mohs*, b. i. s. 460. *Id. Hab.* s. 42. *Id. Leonhard*, Tabel. s. 23.—Schiste coticule, *Brong.* t. i. p. 558.—Wetzschiefer, *Haus.* s. 87. *Id. Karsten*, Tabel. s. 38.—Novaculite, or Honestone, *Kid*, vol. i. p. 216.—Wetzschiefer, *Steffens*, b. i. s. 211. *Id. Lenz*, b. ii. s. 576. *Id. Oken*, b. i. s. 359. *Id. Hoff.* b. ii. s. 95. *Id. Haus.* Handb. b. ii. s. 477.—Whet-slate, *Aikin*, p. 245.

External

External Characters.

Its most common colour is greenish-grey; it is found also mountain, asparagus, olive, and oil green.

It occurs massive.

Internally it is feebly glimmering.

The fracture in the large is straight slaty; in the small, splintery.

The fragments are tabular.

It is translucent on the edges.

The streak is greyish-white.

It is soft in a low degree.

It feels rather greasy.

Specific gravity 2.722, *Karsten.*

Geognostic Situation.

It occurs in beds in primitive and transition clay-slate.

Geographic Situation.

It is found at Seifersdorf, near Freyberg; at Launstein and Sonnenberg, in the district of Meinengen; and also in the Hartz, and in Stiria and Siberia. Very fine varieties are brought from Turkey.

Uses.

When cut and polished, it is used for sharping iron and steel instruments. For these purposes, it is necessary that it contain no intermixed hard minerals, such as quartz. The light-green coloured varieties, from the Levant, are the most highly prized: those from Bohemia are also much esteemed in commerce. The Levant whet-slate is brought in masses to Marseilles, and is there cut into pieces of various sizes. It is ground by means of sand or sandstone, and

and polished with pumice and tripoli. These whet-stones, or *hones*, as they are called, ought to be kept in damp and cool places; for when much exposed to the sun, they become too hard and dry for many purposes.

The powder of whet-slate is used for cutting and polishing metals, and is by artists considered as a variety of emery.

Observations.

1. It is distinguished from other minerals by colour, fracture, transparency, and hardness.

2. This subspecies does not include every kind of mineral used as whet-stone; for some varieties of clay-slate, of sandstone, and of slate-clay, are used for that purpose.

* Drawing-Slate, or Black Chalk.

Zeichenschiefer, *Werner.*

Schistus pictorius nigrica, *Wall.* t. i. p. 358.—Zeichenschiefer, *Wern.* Cronst. s. 208.—Black Chalk, *Kirw.* vol. i. p. 195.—Schwarze Kreide, *Estner,* b. ii. s. 661.—Zeichenschiefer, *Emm.* b. i. s. 303.—Schisto pittorio, *Nap.* p. 269.—Melantirite, ou Crayon noire, *Lam.* t. ii. p. 112.—Argile schisteuse graphique, *Haüy,* t. iv. p. 447.—Le Schiste à dessiner, *Broch.* t. i. p. 391.—Zeichenschiefer, *Reuss,* b. ii. s. 146. *Id. Lud.* b. i. s. 112. *Id. Suck.* 1r th. s. 505. *Id. Bert.* s. 217. *Id. Mohs,* b. i. s. 458. *Id. Hab.* s. 43. *Id. Leonhard,* Tabel. s. 23.—Ampelite graphique, *Brong.* t. i. p. 563.—Zeichenschiefer, *Haus.* s. 85. *Id. Karsten,* Tabel. s. 36.—Black Crayon, *Kid,* vol. i. p. 190.—Zeichenschiefer, *Steffens,* b. i. s. 208. *Id. Lenz,* b. ii. s. 575. *Id. Oken,* b. i. s. 361. *Id. Hoff.* b. ii. s. 91. *Id. Haus.* Handb. b. ii. s. 475.—Black Chalk, *Aikin,* p. 242.

External Characters.

Its colour is intermediate between bluish and greyish black, but rather more inclining to the latter colour.

It is massive.

The lustre of the principal fracture is glimmering, of the cross fracture dull.

The principal fracture is slaty, generally straight, sometimes curved; the cross fracture fine earthy.

The fragments are partly tabular, partly long splintery.

It is opaque.

It soils slightly, and writes.

It retains its colour in the streak, and becomes glistening.

It is very soft.

It is sectile.

It is easily frangible.

It adheres slightly to the tongue.

It feels fine, but meagre.

Specific gravity, 2.110, *Kirwan.*—2.111, *Karsten.*

Chemical Character.

It is infusible.

Constituent Parts.

Silica,	64.06
Alumina,	11.00
Carbon,	11.00
Water,	7.20
Iron,	2.75

According to *Wiegleb*, Crell's Ann. 1797, s. 485.

Geognostic

Geognostic Situation.

It occurs in beds in primitive and transition clay-slate; also in secondary or flœtz formations.

Geographic Situation.

It is found at Marvilla in Spain, Brittany in France, and in Italy; also in Germany, as in the mountains of Bareuth; and in the coal-formation in Scotland.

Uses.

It is used for drawing, and also as a black colour in painting. When used for drawing, it is cut into square pencils, which are sometimes inclosed in wooden cases, like pencils of graphite or black-lead. We must select for this purpose those varieties having the darkest colour, the finest earthy fracture, and which are free of quartzy particles and veins. It has been found, that these pencils become dry, hard, and unfit for drawing by long keeping. To prevent this evil, the pencils should be kept in a moist place; or, what is better, the slate should be ground, and mixed with gum-water, and run into moulds; and pencils of this kind, if well prepared, will remain long fit for use. We must be careful that too much gum-water is not added, otherwise the particles will be so closely aggregated, that the pencils will not leave a trace on the paper; and on the other hand, we must see that too little gum is not added; for if this be the case, the pencil will soil the paper, and no regular or well formed trace will be left on it.

When black chalk is used for painting, it is first pounded and ground, and then mixed with oil or size, and is used as a black paint. It is, however, not much valued, as it is at best but a coarse colour. Certain varieties burn red, or

 reddish-

reddish-brown, and these are sometimes used for red or brown colours.

Observations.

1. Some varieties of bituminous Shale have been confounded with Black Chalk; but a comparison of their trace on paper, enables us at once to distinguish them: the trace of Bituminous Shale being brownish and irregular, whereas that of Black Chalk is regular and black.

2. The most highly prized varieties of this mineral, are those found in Spain, Italy, and France.

* Alum-Slate.

Alum-Slate is divided into two kinds, viz. Common Alum-Slate, and Glossy Alum-Slate.

First Kind.

Common Alum-Slate.

Gemeiner Alaunschiefer, *Werner.*

Schistus aluminaris? *Wall.* t. ii. p. 32.—Var. of Alaunschiefer, *Wid.* s. 396. *Id. Estner,* b. ii. s. 651.—Gemeiner Alaunschiefer, *Emm.* b. i. s. 296.—Schisto aluminoso, *Nap.* p. 264.—Variété de l'Argile schisteuse, *Haüy.*—Le Schiste alumineux commune, *Broch.* t. i. p. 386.—Gemeiner Alaunschiefer, *Reuss,* b. ii. s. 143.—Alaunschiefer, *Lud.* b. i. s. 110. *Id. Suck.* 1r th. s. 529.—Schiefriger Aluminit, *Bert.* s. 219.—Alaunschiefer, *Mohs,* b. i. s. 454.—Gemeiner Alaunschiefer, *Leonhard,* Tabel. s. 22.—Alaunschiefer, *Haus.* s. 86.—Gemeiner Alaunschiefer, *Karsten,* Tabel. s. 36. *Id. Steffens,* b. i. s. 205. *Id. Lenz,*

Lenz, b. ii. s. 571. *Id. Oken,* b. i. s. 362. *Id. Hoff.* b. ii. s. 84. *Id. Haus.* b. ii. s. 481.

External Characters.

Its colour is intermediate between bluish and iron black.

It occurs massive, and sometimes in roundish balls, which are imbedded in the massive varieties.

Its lustre is more or less glimmering.

The fracture is nearly perfect straight slaty.

The fragments are tabular.

It is opaque.

It does not soil.

It retains its colour in the streak, but becomes glistening.

It is intermediate between soft and semihard.

It is easily frangible, and rather brittle.

Specific gravity 2.384, *Kirwan.*

Second Kind.

Glossy Alum-Slate.

Glänzender Alaunschiefer, *Werner.*

Var. Alaunschiefer, *Wid.* s. 395.—Glänzender Alaunschiefer, *Emm.* b. i. s. 297.—Alaunschiefer, *Estner,* b. ii. s. 651.—Varieté de l'Argile schisteuse, *Haüy.*—La Schiste alumineux eclatante, *Broch.* t. i. p. 388.—Glänzender Alaunschiefer, *Reuss,* b. ii. s. 145. *Id. Hab.* s. 49. *Id. Leonhard,* Tabel. s. 22. *Id. Karsten,* Tabel. s. 36. *Id. Steffens,* b. i. s. 206. *Id. Lenz,* b. ii. s. 572. *Id. Oken,* b. i. s. 362. *Id. Hoff.* b. ii. s. 85. *Id. Haus.* Handb. b. ii. s. 481.

External

External Characters.

Its colour is intermediate between bluish and iron black, and it sometimes exhibits on the surface of fissures the pavonine, columbine, or temper-steel tarnish.

It occurs massive.

Its lustre is semi-metallic and splendent, shining, or glistening, on the principal fracture, and glimmering or dull on the cross fracture.

The principal fracture is generally undulating curved and short slaty; seldom inclines to straight slaty. Cross fracture is earthy.

The fragments are tabular, and these run into wedge-shaped fragments.

Specific gravity 2.588, 2.389, *Kirwan.*

In all the other characters it agrees with the preceding subspecies.

Geognostic Situation.

Both subspecies agree in geognostic situation: they occur in primitive, and also in transition clay-slate, and more rarely in veins traversing these rocks. Some varieties of alum-slate have been observed associated with secondary rocks.

Geographic Situation.

It occurs along with greywacke and greywacke-slate in the vicinity of Moffat, in Dumfriesshire; in the transition districts of Lanarkshire, particularly in the neighbourhood of Lead Hills; and near the Ferry-town of Cree in Galloway: there are considerable beds of alum-slate on the Continent of Europe, as in Saxony, Bohemia, France, and Hungary. Esmark observed a vein of alum-slate, about two

two fathoms wide, at Telkobanya in Hungary; and similar veins are to be seen near Freyberg in Saxony.

Uses.

This mineral, when roasted and lixiviated, affords alum.

Observations.

1. Alum-Slate is distinguished from *Clay-Slate*, by its streak always remaining unaltered in the colour.

2. The two kinds were distinguished by Wallerius and Cronstedt.

The following minerals are placed immediately after the genus Mica, on account of the general affinity to it. Their present situation is not to be considered as fixed, but only temporary.

*

1. Native Magnesia, 2. Magnesite, 3. Meerschuum.

**

4. Nephrite, 5. Serpentine, 6. Fullers Earth.

1. Native Magnesia.

Native Magnesia, *Bruce.*

Bruce on Native Magnesia from New Jersey, American Mineralogical Journal, vol. i. p. 26.–30.

External Characters.

Its colour is snow-white, passing into greenish-white.

It

It occurs massive, and in granular and prismatic concretions.

Its lustre is pearly.

It is semi-transparent in the mass, transparent in single folia.

It is soft, and somewhat elastic.

It adheres slightly to the tongue.

Specific gravity 2.13.

Chemical Characters.

Before the blowpipe, it becomes opaque and friable, and loses weight. It is soluble in the sulphuric, nitric, and muriatic acids.

Constituent Parts.

Magnesia, - -	70
Water of crystallization,	30
	100

Bruce, American Min. Journal, vol. i. p. 30.

Geognostic and Geographic Situations.

It occurs in small veins in serpentine, at Hoboken in New Jersey.

Observations.

It was discovered by the late Dr Bruce, Professor of Mineralogy in New York, to whom America is deeply indebted for the present flourishing state of mineralogy in that country.

2. Magnesite.

2. Magnesite.

Reine oder Natürliche Talkerde, *Werner*.

Magnesie native, *Broch.* t. ii. p. 499.—Reine Talkerde, *Reuss*, b. ii. s. 223. *Id. Lud.* b. i. s. 154. *Id. Suck.* 1r th. s. 539.—Luftsaure Bittererde, *Bert.* s. 136.—Reine Talkerde, *Mohs*, b. i. s. 528. *Id. Hab.* s. 68. *Id. Leonhard,* Tabel. s. 27.—Magnesite de Mitchell, *Brong.* t. i. p. 490.—Magnesit, *Karsten*, Tabel. s. 48.—Magnesie carbonatée, *Haüy*, Tabl. p. 16.—Magnesit, *Steffens*, b. i. s. 243. *Id. Lenz*, b. ii. s. 631. *Id. Oken*, b. i. s. 386.—Reine Talkerde, *Hoff.* b. ii. s. 216.—Magnesite, *Haus.* Handb. b. iii. s. 824.

External Characters.

Its colour is yellowish-grey or yellowish-white, passing into cream-yellow. It is marked with yellowish and ash-grey spots, and also with bluish-grey dots, and dendritic delineations.

It occurs massive, tuberose, reniform, and in a shape which is intermediate between vesicular and perforated; and the walls of the vesicles are rough and uneven.

It has a rough surface.

Internally it is dull.

The fracture is large and flat conchoidal, which passes into fine earthy.

The fragments are rather sharp-edged.

It is nearly opaque.

It is scratched by fluor-spar, but it scratches calcareous-spar.

It adheres pretty strongly to the tongue.

It feels rather meagre.

It

It is dull in the streak.
It is rather easily frangible.
Specific gravity 2.881, *Haberle.*

Chemical Characters.

It is infusible; but before the blowpipe it becomes so hard as to scratch glass.

Constituent Parts.

Magnesia, -	48.00	46.00	45.42
Carbonic Acid, -	52.00	51.00	47.00
Silica, - -			4.50
Alumina, -	Trace.	1.00	0.50
Ferruginous Manganese,	Trace.	0.25	0.50
Lime, - -	Trace.	0.16	0.08
Water, - -		1.00	2.00
	Bucholz.	*Bucholz.*	*Bucholz.*

Geognostic and Geographic Situations.

It is found at Hrubschitz in Moravia, in serpentine rocks, along with meerschaum, common and earthy talc, mountain-cork, and rhomb-spar; also at Gulfen, near Kraubat in Upper Stiria, where it occurs in serpentine, along with bronzite; and in serpentine, at Baudissero and Castella-Monte in Italy.

Uses.

The mineral of Baudissero is used in the manufacture of porcelain.

Observations.

Observations.

1. It is characterized by its yellowish colour, denditric delineations, rough surface, dull streak, conchoidal fracture, and hardness.

2. It is distinguished from *Meerschaum*, with which it has been confounded, by its colour, external shape, fracture, meagre feel, and weight.

2. It was first discovered by that excellent mineralogist, the late Dr Mitchell of Belfast.

3. Meerschaum *.

Meerschaum, *Werner*.

Meerschaum, *Wid.* s. 456.—Keffekill, *Kirw.* vol. i. p. 144.—Meerschaum, *Emm.* b. i. s. 378.—Schiuma di Mare, *Nap.* p. 307.—Varieté de Talc, *Lam.* t. i. p. 342.—L'Ecume de Mer, *Broch.* t. i. p. 462.—Meerschaum, *Reuss*, b. ii. s. 219. *Id. Lüd.* b. i. s. 129. *Id. Suck.* 1r th. s. 566. *Id. Bert.* s. 139. *Id. Mohs*, b. i. s. 529. *Id. Hab.* s. 69. *Id. Leonhard*, Tabel. s. 27. *Id. Kid*, vol. i. p. 99. *Id. Karst.* Tabel. s. 42. *Id. Steffens*, b. i. s. 241. *Id. Lenz*, b. ii. s. 626. *Id. Oken*, b. i. s. 386. *Id. Hoff.* b. ii. s. 220. *Id. Haus.* b. ii. s. 744.

External Characters.

Its colours are yellowish and greyish white, seldom snow-white.

It occurs massive.

Internally

* *Meerschaum* in German, signifies *sea-froth*, and is by some philologists alleged to have been applied to this mineral on account of its general aspect and lightness; while others derive it from the Natolian word *myrsen*.

Internally it is dull.

The fracture is fine earthy, passing on the one side into flat conchoidal, on the other into even.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is opaque; rarely translucent on the edges.

It becomes slightly shining in the streak.

It does not soil.

It is very soft.

It is sectile.

It is rather difficultly frangible.

It adheres strongly to the tongue.

It feels rather greasy.

Specific gravity, 1.209, *Karsten*.—1.600, *Klaproth*.—0.988, 1.279, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it melts on the edges into a white enamel.

Constituent Parts.

Silica,	-	-	41.50
Magnesia,	-	-	18.25
Lime,	-	-	0.50
Water and Carbonic Acid,			39.00
			98.25

Klaproth, Beit. b. ii. s. 172.

Geognostic and Geographic Situations.

Europe.—It occurs in veins in the serpentine of Cornwall; in serpentine, at Hrubschitz in Moravia; at Vallecas, near Madrid in Spain, also in serpentine. It is dug at Sebastopol

bastopol and Kaffa, in the Crimea *; and near Thebes in Greece.

Asia.—It occurs in beds immediately under the soil, at Kittisch and Bursa in Natolia; and in the mountains of Esekischehir, also in Natolia, from 600 to 700 men are employed in digging meerschaum.

Uses.

When first dug from the earth, it is soft and greasy. It lathers with water like soap: hence it is used by some nations, as by the Tartars, for washing. In Turkey, it is made into tobacco-pipes. These pipes are manufactured of the meerschaum of Natolia, and that dug near Thebes. It is prepared for that purpose in the following manner: It is first agitated with water in great reservoirs, and is then allowed to remain at rest for some time. The mixture soon passes into a kind of fermentation, resembling that which porcelain-earth experiences when placed in similar circumstances, and a disagreeable odour, resembling that of rotten eggs, is exhaled. As soon as the smell ceases, the mass is farther diluted with water, which is after a time poured off, and fresh water added repeatedly, until the mass is sufficiently washed and purified: what remains is the mass in a pure state. The pure meerschaum is now dried to a considerable degree, is then pressed into a brass mould, and some days afterwards it is hollowed out. The heads formed in this way are then dried in the shade, and, lastly, baked in a furnace constructed for the purpose. The heads in this state are brought to Constantinople, where they are subjected to farther processes: they are first boiled in milk, and next in linseed-oil and wax; when perfectly

* Gallitzin, Descript. Physique de la Contrée de Tauride, p. 85.

fectly cool, they are polished with rushes and leather. The boiling in oil and wax makes them denser, and more capable of receiving a higher polish; and further, when thus impregnated, they acquire, by use, various shades of red and brown on their surface, which is thought to add very considerably to their beauty. In Turkey, and even in Germany, pipes which have been much used, are more valued than those newly made, on account of the colouring they possess. Indeed, in those countries, there are people whose sole employment is smoking tobacco-pipes, until they acquire the favourite tints of colour. By long use, the heads become black; but by boiling in milk and soap, they become white again.

When meerschaum is exposed to a very high degree of heat, it becomes so hard as to give sparks with steel. It is alleged that the porcelain of Samos was made of the meerschaum found in that island; and it is supposed that the porcelain knives mentioned by Pliny, as being used by surgeons, were made from this mineral.

In Spain it is used in the manufacture of porcelain.

Observations.

1. It is distinguished from *Magnesite* by its colour, difficult frangibility, strong adhesion to the tongue, inferior hardness and specific gravity. Its want of distinct concretions at once distinguishes it from *Native Magnesia*.

2. It is nearly allied to Magnesite, into which it sometimes passes.

3. The *Kel* of the Tartars, and the *Keffikel* of the Turks, is not, as some suppose, a variety of Meerschaum, it appears rather to be a kind of fullers earth.

4. Nephrite.

4. Nephrite.

Nephrit, *Werner.*

Of this mineral there are two kinds, viz. Common Nephrite, and Axestone.

a. Common Nephrite.

Gemeiner Nephrit, *Werner.*

Fetter Nephrit, *Saussure.*

Jaspis lapis Nephriticus, *Wall.* Syst. Min. i. p. 302.—Jade, *Kirw.* vol. i. p. 171.—Le Nephrite commune, *Broch.* t. i. p. 467.—Gemeiner Nephrit, *Reuss*, b. ii. 2. s. 187. *Id. Lud.* b. i. s. 131. *Id. Suck.* 1r th. s. 551. *Id. Bert.* s. 144. *Id. Mohs*, b. i. s. 335.—Jade nephrite, *Lucas*, p. 197. *Id. Brong.* t. i. p. 347. *Id. Brard*, p. 410.—Gemeiner Nephrit, *Leonhard*, Tabel. s. 28.—Nephrit, *Haus.* s. 100. *Id. Karsten*, Tabel. s. 44.—Nephrite, *Kid*, vol. i. p. 113.—Jade nephretique, *Haüy*, Tabl. p. 61.—Gemeiner Nephrit, *Steffens*, b. i. s. 266. *Id. Lenz*, b. ii. s. 507. *Id. Oken*, b. i. s. 331. *Id. Hoff.* b. ii. s. 250. *Id. Haus.* Handb. b. ii. s. 753.

External Characters.

Its colour is leek-green, of various degrees of intensity, and sometimes passes into mountain-green, greenish-grey, and greenish-white.

It occurs massive, in blunt-edged pieces, and rolled pieces.

Internally dull or glimmering, owing to intermixed talc and asbestus.

The

The fracture is coarse-splintery, and the splinters are greenish-white.

The fragments are indeterminate angular, and rather sharp-edged.

It is strongly translucent.

It is nearly as hard as rock-crystal.

It is difficultly frangible.

It feels rather greasy.

It is rather brittle.

Specific gravity, 2.962, Oriental, according to *Karsten*.—3.020, Mexican, *Karsten*.—2.970, 3.071, *Saussure*, the Father.—2.957, *Saussure* the Son.—2.989, 3.024, *Breithaupt* *.

Chemical Characters.

Before the blowpipe, it melts into a white enamel.

Constituent Parts.

Silica,	50.50
Magnesia,	31.00
Alumina,	10.00
Iron,	5.50
Chrome,	0.05
Water,	2.75

Karsten.

Geognostic and Geographic Situations.

Europe.—In Switzerland, nephrite occurs in granite and gneiss; in the Hartz, in veins that traverse primitive greenstone; and in rolled masses near Leipsic in Saxony.

Asia.

* Clarke Abel gives the following specific gravities of the *Yu* stone of the Chinese, which appears to belong to this mineral, 2.858, 3.19, 3.33, 3.4.

Asia.—The most beautiful varieties of this mineral are brought from Persia and Egypt, from the mines of Seminowski, near Kolyvan in Siberia; and from China.

America.—It is found on the banks of the River of Amazons, and near Tlascala in Mexico.

Uses.

Nephrite, when cut and polished, has always an oily and muddy aspect, yet it is prized as an ornamental stone. The Turks cut it into handles for sabres and daggers. Artists sometimes engrave figures of different kinds on it; and it is said to be highly esteemed as a talisman by the savage tribes of the countries where it is found. It was formerly believed to be useful in alleviating or preventing nephritic complaints: hence it has been called *Nephritic Stone*.

The stone called *Yu* by the Chinese, and which is so highly prized by them, appears to be a variety of nephrite *. It is worked by the Chinese artists into a variety of forms; into beautifully carved rings, worn on the thumbs of archers, to defend them from the friction of the bowstring, and into fine chains, cups, and vases. Mr Clarke Abel saw in China a beautiful vase of a greenish-white *Yu*. The handle represented a lizard, with all its parts minutely displayed. Figures of the same animal were sculptured in high relief on its sides, some crawling up, and others overlooking the rim of the vessel. Whatever part of the exterior surface they left unoccupied, was filled with Chinese characters deeply engraved. Its price was one hundred and twenty Spanish dollars. A sceptre of the whitish

* Clarke Abel's Journey into China, p. 132.

variety was sent from the Emperor of China to the Prince Regent *.

Observations.

1. This mineral is characterized by colour, coarse-splintery fracture, white-coloured splinters, resinous aspect, and considerable hardness and weight.

2. It is the *Pietra d'Egitto* of antiquaries.

3. The *Omphax* of Theophrastus appears to be our nephrite.

4. The South American variety is sometimes named *Amazon-stone.*

b. Axestone.

Beilstein, *Werner.*

Panamustein, *Blumenbach.*

Beilstein, *Estner,* b. ii. s. 851. *Id. Emm.* b. iii. s. 351.—La Pierre de Hache, *Broch.* t. i. p. 470.—Beilstein, *Reuss,* b. ii. 2. s. 120. *Id. Leonhard,* Tabel. s. 28.—Jade axinien, *Brong.* t. i. p. 349.—Neuseelandischer Nephrit, *Oken,* b. i. s. 331.—Beilstein, *Hoff.* b. ii. s. 248.—Schaaliger Serpentin, *Haus.* Handb. b. ii. s. 755.

External Characters.

Its colour is intermediate between grass-green and leek-green, and passes into mountain-green, oil-green, and greenish-grey.

It

* In the article *Prehnite* in this work, the Chinese nephrite is stated, on the authority of Bournon, to be a variety of that mineral, but from the lately published observations of Abel, it appears to belong to nephrite.

It occurs massive.

Internally its lustre is strongly glimmering, inclining to glistening.

The fracture is slaty in the great, and more or less distinctly splintery in the small.

The fragments are tabular.

It is translucent, or only strongly translucent on the edges.

It is semi-hard, approaching to hard.

It is softer than common nephrite.

It is rather difficultly frangible.

Specific gravity, 3.008, 3.000, *Karsten.*—3.007, *Lichtenberg.*—2.932, *Breithaupt.*

Geographic Situation.

It occurs in New Zealand, and several of the islands in the South Sea. Also in Saxony; and at Gothaab in Greenland in primitive rocks.

Uses.

It is used by the natives of New Zealand, and other islanders in the South Sea, for hatchets and ear-drops.

Observations.

1. It is nearly allied to common nephrite, indurated talc, and serpentine.

2. It was first brought to Europe by Captain Cook, and into Germany by Dr Forster, who accompanied that illustrious commander in his second voyage round the world.

5. Serpentine.

Serpentin, *Werner*.

There are two kinds of this mineral, viz. Common Serpentine, and Precious Serpentine.

a. Common Serpentine.

Gemeiner Serpentin, *Werner*.

Steatites serpentinus, *Wall.* t. i. p. 156.—Serpentin, *Wid.* s. 462. *Id. Kirwan*, vol. i. p. 156. *Id. Emm.* b. i. s. 384. *Id. Estner*, b. ii. s. 855.—La Serpentine, *Broch.* t. i. p. 481.—Roche serpentineuse, *Haüy*, t. iv. p. 436.—Gemeiner Serpentin, *Reuss*, b. ii. 2. s. 210. *Id. Lud.* b. i. s. 133. *Id. Suck.* 1r th. s. 561. *Id. Bert.* s. 146. *Id. Mohs*, b. i. s. 551. *Id. Hab.* s. 58. *Id. Leonhard*, Tabel. s. 28.—Serpentine commune, *Brong.* t. i. p. 486.—Gemeiner Serpentin, *Haus.* s. 100. *Id. Karsten*, Tabel. s. 42.—Serpentine, *Kid*, vol. i. p. 93.—Gemeiner Serpentin, *Steffens*, b. i. s. 268. *Id. Lenz*, b. ii. s. 651. *Id. Oken*, b. i. s. 378. *Id. Hoff.* b. ii. s. 255. *Id. Haus.* Handb. b. ii. s. 758.—Common Serpentine, *Aikin*, p. 235.

External Characters.

Its principal colour is green, of which it presents the following varieties: leek, oil, and olive green; from oil-green it passes into mountain-green and greenish-grey; from leek-green it passes into greenish-black; from greenish-black into blackish-green; sometimes it occurs straw-yellow, and rarely yellowish-brown, and liver-brown: further, red; of which the following varieties occur; blood-red, brownish-red, peach-blossom-red, and scarlet-red. The peach-

peach-blossom and scarlet red are the rarest. The colour is either uniform, or veined, spotted, dotted, and clouded; and frequently several of these delineations occur together.

It occurs massive.

Internally it is dull, or glimmering, owing to intermixed foreign parts.

The fracture is small and fine splintery, sometimes small and fine grained uneven, which sometimes passes into even; and it is occasionally large, and flat conchoidal.

The fragments are rather sharp-edged.

It is translucent on the edges, or opaque.

It is soft. It does not yield to the nail, but is scratched by calcareous-spar.

It is rather sectile.

It is rather difficultly frangible.

It feels somewhat greasy.

Specific gravity, 2.348, *Karsten.*—2.587, *Brisson.*—2.561, 2.574, *Kirwan.*—2.560, 2.604, *Breithaupt.*

Physical Characters.

Some varieties of serpentine not only move the magnetic needle, but even possess magnetic poles.

Chemical Characters.

It is infusible before the blowpipe, but on exposure to a higher temperature, it melts with difficulty into an enamel.

Constituent

Constituent Parts.

Silica,	31.50	28.00	Silica,	32.00
Magnesia,	47.25	34.50	Magnesia,	37.24
Alumina,	3.00	23.00	Alumina,	0.50
Lime,	0.50	0.50	Lime,	10.60
Iron,	5.50	4.50	Iron,	0.66
Oxide of Manganese,	1.50		Volatile matter, and	
Water,	10.50	10.50	Carbonic Acid,	14.16
	John, Chem. Untersuch. ii. s. 94.	*Rose*.		*Hisinger*, Afhandlingar, i Fysik, iii. p. 303.

Richter and Rose discovered a small portion of Chrome in the serpentine of Saxony.

Geognostic Situation.

Serpentine occurs in primitive, transition, and secondary rocks. In primitive mountains, it occurs in beds, often of great thickness, in gneiss, mica-slate, and clay-slate; in transition rocks, it is associated with clay-slate; and in secondary rocks, it is imbedded in greenstone, into which it seems to pass. These beds, particularly those that occur in primitive mountains, contain many of the minerals of the talc and steatite kinds, and not unfrequently ores, particularly of magnetic ironstone, and veins of native copper.

Geographic Situation.

Europe.—In Scotland, it occurs in the islands of Unst and Fetlar, in Shetland; Isle of Glass in the Hebrides *; at Portsoy in Banffshire; near Drimnadrochit, and the town of Inverness in Inverness-shire; at the Bridge of Cortachie in Forfarshire; between Ballantrae and Girvan, in Ayrshire; and near Burntisland in Fifeshire. It abounds in

* Neill.

in some districts in Cornwall in England; and it occurs at Cloghan Lee, on the west coast of Ireland, in the county of Donnegal *. On the Continent of Europe, it occurs in Saxony, Bohemia, Silesia, Bavaria, Salzburg, Tyrol, Austria, Switzerland, Savoy, Italy, and the island of Corsica.

Asia.—It is found in different districts in Siberia; and in New Holland.

America.—In the Bare Hills near Baltimore in Maryland; in several counties in Pennsylvania; along with limestone in Massachusets; and near Newport in Rhode Island; also in the Island of Cuba.

Uses.

As it is soft and sectile, and takes a good polish, it is cut and turned into vessels and ornaments of various kinds. But it must be used soon after it is quarried, otherwise it becomes harder, and is not so easily turned. At Zöblitz in Upper Saxony, many people are employed in quarrying, cutting, turning, and polishing the serpentine which occurs in that neighbourhood; and the various articles into which it is there manufactured are carried all over Germany. At Portsoy in Banffshire, the serpentine is also turned into a variety of elegant ornamental articles, which, on account of the beauty of the stone, are sold at a high price. The serpentine of Portsoy much exceeds that of Zöblitz in beauty and variety of colour, and hence is deservedly more esteemed. Those varieties which have an intermixture of blood-red, peach-blossom-red, and scarlet-red, and yellowish-green, are the most highly prized: indeed, in Saxony, they are in such estimation, as to be arranged with the precious stones, and claimed as the property of the State. In ancient

* Greenough.

ancient times, serpentine was an article of the materia medica: it was prescribed with wine as a remedy for the stone, recommended as a certain cure for the bite of serpents, and was considered as possessing talismanic powers in lethargy, small-pox, poisoning, and madness. Boetius de Boot gravely remarks, that serpentine has a repulsion for poison of every kind, so that the moment the poisoning liquid is poured into a vessel of this mineral, it begins to foam, and is expelled from it.

Observations.

1. It is distinguished from *Precious Serpentine* by its numerous colours, want of lustre, uneven or splintery fracture, inferior translucency, and inferior hardness.

2. It passes into Steatite, and from thence into Talc, Asbestus, and Amianthus.

3. The greenish-black, with white or red veins, is named *Verde di Prato*; the green with white veins *Verde di Susa.*

4. It is worthy of remark, that Common Serpentine passes on the one hand into Greenstone, and on the other into Asbestus, which passes into Actynolite or Hornblende.

b. Precious Serpentine.

Edler Serpentin, *Werner.*

Le Serpentine noble, *Broch.* t. i. p. 484.—Edler Serpentin, *Reuss,* b. ii. 2. s. 210. *Id. Lud.* b. i. s. 134. *Id. Suck.* 1r th. s. 563. *Id. Bert.* s. 147. *Id. Leonhard,* Tabel. s. 28.—Serpentine Noble, *Brong.* t. i. p. 485.—Edler Serpentin, *Haus.* s. 100. *Id. Karst.* Tabel. s. 42.—Noble Serpentine, *Kid,* vol. i.

vol. i. p. 94.—Edler Serpentin, *Steffens,* b. i. s. 271. *Id. Lenz,* b. ii. s. 656. *Id. Oken,* b. i. s. 331. *Id. Hoff.* b. ii. s. 261. *Id. Haus.* Handb. b. ii. s. 756.

This mineral is divided into two sub-kinds, viz. Splintery Precious Serpentine, and Conchoidal Precious Serpentine.

α. Splintery Precious Serpentine.

Edler Splittriger Serpentin, *Werner.*

External Characters.

Its colour is dark leek-green.

It occurs massive.

Internally it is feebly glimmering.

The fracture is coarse and long splintery, and sometimes inclines to slaty in the large.

The fragments are rather sharp-edged.

It is feebly translucent.

It is soft, passing into semi-hard.

Specific gravity, 2.704, *Breithaupt.*

In other characters it agrees with Common Serpentine.

Geognostic and Geographic Situations.

It occurs in the Island of Corsica, and in Bareuth.

Use.

In Corsica it is cut into snuff-boxes, and other similar articles.

Observations.

1. Its inferior lustre, and flat splintery fracture, distinguish it from conchoidal serpentine.

2. It is a rare mineral.

β. Conchoidal

β. Conchoidal Precious Serpentine.

Edler muschlicher Serpentin, *Werner.*

External Characters.

Its colour is leek-green, which sometimes passes into blackish-green; seldom into pistachio-green, siskin-green, and oil-green.

It occurs massive, and disseminated.

Its lustre is glistening, passing into glimmering, and is resinous.

The fracture is flat conchoidal.

The fragments are sharp-edged.

It is translucent, but only translucent on the edges in the dark varieties.

It is intermediate between soft and semi-hard.

Specific gravity 2.561, 2.643, *Breithaupt.*

In other characters it agrees with the foregoing.

Constituent Parts.

Silica, - -	42.50
Magnesia, -	38.63
Lime, - -	0.25
Alumina, - -	1.00
Oxide of Iron, -	1.50
Oxide of Manganese,	0.62
Oxide of Chrome, -	0.25
Water, -	15.20

John, Chem. Untersuchungen, b. ii. s. 218.

Geognostic

Geognostic Situation.

It generally occurs intermixed with foliated granular limestone in beds subordinate to gneiss, mica-slate and other primitive rocks. It sometimes occurs in cotemporaneous masses in common serpentine, and then it occasionally contains scales of mica.

Geographic Situation.

It occurs at Portsoy in Banffshire, and in the Shetland islands. In the island of Holyhead. At Sala in Sweden; at Waldheim and Zöblitz in Saxony; at Chambane near Aosta in Italy; Kerchenstein in Silesia; and at Dobschau in Upper Hungary.

Uses.

It receives a finer polish than common serpentine, and was much used by the ancients for pillars and other similar ornamental purposes. At present it is also in great esteem as an ornamental stone.

Observations.

1. The distinctive characters of this kind of serpentine are its simple colours, fracture, lustre, considerable translucency and hardness. Its higher lustre, and conchoidal fracture, distinguish it from *Splintery Serpentine.*

2. Many mineralogists are of opinion, that the Ophites (Οφιτης) of the ancients is precious serpentine. Dr John of Berlin controverts this opinion, and maintains that it is common, not precious serpentine. But the passages in Dioscorides, v. 162. and in Pliny, Hist. Nat. xxxvi. 7. do not countenance either opinion, but show that the ancient name

name Ophites was applied to a mixture of precious serpentine and foliated granular limestone, which is known to artists under the name *Verde Antico* and *Polzevera*, and is found not only in Italy, but also in Sweden, isle of Anglesey, and in Scotland.

6. Fullers Earth.

Walkerde, *Werner*.

Walkerde, *Wid.* s. 429.—Fullers Earth, *Kirw.* vol. i. p. 184.—Walkerde, *Estner,* b. ii. s. 777. *Id. Emm.* b. ii. s. 375.—Terra da Follone, *Nap.* p. 258.—La Terre à foulon, *Broch.* t. i. p. 464.—Argile smectique, *Haüy,* t. iv. p. 443.—Walkerde, *Reuss,* b. ii. s. 111. *Id. Lud.* b. i. s. 130. *Id. Mohs,* b. i. s. 532. *Id. Hab.* s. 39. *Id. Leonhard,* Tabel. s. 27.—Argile smectique, *Brong.* t. i. p. 522.—Walkthon, *Haus.* s. 86.—Walkerde, *Karsten,* Tabel. s. 28.—Fullers Earth, *Kid,* vol. i. p. 175.—Walkerde, *Steffens,* b. i. s. 250. *Id. Lenz,* b. ii. s. 640. *Id. Oken,* b. i. s. 385. *Id. Hoff.* b. ii. s. 230.—Walkthon, *Haus.* Handb. b. ii. s. 461.—Fullers Earth, *Aikin,* p. 239.

External Characters.

Its colours are greenish-white, greenish-grey, olive-green, and oil-green. Some varieties exhibit clouded and striped colour-delineations.

It occurs massive.

It is dull.

The fracture is coarse and fine grained uneven; some varieties are large conchoidal; and others incline to slaty.

The fragments are blunt-edged, and occasionally incline to slaty.

It

It is opaque; but when it inclines to steatite it is translucent on the edges.

It becomes shining and resinous in the streak.

It is very soft, sometimes nearly friable.

It is sectile.

It scarcely adheres to the tongue.

It feels greasy.

Specific gravity, 1.72, *Karsten.*—1.198, *Hoffmann.*—2.198, *Breithaupt.*

Chemical Characters.

It falls into powder in water, without the crackling noise which accompanies the disintegration of bole.

It melts into a brown spongy scoria before the blowpipe.

Constituent Parts.

	Fullers Earth of Rygate.	
Silica,	53.00	51.8
Alumina,	10.00	25.0
Magnesia,	1.25	0.7
Lime,	0.50	3.3
Muriat of Soda,	0.10	
Trace of Potash.		
Oxide of Iron,	9.75	0.7
Water,	24.00	15.5
	98.60	*
	Klaproth, Beit. b. iv. s. 338.	*Bergmann*, Opusc. t. iv. p. 156.

Geognostic

* Gehlen found Chrome in fullers earth.

Geognostic and Geographic Situations.

In England, it occurs in beds, sometimes below, sometimes above the chalk formation; at Rosswein, in Upper Saxony, under strata of greenstone-slate; and in different places in Austria, Bavaria, and Moravia, it is found immediately under the soil.

Uses.

This mineral was employed by the ancients for cleaning woollen, and also linen cloth, and they named it *Terra Fullonum*, and *Creta Fullonum;* hence the name *Fullers Earth.* The *Morochtus* of Dioscorides, which he celebrates on account of its remarkable saponaceous properties, is conjectured to have been a variety of fullers earth. Some ancient writers describe it under the name *Galactites*, because it communicates to water a milk-white colour; also *Mellilites*, from the fancied sweet taste it communicates to water. The fullers earth of different countries varies in goodness: the most celebrated, and the best, is that found in Buckinghamshire and Surry. Good fullers earth has a greenish-white or greenish-grey colour, falls into powder in water, appears to melt on the tongue like butter, communicates a milky colour to water, and deposites very little sand when mixed with boiling water. The remarkable detersive property of this substance depends on the alumina it contains; and it appears that the proportion of this should not be less than a fourth or fifth of the whole mass. It should not, however, be much more, for in that case the fullers earth would be so tenacious that it would not diffuse itself through water *. Before the general use of

* Kid's Mineralogy, vol. i. p. 476.

of soap, this substance was very universally employed for cleansing woollen cloth; but in consequence of the general substitution of soap, it is now much less used than formerly *. It is also used for extracting greasy stains or spots from woollen cloth, and from silk. When we wish to remove a greasy stain or spot, the fullers earth is scraped down, and then diffused in hot water; in this state it is applied to the cloth or silk, allowed to dry, and afterwards brushed off.

Observations.

1. Fullers earth, although nearly allied to Steatite, is distinguished from it by colour, fracture, opacity, and inferior specific gravity. Some varieties of steatite, particularly the greenish-grey, pass into fullers earth.

2. Werner is of opinion that the fullers earth of Rosswein in Saxony, is formed by the decomposition of greenstone-

* Although the demand for fullers earth is not now nearly so great as it was formerly, in consequence of many of the clothiers using soap instead of it, yet there is still a considerable demand for it, especially for that which is procured in Surry. Mr Malcolm, in his Agricultural Report of that county, says, that he endeavoured to ascertain the annual consumption of the kingdom, and that as nearly as might be, he found it to be about 6300 tons; of which quantity, about 4000 tons were sent from Surry. The price at the pit in 1805, was about 5s. or 6s. *per* ton, whereas in 1744, the price was 4d. *per* bushel, which is after the rate of 8s. *per* ton,—a proof either that the supply had increased, or that the demand had diminished. Fullers earth was deemed by the Legislature of so much consequence to our woollen manufactures, that a special act was passed in the 28th year of the reign of his present Majesty, prohibiting the exportation of fullers earth and fulling clay, under a heavy penalty, and obliging the dealers and buyers of it to enter into bonds, to prevent its exportation; and certainly, whatever be the opinion and practice now, the great and acknowledged superiority of English cloth was formerly ascribed, both at home and abroad, to the use of fullers earth. —Edinburgh Encyclopædia, art. *England*, p. 742, 743.

stone-slate, as it is covered by it, and we can trace the gradation from the fully formed fullers earth to the fresh greenstone-slate. Steffens conjectures it to have been formed from previously existing strata, by a proceess analogous to that by which muscular fibre is converted into a kind of spermaceti: hence he says it is of newer formation than the bounding rocks.—May it not be an original deposition of greenstone, in a loose state of aggregation, resembling the disintegrated felspar in certain granites?

ORDER IV.

ORDER IV. MALACHITE.

THIS Order contains four Genera, viz. 1. Copper-Green, 2. Malachite, 3. Olivenite, and, 4. Emerald-Copper.

GENUS I.—COPPER-GREEN.

Trauben Malachit, *Mohs.*

THIS Genus contains one Species, viz. Common Copper-Green.

1. Common Copper-Green, or Chrysocolla.

Untheilbarer Trauben Malachit, *Mohs.*

Kupfergrün, *Werner.*

THIS Species is divided into three Subspecies, viz. 1. Conchoidal Copper-Green, 2. Earthy Iron-shot Copper-Green, 3. Slaggy Iron-shot Copper-green.

First Subspecies.

Conchoidal Copper-Green.

Kupfergrün, *Werner.*

Χρυσοκολλα, *Theophr.* 46, 47.—Chrysocolla, *Plin.* Hist. Nat. xxxiii. 26.–30.—G. Agricola, De Natura Fossilium, Lehm.

Transl. iii. s. 173.—Beckman, in Aristot. Mirab. p. 124.—Schwarze, De quodam Pseudo-Smaragdorum, apud veteres genere, Gorl. 1803.—Kupfergrün, *Wern.* Pabst. b. i. s. 96. *Id. Wid.* s. 772.—Mountain Green, *Kirw.* vol. ii. p. 134.—Kupfergrün, *Estner,* b. iii. s. 595. *Id. Emm.* b. ii. s. 260.—Le Vert de Cuivre, ou la Chrysocolle, *Broch.* t. ii. p. 203.—Kupfergrün, *Reuss,* b. iii. s. 477. *Id. Lud.* b. i. s. 231. *Id. Suck.* 2ter th. s. 210. *Id. Bert.* s. 393. *Id. Mohs,* b. iii. s. 287. *Id. Leonhard,* Tabel. s. 59.—Cuivre carbonaté vert compacte, *Haüy.*—Kiesel Malachit, *Haus.* Handb. b. iii. s. 1028.—Kupfergrün, *Hoff.* b. iv. s. 152.—Chrysocolla, *Aikin,* p. 91.

External Characters.

Its principal colour is verdigris-green, of different degrees of intensity, which on the one side passes into emerald-green, and even into pistachio-green, on the other into sky-blue.

It occurs massive, disseminated, and coating or incrusting malachite, and sometimes small reniform, and small botryoidal.

Internally it is shining, passing into glistening, and the lustre is resinous.

The fracture is small conchoidal.

The fragments are indeterminate angular, and more or less sharp-edged.

It alternates from translucent to translucent on the edges.

It is harder than gypsum, but not so hard as calcareous spar.

Its colour is not changed in the streak.

It is easily frangible, and rather brittle.

Specific gravity, 2.0, 2.2, *Mohs.*

Chemical

Chemical Characters.

Before the blowpipe, it becomes first black, then brown, but is infusible: on the addition of borax, it melts rapidly, and effervesces, tinging the flame green, and is reduced to the metallic state. In diluted muriatic acid, it effervesces slightly; the oxide of copper dissolves, and there remains behind a nearly colourless and often semi-gelatinous mass of silica, of the same size as the original specimen.—*Aikin.*

Constituent Parts.

Copper, -	40.00	42.00
Oxygen, -	10.00	7.63
Carbonic Acid, -	7.00	3.00
Water,	17.00	17.50
Silica, - -	26.00	28.37
Sulphat of Lime -		1.50
	100.00	100.00
	Klaproth, Beit. b. i. s. 36.	*John*, Chem. Unters. b. ii. s. 260.

Geognostic Situation.

It is met with in the same geognostic situations as malachite, and is usually associated with copper-pyrites, tile-ore, grey copper-ore, malachite, brown ironstone, and other ores.

Geographic Situation.

Europe.—It occurs in Cornwall, along with olivenite, and also in the vale of Newlands, near Keswick. It is found at Zinwald, along with tinstone, wolfram, tungsten, copper, iron, and arsenical pyrites, copper-glance or vitreous copper, galena or lead-glance, fluor-spar, and quartz; at Arendal in Norway; at Spitz in Austria, with tile-ore; Falkenstein in the Tyrol, in compact limestone, with grey copper, and earthy tile-ore; in the Bannat, where it formerly occurred in great beauty, along with blue copper, malachite, copper-black or black oxide of copper, foliated red copper-ore, tile-ore, and copper-pyrites, in clay-porphyry; at Herrngründe in Lower Hungary, along with grey copper, malachite, and selenite, in grey-wacke; in Upper Hungary, associated with tile-ore, compact malachite, compact red copper-ore, and white lead-spar.

Asia.—In Siberia, along with blue copper, compact and foliated red copper-ore, native copper, copper-black or black oxide of copper, malachite, tile-ore, iron-ochre, and brown-spar, in sandstone; and in China, along with tile-ore.

America.—In Mexico, along with red copper-ore, malachite, and blue copper; also in Chili.

Observations.

1. It is distinguished from *Malachite*, by colour, lustre, fracture, translucency, and inferior specific gravity; its feeble effervescence with acids also distinguishes it from that mineral; and it is distinguished from certain varieties of *Steatite*, by its brittleness, and easy frangibility.

2. John, in his Chem. Unters. b. ii. s. 252. gives the following account of a mineral allied to Copper-green, and which he considers to be a new species:—

Siliceous

Siliceous Copper.

Kieselkupfer, *John.*

Its colours are asparagus-green, and celandine-green, inclining to sky-blue.

It occurs in crusts.

It is dull, or faintly glistening, and resinous.

The fracture is even or earthy.

It is opaque, and rarely translucent on the edges.

It is soft.

Constituent Parts.—Copper, 37.8. Oxygen, 8. Water, 21.8. Silica, 29; and Sulphate of Lime, 3.

Second Subspecies.

Earthy Ironshot Copper-Green.

Erdiches eisenschüssiges Kupfergrün, *Werner.*

Id. Werner, Pabst. b. i. s. 96. *Id. Wid.* s. 773.—Earthy Ironshot Mountain-green, *Kirw.* vol. ii. p. 151.—Erdiches eisenschüssiches Kupfergrün, *Estner,* b. iii. s. 605. *Id. Emm.* b. ii. s. 262.—Le Vert de Cuivre ferrugineux terreux, *Broch.* t. ii. p. 205.—Erdiges eisenschussig-Kupfergrün, *Reuss,* b. iii. s. 482. *Id. Lud.* b. i. s. 232. *Id. Suck.* 2ter th. s. 210. *Id. Bert.* s. 393. *Id. Mohs,* b. iii. s. 290. *Id. Leonhard,* Tabel. s. 59.—Cuivre Malachite ferrugineux terreux, *Brong.* t. ii. p. 223.—Erdiges eissenschüssiges Kupfergrün, *Karsten,* Tabel. s. 62.—Eissenschüssiger erdiger Malachit, *Haus.* s. 135.—Cuivre hydraté silicifere compacte, *Vauquelin,* Journ. des Mines,

Mines, t. xxxiii. p. 341.—Erdiges eissenschüssiges Kupfergrün, *Haus.* Handb. b. iii. s. 1029. *Id. Hoff.* b. iv. s. 156.

External Characters.

Its colour is olive-green, which sometimes passes into pistachio-green, and inclines to leek-green.

It occurs massive, and in crusts.

It is generally of friable consistence, and is composed of dull, dusty particles, which are more or less cohering, and that do not soil.

The compact varieties have an earthy fracture.

It is opaque.

It is very soft, passing into friable.

It is sectile, and easily frangible.

Observations.

Its earthy and friable properties distinguish it from *Malachite* and *Conchoidal Copper-Green.*

Third Subspecies.

Slaggy Ironshot Copper-Green.

Schlackiges eisenschüssiges Kupfergrün, *Werner.*

Id. Werner, Pabst. b. i. s. 97. *Id. Wid.* s. 775.—Glassy Ironshot Mountain-green, *Kirw.* vol. ii. p. 152.—Schlackiges eisenschüssiges Kupfergrün, *Estner,* b. iii. s. 606. *Id. Emm.* b. ii. s. 263.—Le Vert de Cuivre ferrugineux scoriacé, *Broch.* t. ii. p. 206.—Schlackiges eisenschüssiges Kupfergrün, *Reuss,* b. iii. s. 483. *Id. Lud.* b. i. s. 232. *Id. Suck.* 2ter s. 211. *Id. Bert.* s. 394. *Id. Mohs,* b. iii. s. 290. *Id. Leonhard,* Tabel. s. 62.—Cuivre Malachite ferrugineux resineuse, *Brong.* t. ii. p. 224.

p. 224.—Schlackiges eisenschüssiges Kupfergrün, *Karsten*, Tabel. s. 62.—Muschlicher Pharmakochalzit, *Haus*. s. 136.—Cuivre hydraté silicifere resinite, *Vauquelin*, Journ. des Mines, t. xxxiii. p. 341.—Schlakkiges eisenschüssiges Kupfergrün, *Hoff*. b. iv. s. 157.

External Characters.

It is blackish-green, and dark pistachio-green.

It occurs massive and disseminated.

Internally it is shining and glistening, and the lustre is resinous.

The fracture is small conchoidal.

The fragments are indeterminate angular, and more or less sharp-edged.

It is opaque.

Its colour becomes paler in the streak.

It is soft, verging into very soft.

It is easily frangible.

Constituent Parts.

It is probably a compound of Conchoidal Copper-Green and Oxide of Iron.

Geognostic Situation.

Both subspecies usually occur together, and they frequently pass into each other. They are usually accompanied with copper-green, blue copper, and malachite; frequently also with grey copper, foliated copper-glance, tile-ore, ochry and compact brown iron-ore, compact red copper-ore, quartz, and straight lamellar heavy-spar.

Geographic

Geographic Situation.

Europe.—It occurs in Cornwall, along with olivenite; at Saalfeldt in Thuringia, it is associated with malachite, blue copper, copper-green, copper-pyrites, grey copper, yellow and brown cobalt-ochre, red cobalt, and straight lamellar heavy-spar; at Lauterberg in the Hartz, along with blue copper, malachite, and grey copper; at Schwatz in the Tyrol, along with foliated copper-glance, copper-green, fibrous malachite, and blue copper; at Saska in the Bannat, along with copper-ore, green and red copper-ore.

Asia.—In the Gumashevsk mines in Siberia, associated with compact and ochry brown iron-ore, tile-ore, malachite, blue copper, grey copper, red copper-ore, white and yellow lead spars, and native silver, with quartz; also in other mines in Siberia.

America.—Chili.

Observations.

Mr Kirwan suspects, from its olive-green colour, that it may contain arsenic acid. Heergen says, that he convinced himself of the presence of this acid in many varieties, and proposes to consider it as a subspecies of olivenite *; but the experiments of Vauquelin already mentioned, show that it cannot be considered as an arseniate of copper.

GENUS II.

* Heergen, Descripcion y annuncio de varios Minerales del Regno de Chile; and in the Anales de Ciencias Naturales, mes. d. Julio 1801, n. 11. t. 4. p. 198; also in Von Moll's Annalen der Berg und Huttenkünde, 1r B. 2te Lieferung, s. 150.

Genus II.—MALACHITE.

Kalo Malachit, *Mohs.*

This Genus contains two species, viz. 1 Blue Copper or Prismatic Malachite, and 2. Common or Acicular Malachite. * Brown Copper.

1. Blue Copper or Prismatic Malachite.

Prismatischer Kalo-Malachit, *Mohs.*

Kupferlazur, *Werner.*

This species is divided into two subspecies, viz. Radiated Blue Copper, and Earthy Blue Copper. * Velvet Blue-Copper.

First Subspecies.

Radiated Blue Copper.

Feste Kupferlazur, *Werner.*

Strahlige Kupferlazur, *Wern.* Pabst. b. i. s. 89. *Id. Wid.* s. 764.—Striated Mountain-blue, *Kirw.* vol. ii. p. 130.—Strahlige Kupferlazur, *Estner*, b. iii. s. 564. *Id. Emm.* b. ii. s. 249.—L'Azur de Cuivre rayonné, *Broch.* t. ii. p. 192.—Cuivre carbonaté bleu, *Haüy*, t. iii. p. 562.—Strahlige Kupferlazur, *Reuss*, b. iii. s. 453. *Id. Lud.* b. i. s. 229. *Id. Suck.* 2ter th. s. 203. *Id. Bert.* s. 390. *Id. Mohs*, b. iii. s. 272.—Cuivre carbonaté bleu, *Lucas*, p. 131.—Strahlige Kupferlazur, *Leonhard*, Tabel. s. 59.—Cuivre azure, *Brong.* t. ii. p. 220.—Cuivre

Cuivre carbonaté bleu, *Brard*, p. 298.—Strahlige Kupferlazur, *Karsten*, Tabel. s. 62.—Edler Kupferlazur, *Haus*. s. 135.—Cuivre carbonaté bleu, *Haüy*, Tabl. p. 89.—Feste Kupferlazur, *Hoff*. b. iv. s. 137.—Edler Kupferlazur, *Haus*. Handb. b. iii. s. 1021.—Blue Copper, *Aikin*, p. 30.

External Characters.

Its principal colour is azure-blue, which often passes into blackish-blue, seldomer into Berlin-blue and smalt-blue.

It occurs massive, disseminated, in plates, in crusts; also globular, botryoidal, reniform, stalactitic, and cellular; in prismatic distinct concretions, which are straight, narrow, scopiform, and stellular, and these are again traversed by others which are curved lamellar. Sometimes there is a tendency to granular concretions. It is very frequently crystallized. Its primitive form is an oblique prism, the dimensions of which have not yet been determined. The following are some of its secondary forms:

1. Oblique four-sided prism, rather acutely bevelled on the terminal planes, the bevelling planes set on the acuter lateral edges. It exhibits the following varieties:
   - *a*. The angles which the bevelling planes make with two lateral planes, or with the obtuse lateral edges, truncated.
   - *b*. The acute lateral edges bevelled, the edges of the bevelment, and the obtuse lateral edges, truncated: when these planes meet, an eight-sided prism is formed.
   - *c*. The proper edge of the bevelment on the terminal planes more or less deeply truncated; sometimes so deeply, that the figure appears as a simple oblique four-sided prism.

d. Two

d. Two opposite planes, so much larger than the others, that the crystal has a tabular form.

e. Rectangular four-sided prism, or eight-sided prism, acuminated with four planes, which are set on the lateral planes.

The crystals are small and very small, seldom middle-sized. They are sometimes aggregated in globular and botryoidal forms; other crystals occur in druses, or singly superimposed.

The external surface of the particular external shapes is drusy and glimmering; that of the crystals sometimes smooth and splendent; sometimes the lateral planes of the rectangular four-sided prism is obliquely streaked.

Externally the crystallized varieties are shining, but the massive and particular external shapes are dull.

Internally it is shining and glistening, and the lustre is intermediate between vitreous and resinous.

Its cleavage is threefold; two of the cleavages are parallel with the sides of an oblique four-sided prism, the third one with the shorter diagonal of the prism.

The fracture is small and imperfect conchoidal.

The fragments of the prismatic or radiated varieties are wedge-shaped; those of the foliated and conchoidal splintery.

The crystals are translucent, passing into semi-transparent, and are sometimes only translucent on the edges.

The colour becomes lighter in the streak.

It is harder than calcareous-spar, but not so hard as fluor-spar.

It is brittle, and rather easily frangible.

Specific gravity, 3.6082, *Brisson.*—3.652, *Breithaupt.*—3.5,—3.7, *Mohs.*

Chemical

Chemical Characters.

It is soluble with effervescence in nitric acid. Before the blowpipe, without addition, it blackens, but does not melt: with borax, on charcoal, it effervesces, yields a metallic globule, and colours the flux green.

Constituent Parts.

		Siberia.	Chessy.
Copper, -	66 to 70	56.00	56.00
Carbonic Acid,	18 to 20	24.00	25.00
Oxygen, -	8 to 10	14.00	12.50
Water, -	2 to 2	6.00	6.50
		100.00	100.00
	Pelletier, in Mem. et Observ. de Chimie, t. ii. p. 20.	*Klaproth*, Beit. b. iv. s. 33.	*Vauquelin*, An. du Mus. t. xx. p. 3.

Geognostic Situation.

This mineral occurs in veins that traverse primitive, transition, and secondary or flœtz, rocks: in smaller quantity and less frequently, in beds. Thus, at Catharinenburg in Bohemia, and in the electorate of Triers, it occurs in gneiss; at Kleingabel, near Pries in Lower Hungary, in mica-slate, passing to clay-slate; at Zellerfeld in the Hartz, in grey-wacke and grey-wacke-slate; in the limestone mountains of the Tyrol; in the secondary limestone of Krakau in Lower Saxony; in the sandstone of the Uralian Mountains; in the old red sandstone of Thuringia, along with copper-green, forming what is called sand-ore, *(sanderz)*; and also in rocks of the coal formation.

There are several formations of this species: in one of these, it is associated with malachite, brown iron-ore, also red

red copper-ore, tile-ore, and probably grey copper and copper-pyrites; in another with white and green lead-spar; and in a third, with earthy cobalt-ochre, and straight lamellar heavy-spar.

At Leadhills, in Lanarkshire, it is accompanied with galena or lead-glance, ochre of manganese, earthy lead-spar, sparry ironstone, calamine, ochry brown iron-ore, brown hematite, iron-pyrites, green lead-spar, white lead-spar, and lead-vitriol or sulphate of lead.

The most beautiful specimens of this mineral are those found in the mines of Chessy, near Lyons in France.

In Hungary, it is associated with copper-pyrites, malachite, copper-green, grey copper, and iron-ochre; in the Bannat, which produces very beautiful specimens, it occurs along with fibrous malachite, earthy tile-ore, compact red copper-ore, iron-ochre, copper-green, and asbestous actynolite; near Laak in Upper Carniola, with quartz and malachite; in the district of Kamsdorf in Saxony, it is accompanied with yellow and brown iron-ochre, ironshot copper-green, and several ores of copper; at Saalfeld in Thuringia, with straight lamellar heavy-spar, grey copper, malachite, ironshot copper-green, tile-ore, and iron-ochre; at Kupferberg in Silesia, with brown-spar and malachite: the Siberian, which rivals that of the Bannat in beauty, is accompanied with copper-green, malachite, tile-ore, green and white lead-spars, brown iron-ore, heavy-spar, and quartz.

Geographic Situation.

Europe.—It occurs at Leadhills in Dumfriesshire, and Wanlockhead in Lanarkshire; Huel-Virgin and Carharrack in Cornwall. On the Continent, it is met with in the iron-mines at Arendal in Norway; in the government of Olnetz in Russia; in the Hartz; Thalitter in Hessia; Moschelandsberg in Deux-

Deux-Ponts; in Salzburg; Schwatz in the Tyrol; West Gallicia; Corsica; and Spain.

Asia.—Kamtschatka and Kolyvan; and in many mines in the Uralian Mountains.

America.—In veins in granite at Neustra Senora del Rosario in Chili, where it is associated with cinnabar, white lead-spar, grey copper, and heavy-spar *.

Uses.

This species is not only used as an ore of copper, but also as a blue colour, (called Mountain-blue), of which there is a manufactory at Schwatz in the Tyrol.

Observations.

1. The *Armenian Stone* of the ancients, which was brought from Armenia, is a limestone impregnated with earthy blue copper, and in which copper and iron-pyrites are sometimes disseminated †. It is the *Cæruleum montanum* of Wallerius, and the *Azur de Cuivre*, or *Fleurs de Cuivre bleues*, of Romé de Lisle.

2. Its blue colour, in which there is not a trace of green, and inferior hardness, distinguish it from *Azurite* and *Blue Spar*; while its crystallizations and fracture distinguish it from *Azurestone.* Its want of saline taste distinguishes it from *Blue Vitriol* or *Sulphate of Copper.*

Second

* Heuland.

† Vid. A. Boetius de Boot, Gemmarum et Lapidum Historia, lib. 2. cap. 144.

Second Subspecies.

Earthy Blue Copper.

Erdiger Kupferlazur, *Werner.*

Erdiche Kupferlasur, *Wern.* Pabst. b. i. s. 89. *Id. Wid.* s. 762. —Earthy Mountain-blue, *Kirw.* vol. ii. p. 129.—Erdiche Kupferlasur, *Estner,* b. iii. s. 560. *Id. Emm.* b. ii. s. 246.—L'Azur de Cuivre terreux, *Broch.* t. ii. p. 191.—Gemeine Kupferlasur, *Reuss,* b. iii. s. 449.—Erdiche Kupferlazur, *Lud.* b. i. s. 228. *Id. Suk.* 2ter th. s. 198. *Id. Bert.* s. 388. *Id. Mohs,* b. iii. s. 262. *Id. Leonhard,* Tabel. s. 58.—Gemeine Kupferlasur, *Karsten,* Tabel. s. 62. *Id. Haus.* s. 135.—Blue Carbonate of Copper, *Kid,* vol. ii. p. 117.—Cuivre carbonaté bleu terreux, *Haüy,* Tabl. p. 89.—Erdige Kupferlazur, *Hoff.* b. iv. s. 135.—Zerreibliche Kupferlazur, *Haus.* Handb. b. iii. s. 1023. —Earthy Blue Copper, *Aikin,* p. 30.

External Characters.

Its colour is smalt-blue, which sometimes inclines slightly to sky-blue.

It is massive, often disseminated, thinly coating, and rarely small botryoidal.

It is of friable consistence, and is composed of dull and fine dusty particles that soil very faintly, and which are more or less cohering.

Specific gravity 3.354, *Breithaupt.*

Chemical Characters.

Are the same as those of the radiated subspecies.

Geognostic

Geognostic Situation.

It occurs in small quantity, and is usually accompanied with malachite and copper-green. In Silesia, it is found incrusting bituminous marl-slate; in Thuringia, coating varieties of the old red sandstone; and in Siberia, disseminated in sandstone.

Geographic Situation.

Europe.—It is found in Norway; at Saalfeld, Sangerhausen, Bottendorf, and Eisleben in Thuringia; Thalitter in Hessia; Zellerfeld in the Hartz; Prausnitz, &c. in Silesia; Leogang in Salzburg; and in West Gallicia.

Asia.—Siberia.

* Velvet-Blue Copper.

Kupfersammterz, *Werner.*

Kupfersammterz, *Karsten,* Tabel. s. 62. *Id. Hoff.* b. iv. s. 143.

External Characters.

Its colour is intermediate between smalt-blue and sky-blue, and sometimes passes into sky-blue.

It occurs in very small and delicate capillary crystals, which generally form a velvety crust, and are seldom aggregated in balls.

Externally and internally the lustre is glistening and pearly, or silky.

It is very soft.

Geognostic

Geognostic and Geographic Situations.

It is a very rare mineral, and has hitherto been found only at Oravicza in the Bannat, along with malachite and brown ironstone *.

Observations.

According to Werner, it forms the connecting link between Blue Copper and Malachite.

Genus II.—MALACHITE.

This genus contains one species, viz. Malachite.

1. Malachite †.

Malachit, *Werner.*

This species is divided into two subspecies, viz. Fibrous Malachite and Compact Malachite. * Brown Copper.

* This species is so rare, that 50 dollars have been given for single specimens of it.

† The name of the species is derived from the word μαλαχη, *malva*, from the resemblance of its green colour to that of the *marsh-mallow*. The Greek word is sometimes corruptly written μολοχη, whence Pliny has derived the term *molochites*: "Non translucet molochites, spissius virens et crassius quam smaragdus, a colore malvæ nomine accepto."

First Subspecies.

Fibrous Malachite.

Fasricher Malachit, *Werner*.

Ærugo nativa crystallisata, *Wall.* t. ii. p. 287.—Fasriche Malachit, *Werner,* Pabst. b. i. s. 92. *Id. Wid.* s. 768.—Fibrous Malachite, *Kirw.* vol. ii. p. 131.—Fasriger Malachit, *Estner,* b. iii. s. 577. *Id. Emm.* b. ii. s. 254.—Cuivre vert soyeux, *Haüy,* t. iii. p. 571,–575.—La Malachite fibreuse, *Broch.* t. ii. p. 197.—Cuivre carbonaté vert, *Haüy,* t. iii. p. 571.—Fasriger Malachit, *Reuss,* b. iii. s. 461. *Id. Lud.* b. i. s. 230.—Malachit Kupfer, *Suck.* 2ter th. s. 203. *Id. Bert.* s. 390. *Id. Mohs,* b. iii. s. 272.—Cuivre carbonaté vert, *Lucas,* p. 132.—Fasriger Malachit, *Leonhard,* Tabel. s. 59.—Cuivre Malachit soyeux, *Brong.* t. ii. p. 222.—Cuivre carbonaté, *Brard,* p. 296. —Fasriger Malachit, *Karsten,* Tabel. s. 62.—Edler Malachit, *Haus.* s. 135.—Green Carbonate of Copper, *Kid,* vol. ii. p. 119. —Cuivre carbonaté vert aciculaire soyeux, *Haüy,* Tabl. p. 90. —Fasriger Malachit, *Hoff.* b. iv. s. 145. *Id. Haus.* Handb. b. iv. s. 1026.—Malachite, *Aikin,* p. 90.

External Characters.

Its most common colour is perfect emerald-green, sometimes inclining to grass-green, and sometimes to dark leek-green.

It is seldom massive, sometimes disseminated, tuberose, stalactitic, reniform, botryoidal, fruticose, most frequently as a coating, also in fibrous distinct concretions, which are delicate and scopiform or stellular, and collected into others which are large, coarse, and sometimes longish granular, or wedge-shaped. It is frequently crystallized, and the following are the figures which have been observed:

1. Rather

1. Rather oblique four-sided prism, bevelled on the extremities, the bevelling planes set on the obtuse lateral edges *.
2. The preceding figure truncated on the obtuse lateral edges, which thus forms a six-sided prism, in which the bevelling planes are set on two opposite lateral planes.
3. Acute angular three-sided prism, in which the terminal planes are set on, either straight or oblique.

The crystals are generally short, capillary, and acicular. When very short, they form velvety drusy pellicles; and when longer, they are scopiformly aggregated.

Internally it is intermediate between glistening and glimmering, and the lustre is pearly or silky.

The fragments are wedge-shaped and splintery.

The crystals are translucent, but the massive varieties only translucent on the edges, or opaque,

It is softer than blue copper.

The colour of the streak is pale-green.

It is brittle, inclining to sectile, and easily frangible.

Specific gravity, 3.5718, *Brisson*.—3.661, 3.712, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it decrepitates and becomes black, and is partly infusible, partly reduced to a black slag. It melts with borax, to which it communicates a dark yellowish-green colour, and readily affords with it a bead of cop-

 per.

* According to Bournon, the lateral planes of the prism meet under angles of 103° and 77°; whereas those in the oblique four-sided prism of blue copper, are said to meet under angles of 116° and 56°.

per. It effervesces with acids, and forms a blue-coloured solution with ammonia.

Constituent Parts.

	Siberia.		Arragon.		Chessy.
Copper,	58.00	Copper,	56.8	Copper,	56.10
Carbonic Acid,	18.00	Carbonic Acid,	27.0	Carbonic Acid,	21.25
Oxygen,	12.50	Oxygen,	14.2	Oxygen,	14.00
Water, -	11.50	Sand, -	1.0	Water, -	8.75
		Lime, -	1.0		
	100.00		100.0		100.00
	Klaproth, Beit. b. ii. s. 290.		Ann. Mus. t. xx. p. 7.		Ibid. p. 8.

Geognostic Situation.

It occurs principally in veins, and these generally contain, besides this mineral, red copper-ore, tile-ore, brown iron-ore, blue copper, copper-pyrites, copper-glance or vitreous copper, along with calcareous-spar and quartz. These veins traverse primitive, transition, and secondary rocks.

Geographic Situation.

Europe.—It occurs at Sandlodge in Mainland, one of the Shetland Islands, in veins that traverse red sandstone, in which it is associated with grey copper, copper-pyrites, and brown iron-ore; at Landidno in Caernarvonshire; in the mines of Arendal in Norway, along with magnetic iron-ore, copper-pyrites, and grey copper; Fahlun and Sahlberg in Sweden; at Lauterberg in the Hartz, with copper-pyrites, compact brown iron-ore, and tile-ore; at Frankenberg in Hessia, in secondary limestone, along with radiated blue copper; at Thalitter in Hesse-Darmstadt, with copper-green, blue copper, variegated copper-pyrites, and mineral

mineral pitch; at Kaisersteinmel in Nassau, in veins in clay-slate and greywacke, along with native copper, copper-pyrites, copper-glance or vitreous copper, fibrous and foliated olivenite, red copper-ore, iron-pyrites, brown iron-ore, and quartz; in the copper-mine of Malsheid, also in Nassau, with black and white lead-spar, and galena or lead-glance, blende, copper and iron pyrites, copper-black or black oxide of copper, and quartz; Kupferberg in Silesia; on the Buchberg, near Landshut in Lusatia, in basalt, and along with calcareous-spar; at Chessy near Lyons in France; in the Bannat, along with red copper-ore, blue copper, tile-ore, and brown iron-ore; and in the government of Olnetz in Russia.

Asia.—In the mines of Kolywan, along with tile-ore, red copper-ore, brown iron-ore, copper-glance or vitreous copper, copper-green, blue copper, white lead-spar, brown-spar, ironshot quartz, and hornstone; and in several of the mines situated in the Uralian Mountains.

America.—In Maryland and Pennsylvania in the United States; and in the copper mines of Chili, in South America.

Second Subspecies.

Compact Malachite.

Dichter Malachit, *Werner.*

Molochites, *Plin.* Hist. Nat. xxxvii. 8. s. 36.—Ærugo nativa, fissilis, stalactitica, solida, *Wall.* t. ii. p. 287.—Dichter Malachit, *Werner,* Pabst. b. i. s. 94. *Id. Wid.* s. 770.—Compact Malachite, *Kirw.* vol. ii. p. 132.—Dichter Malachit, *Estner,* b. iii. s. 586. *Id. Emm.* b. ii. s. 256.—Cuivre carbonaté vert concretionné,

concretionné, *Haüy*, t. iii. p. 571.—La Malachite compacte, *Broch.* t. ii. p. 199.—Dichter Malachit, *Reuss*, b. iii. s. 467. *Id. Lud.* b. i. s. 230. *Id. Suck.* 2ter th. s. 203. *Id. Bert.* s. 390. *Id. Mohs*, b. iii. s. 272. *Id. Leonhard*, Tabel. s. 69.—Cuivre Malachite concretionné, *Brong.* t. ii. p. 223.—Dichter Malachit, *Karsten*, Tabel. s. 62.—Gemeiner Malachite, *Haus.* s. 135.—Cuivre carbonaté vert compacte, *Haüy*, Tabl. p. 90. —Dichter Malachit, *Hoff.* b. iv. s. 149. *Id. Haus.* Handb. b. iii. s. 1027.—Massive Malachite, *Aikin*, p. 91.

External Characters.

Its colour is intermediate between emerald-green and verdigris-green; but in general inclining more to the first. The colours are often disposed in concentric delineations, and are varied with dark-coloured dendritic markings.

It occurs massive, disseminated, and in membranes; most frequently reniform and botryoidal, frequently tuberose, stalactitic, fruticose, cellular, and amorphous; also in distinct concretions, which are sometimes extremely delicate and scopiform fibrous; more frequently thin lamellar, or large, coarse, and small angulo-granular; and sometimes crystallized in oblique four-sided prisms.

The external surface of the particular shapes is generally rough and drusy, seldomer smooth, and then it is shining and glistening. The surface of the distinct concretions is apparently covered with a greenish-white film.

Internally it passes from glistening through glimmering to dull, but it is most commonly glimmering, and the lustre is silky.

The fracture is small and fine-grained uneven, which sometimes passes into small and flat conchoidal, and even.

The fragments are indeterminate angular, and rather sharp-edged.

It

It is opaque.

It is rather harder than fibrous malachite.

It is rather brittle, and easily frangible.

Its streak is pale-green.

Specific gravity, 3.653, *Kirwan*.—3.6412, *Brisson*.—3.708, *Breithaupt*.

Its chemical characters and constituent parts are nearly the same with the preceding subspecies.

Geognostic Situation.

It occurs in veins, which traverse primitive transition, and secondary rocks.

Geographic Situation.

Europe.—In the copper-mines of Huel-Carpenter and Huel-Husband, in Cornwall; in the copper-mines of Aardal in Norway; in small quantity in veins in Lauterberg in the Hartz, along with copper-pyrites, fibrous malachite, copper-green, tile-ore, quartz, heavy-spar, and calcareous spar: in many of the mines in the Saxon Erzgebirge, but in none of them in great quantity; also in several copper-mines in Silesia, and Hessia; at Schwatz in the Tyrol, in limestone; Herrengrund, Kasemarkt, Schmolnitz, and other places in Hungary; but most abundantly, and in greatest variety, in the mines of Moldawa, Oravicza and Saska, in the Bannat.

Asia.—In the mines of Kolywan, Gamasherk, Turja, &c. in Siberia, where the most beautiful and largest specimens of this mineral are met with along with tile-ore, red-copper-ore, brown iron-ore, copper-glance or vitreous copper, blue copper, copper-green, white lead-spar, brown-spar, ironshot

ironshot quartz, hornstone, &c. It is also met with in different parts of China.

Africa.—In the land of the Namuquas, in Southern Africa.

America.—In Maryland, Pennsylvania, Mexico, and St Christopher's, in North America: and in Chili in South America.

Uses.

It was formerly esteemed as a precious stone, and was cut into ornamental forms of various descriptions. Even at present it is highly prized, and is cut into consoles, candlesticks, snuff-boxes, and other similar articles. Where it occurs in quantity, it is smelted as an ore of copper, and is sometimes used as a green pigment.

Observations.

1. The finest specimens of European malachite, are those of the Tyrol and the Bannat; but they do not equal, either in size or magnificence, the Siberian. M. Patrin observed at St Petersburgh a plate of malachite about 32 inches long by 17 inches broad, which was valued at 20,000 livres.

2. The bones and teeth of animals which are coloured with malachite and blue copper, are so hard as to receive a high polish. These are named *Turquoises*, because the first specimens of this kind were brought from Turkey: they are also found in Persia, and in France, and are esteemed as ornamental articles. These turquoises, however, must not be confounded with the Calaite or Mineral Turquoise described page 403. vol. i.

* Brown

* Brown Copper.

Analysis of a new species of Copper-ore by *Dr Thomson*, Phil. Trans. for 1814.

External Characters.

Its colour, when pure, is dark blackish-brown; but it is very generally intermixed with malachite and red copper-ore, so that the colour appears a mixture of green, red, and brown, sometimes one and sometimes another prevailing. Small green veins of malachite likewise traverse it in different directions.

It occurs massive, with numerous imbedded small rock-crystals.

Its lustre is glimmering and resinous.

The fracture is small conchoidal, and sometimes inclining to foliated.

It is soft, being easily scratched by the knife.

It is sectile.

The streak is reddish-brown.

Specific gravity, 2.620, *Thomson.*

Chemical Characters.

It effervesces in acids, and dissolves, letting fall a red powder. The solution is green or blue, according to the acid, indicating that it consists chiefly of copper.

Constituent

Constituent Parts.

Carbonic Acid,	-	16.70
Per-oxide of Copper,		60.75
Per-oxide of Iron,	-	19.50
Silica,	- -	2.10
Loss,	- -	0.95
		100.00

Thomson, in Phil. Trans. for 1814.

Geognostic Situation.

It appears to occur in nests in primitive rocks, which are of greenstone, or some similar rock of the primitive trap series subordinate to mica-slate. It is associated with malachite.

Geographic Situation.

In the peninsula of Hindostan, near the eastern border of the Mysore country.

Observations.

1. This mineral was discovered by Dr Benjamin Heyné, about the year 1800, in the Mysore country, and was first described and analysed by Dr Thomson in 1813.

2. It is placed beside malachite, until its place shall be accurately determined.

GENUS III.

Genus III. OLIVENITE.

Oliven-Malachit, *Mohs.*

This genus contains four species, viz. 1. Prismatic Olivenite, or Phosphat of Copper, 2. Di-prismatic Olivenite, or Lenticular Copper, 3. Acicular Olivenite, 4. Hexahedral Olivenite, or Cube-Ore. * Atacamite.

1. Prismatic Olivenite, or Phosphat of Copper.

Prismatischer Oliven-Malachit, *Mohs.*

Phosphorsaures Kupfer, *Karsten,* in d. N. Schriften der Berlin. Ges. Natf. Fr. b. iii. s. 304.—Cuivre phosphaté, *Broch.* t. ii. p. 544.—Phosphorsaures Kupfer, *Leonhard,* Tabel. s. 61.—Cuivre phosphaté, *Brong.* t. ii. p. 227.—Phosphor Kupfer, *Karst.* Tabel. s. 64.—Cuivre phosphaté, *Haüy,* Tabl. p. 92. —Pseudo-Malachit, *Haus.* Handb. b. iii. s. 1035.—Phosphor Kupfererz, *Hoff.* b. iv. s. 183.—Phosphat of Copper, *Aikin,* p. 92.

External Characters.

Its principal colour is emerald-green, which passes into blackish-green; externally it is sometimes greenish-black.

It occurs massive, in imperfect reniform masses, with a very drusy surface, and in coarse fibrous distinct concretions, which are straight and scopiform. Also crystallized in oblique four-sided prisms of 110°.

The

The crystals are small and very small, superimposed and in druses.

Externally it is shining; internally it passes from shining, through glistening, to glimmering, and the lustre is resinous, inclining to pearly. It has an oblique double cleavage, in which the folia are parallel with the sides of the prism of 110°.

The fracture is splintery.

The fragments are wedge-shaped splintery, or indeterminate angular, and rather blunt-edged.

It is opaque.

Its streak is verdigris-green.

It is as hard as apatite.

It is brittle and easily frangible.

Specific gravity, 4.0, 4.3, *Mohs.*—4.070, *Hersart.*

Chemical Characters.

On the first impression of the heat it fuses into a brownish globule, which, by the further action of the blowpipe, extends on the surface of the charcoal, and acquires a reddish-grey metallic colour.

Constituent Parts.

Oxide of Copper,	-	68.13
Phosphoric Acid,	-	30.95
		99.08

Klaproth, Beit. b. iii. s. 201.

Geognostic and Geographic Situations.

Europe.—The principal locality of this rare mineral is Virneberg near Rheinbreitenbach on the Rhine, where it occurs along with quartz, calcedony, red copper-ore, and malachite.

lachit, in greywacke. It is said also to occur at Libethen near Neusohl, in Hungary, in a bed of copper-ore, along with quartz, in mica-slate.

America.—Farallon and Faluen in Chili *.

Observations.

It is distinguished from the other species of *Olivenite* by its dark external colour, form, and hardness.

2. Di-prismatic Olivenite, or Lenticular Copper.

Di-prismatischer Oliven-Malachit, *Mohs.*

Linsenerz, *Werner.*

Arseniate of Copper, in the form of an obtuse octahedron, *Bournon*, Phil. Trans. part i. 1801.—Linsenerz, *Mohs*, b. iii. s. 292. —Cuivre arseniaté obtus, *Brong.* t. ii. p. 230.—Linsenerz, *Karsten*, Tabel. s. 64.—Cuivre arseniaté primitif, *Haüy*, Tabl. p. 90.—Linsenerz, *Hoff.* b. iv. s. 165.—Linsenkupfer, *Haus.* Hand. b. iii. s. 1051.—Octahedral Arseniate of Copper, *Aikin*, p. 93.

External Characters.

Its colour is sky-blue, which sometimes passes into verdigris-green.

It scarcely occurs massive, generally crystallized:

1. Very oblique four-sided prism, acutely bevelled on the extremity, and the bevelling planes set on the obtuse lateral edges.
2. Very flat, longish, rectangular double four-sided pyramid,

* Heuland.

ramid, in which the lateral planes of the one are set on the lateral planes of the other *.

The crystals are middle-sized and small, and sometimes crystallized in druses.

Externally it is smooth and shining; internally glistening and shining, and pearly, inclining to vitreous.

The cleavage is in the directions of the lateral and bevelling planes of the oblique four-sided prism.

The fracture is small-grained uneven, which sometimes passes into imperfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent.

It yields a pale verdigris-green, or sky-blue coloured streak.

It is harder than gypsum, but not so hard as calcareous spar.

It is nearly brittle, and uncommonly easily frangible.

Specific gravity, 2.8, 2.9, *Mohs.*—2.881, *Bournon.*

Chemical Characters.

Before the blowpipe it is converted into a black friable scoria.

Constituent Parts.

Oxide of Copper,	-	49
Arsenic Acid,	-	14
Water,	- -	35
		98

Chenevix in Phil. Trans. for 1801.

Geognostic

* The double four-sided pyramid is so flat, that it has a lenticular aspect; hence the name *Lenticular Copper* given to this species.

Geognostic and Geographic Situations.

It has been hitherto found only in Cornwall, where it is associated with copper-mica, and other cupreous minerals.

Observations.

It is characterized by its colour, form, and hardness. Its colour, form, and inferior hardness, distinguish it from *Blue Copper*; and the latter character distinguishes it from *Azurite*, and other similar blue-coloured minerals.

3. Acicular Olivenite.

Nadelförmiger Oliven-malachit, *Mohs.*

This species is divided into four subspecies, viz. Radiated Acicular Olivenite, Foliated Acicular Olivenite, Fibrous Acicular Olivenite, and Earthy Acicular Olivenite.

First Subspecies.

Radiated Acicular Olivenite.

Strahlerz, *Werner.*

Cupreous Arseniate of Iron, *Bournon,* Phil. Trans. for 1801, part i. p. 191.—Cuivre arseniaté ferrifere, *Brong.* t. ii. p. 232. —Strahlenkupfer, *Karsten,* Tabel. s. 64.—Cuivre arseniaté ferrifere, *Haüy,* Tabl. p. 91.—Strahlenkupfer, *Haus.* Handbuch, b. iii. s. 1050.—Strahlerz, *Hoff.* b. iv. s. 168.—Martial Arseniate of Copper, *Aikin,* p. 93.

External

External Characters.

Externally its colour is dark verdigris-green, sometimes bordering on blackish-green; internally it is pale verdigris-green, either pure, or intermixed with sky-blue.

It occurs massive and flat reniform; also in radiated prismatic concretions, which are straight and scopiform; and crystallized in flat oblique four-sided prisms, acuminated with four planes; sometimes the acute edges are truncated, when the prism appears six-sided, or all the lateral edges are truncated, when it appears eight-sided.

The crystals are generally small, and superimposed.

The external surface of the reniform shape is very drusy.

Internally the lustre is intermediate between shining and glistening, and is pearly.

The fragments are wedge-shaped.

It is translucent on the edges.

It is as hard as calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, 3.400, *Bournon.*

Second Subspecies.

Foliated Acicular Olivenite.

Blättriches Olivenerz, *Werner.*

Arseniate of Copper, in the form of an acute octahedron, *Bournon,* Phil. Trans. part i. for 1801.—Cuivre arseniaté aigue, *Brong.* t. ii. p. 231.—Dichtes Olivenerz, *Karsten,* Tabel. s. 64.—Cuivre arseniaté octaedre aigue, *Haüy,* Tabl. p. 91.—Cuivre arseniaté en prisme tetraedre rhomboidal, *Bournon,* Catalogue Mineralogique, p. 254.—Gemeines Oliven Kupfer, *Haus.*

Haus. Handb. b. iii. s. 1045.—Blättriges Olivenerz, *Hoff.* b. iv. s. 171.—Prismatic Arseniate, *Aikin*, p. 94.

External Characters.

Its colour is dark olive-green, which passes on the one side into pistachio-green, on the other into blackish and leek-green.

It seldom occurs massive, and in angulo-granular concretions, generally in drusy crusts, and in small crystals, which present the following varieties of form:

1. Oblique four-sided prism, acutely bevelled on the extremities, the bevelling planes set on the acute lateral edges.
2. Preceding figure, in which the obtuse lateral edges are more or less deeply truncated.
3. Acute double four-sided pyramid; sometimes the angles on the common base are flatly bevelled; and the bevelling planes are set on the lateral edges.

The crystals are small and very small, and always superimposed.

The planes of the crystals are smooth, shining, and splendent.

Internally it is glistening, and the lustre is resinous, inclining to pearly.

The cleavage or foliated structure is imperfect.

The fracture is small and imperfect conchoidal, which passes into uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It ranges from translucent to translucent on the edges.

It yields an olive-green coloured streak.

It is as hard as calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity, 4.280, *Bournon*.—4.2, 4.6, *Mohs*.

Chemical Characters.

Before the blowpipe, it first boils, and then gives a hard reddish-brown scoria.

Constituent Parts.

Oxide of Copper,	-	60.0
Arsenic Acid,	- -	39.7
		99.7

Chenevix, Phil. Trans. 1801.

Geognostic and Geographic Situations.

It has been hitherto found only in the copper-mines of Cornwall.

Third Subspecies.

Fibrous Acicular Olivenite.

Fasriges Olivenerz, *Werner*.

Hæmatitiform and Amianthiform Arseniate, *Bournon*, Phil. Trans. for 1801.—Cuivre arseniaté capillaire et mamelonné, *Brong*. t. ii. p. 231, 232.—Fasriges Olivenerz, *Karsten*, Tabel. s. 64.—Cuivre arseniaté mamelonné fibreux, *Haüy*, Tabl. p. 91.—Cuivre arseniaté en petites masses habituellement fibreuses et mamelonnées, *Bournon*, Catalogue Mineralogique, p. 259.—Fasriges Oliven Kupfer, *Haus*. Handbuch, b. iii. s. 1047.—Fasriges Olivenerz, *Hoff*. b. iv. s. 173.—Hæmatitic and Amianthiform Arseniate, *Aikin*, p. 94.

External

External Characters.

Its colour is olive-green of different degrees of intensity. The darker varieties border on blackish-green, the lighter pass into pistachio-green, straw-yellow, liver-brown, wood-brown, and greenish-white.

The colours are sometimes arranged in curved and striped delineations.

It occurs massive, and reniform; in fibrous concretions which are delicate, straight, and scopiform, and these are collected into coarse or small granular concretions, and sometimes traversed by others, which are curved lamellar; also crystallized in capillary and acicular oblique four-sided prisms, in which the obtuse lateral edges are truncated, and bevelled on the extremities, the bevelling planes being set on the acute edges.

The crystals are small and very small, and sometimes scopiformly aggregated.

Internally the massive varieties are glistening or glimmering, with a pearly or silky lustre.

The fragments are intermediate angular, and wedge-shaped.

It is opaque, seldom translucent on the edges, and only translucent in the crystals.

It is as hard as calcareous-spar.

It is rather brittle.

The fibres are sometimes flexible *.

* The fibres are sometimes so delicate, so short, and so confusedly grouped together, that the whole appears like a dusty cottony mass, the true nature of which is discoverable only by the lens. At other times, this variety appears in thin laminæ, rather flexible, sometimes scarcely perceptible to the naked eye, sometimes tolerably large, and perfectly like Amianthus papyraceus.—*Bournon*, Phil. Trans. for 1801, part i. p. 180.

The streak is brown or yellow.

Specific gravity, between 4.100 and 4.200, *Bournon.*

Constituent Parts.

	Amianthiform.	Hæmatitiform.
Oxide of Copper, -	50	50
Arsenic Acid, -	29	29
Water, - -	21	21
	100	100

Chenevix, in Phil. Trans. for 1801.

Geognostic and Geographic Situations.

It is associated generally with the other arseniates of copper, and various ores of copper.

It occurs principally in Cornwall; it has been lately discovered in small quantity at Zinwald in Saxony, and, I believe, also in the Kaisersteimel, on the Rhine.

Fourth Subspecies.

Earthy Acicular Olivenite.

Cuivre arseniaté terreux, *Haüy*, Tabl. p. 91.—Erdiches Olivenkupfer, *Haus.* Handb. b. iii. s. 1049.

External Characters.

Its colours are olive-green, verdigris-green, and siskin-green.

It occurs massive, disseminated, and in crusts.

It is dull.

The

The fracture is fine earthy.

It sometimes occurs in concentric lamellar distinct concretions.

It is opaque.

It is soft and very soft.

Geognostic and Geographic Situations.

It occurs along with the other subspecies of olivenite in the copper-mines of Cornwall.

4. Hexahedral Olivenite, or Cube-Ore.

Wurfelerz, *Werner.*

Wurfelerz, *Reuss*, b. iv. s. 163. *Id. Lud.* b. i. s. 183.—Arsenik-saures Eisen, *Suck.* 2ter th. s. 297.—Wurfelerz, *Bert.* s. 420. *Id. Mohs*, b. iii. s. 437.—Fer arseniaté, *Lucas*, p. 148.—Wurfelerz, *Leonhard*, Tabel. s. 68.—Fer arseniaté, *Brong.* t. ii. p. 182. *Id. Brard*, p. 332.—Wurfelerz, *Karsten*, Tabel. s. 66. —Pharmakosiderit, *Haus.* s. 138.—Arseniate of Iron, *Kid*, vol. ii. p. 101.—Fer arseniaté, *Haüy*, Tabl. p. 100.—Pharmakosiderit, *Haus.* Handb. b. iii. s. 1066.—Wurfelerz, *Hoff* b. iv. s. 177.—Arseniate of Iron, *Aikin*, p. 107.

External Characters.

Its colour is pistachio-green, of different degrees of intensity, which passes on the one side into olive-green, on the other into blackish green; it rarely approaches to leek-green.

It occurs massive; and crystallized in the following figures:

1. Perfect cube.

2. Cube

2. Cube, in which four diagonally opposite angles are truncated.
3. Cube truncated on all the edges.
4. Cube truncated on all the edges and angles.

The crystals are small and very small, and always superimposed and in druses.

The planes of the crystals are smooth and splendent.

Internally it is glistening, and the lustre is intermediate between vitreous and resinous.

It has a cleavage which is parallel with the truncations on the angles.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent, or translucent on the edges.

The streak is straw-yellow.

It is harder than gypsum, but softer than calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity, 3.000, *Bournon*.—2.9, 3.0, *Mohs*.

Chemical Characters.

Before the blowpipe it melts, and gives out arsenical vapours.

Constituent Parts.

Iron, - -	48
Arsenic Acid,	18
Water of crystallization, -	32
Carbonate of Lime,	2 to 3
	100

Vauquelin, in Brong. Min. t. ii. p. 183.

Arsenic Acid,	31.0
Oxide of Iron,	45.5
Oxide of Copper,	9.0
Silica, - -	4.0
Water, -	10.5
	100

Chenevix, in Phil. Trans. for 1801.

Geognostic

Geognostic Situation.

It is found in veins, accompanied with ironshot quartz, copper-glance or vitreous copper, copper-pyrites, and brown iron-ore.

Geographic Situation.

It occurs in Tincroft, Carrarach, Muttrel, Huel-Gorland, and Gwenap mines in Cornwall; and at St Leonard, in the department of Haut-Vienne in France.

* Atacamite, or Muriate of Copper.

Salzkupfererz, *Werner.*

This species is divided into two subspecies, viz. Compact and Arenaceous.

First Subspecies.

Compact Atacamite, or Muriate of Copper (a).

Festes Salzkupfererz, *Werner.*

Cuivre muriaté massif, *Brong.* t. ii. p. 228.—Gemeines Salzkupfererz, *Karsten,* Tabel. s. 64.—Cuivre muriaté, *Haüy,* Tabl. p. 89.—Blättricher & Strahliger Smaragdochalzit, *Haus.* Handb. b. iii. s. 1039.—Salzkupfererz, *Hoff.* b. iv. s. 180.—Muriate of Copper, *Aikin,* p. 92.

External

(a) I place this mineral immediately after the Genus Olivenite, on account of its resemblance to it; but want of accurate information in regard to it, prevents me including it as a species of that genus.

External Characters.

Its colour is leek-green, which passes on the one side into blackish-green, on the other into pistachio-green.

It occurs massive, disseminated, imperfect reniform, in prismatic distinct concretions, which are short, small and scopiform, also in granular concretions; in crusts or investing; and in short needle-shaped crystals, of the following forms:

1. Oblique four-sided prism, bevelled on the extremities; the bevelling planes set on the acute lateral edges.
2. The preceding figure, in which the acuter lateral edges are deeply truncated, thus forming a six-sided prism.

Internally it is shining and glistening, and pearly.

It has an imperfect cleavage.

The fragments are indeterminate angular.

It is translucent on the edges.

It is soft.

It is brittle, and easily frangible.

Specific gravity, 4.4 ?

Chemical Character.

It tinges the flame of the blowpipe of a bright green and blue, muriatic acid rises in vapours, and a bead of copper remains on the charcoal. It is soluble in nitric acid without effervescence.

Constituent

Constituent Parts.

Oxide of Copper,	73.0	76.595
Water, - - -	16.9	12.767
Muriatic Acid, -	10.1	10.638
	100.0	100.000
	Klaproth, Beit. b. iii. s. 200.	*Proust*. in Journ. de Phy. t. 50. p. 63.

Geognostic and Geographic Situations.

It occurs in veins at Los Remolinos, La Soledad, Guasco, Caymas, and Ojanos, in Chili; also at Virneberg near Rheinbreitenbach on the Rhine, and at Schwarzenberg in Saxony. In the fissures of the lavas of Vesuvius, particularly those of the years 1804 and 1805.

Observations.

This mineral was first brought from Chili to Europe, by Mr Christian Heuland, brother of the present Mr Heuland, the first and principal collector of the minerals of that remote and interesting country.

Second Subspecies.

Arenaceous Atacamite, or Copper-Sand.

Kupfersand, *Werner*.

Cuivre muriaté pulverulent, *Haüy*, t. iii. p. 561. *Id. Brong*. t. ii. p. 229.—Sandiges Salzkupfer, *Karsten*, Tabel. s. 64.—Cuivre muriaté pulverulent, *Haüy*, Tabl. p. 89.—Sandiger Smaragdochalzit, *Haus*. Handb. b. iii. s. 1040.

External

External Characters.

Its colour is grass-green, inclining to emerald-green.

It occurs in scaly particles, which are shining, glistening, and pearly.

It does not soil.

It is translucent.

Constituent Parts.

Oxide of Copper, -	63	70.5
Water, - -	12	18.1
Muriatic Acid, -	10	11.4
Carbonate of Iron, -	1	
Mixed Siliceous Sand,	11	
	97	100.0
	La Rochefoucault, *Berthollet*, and *Fourcroy*, Mem. de l'Acad. 1786, p. 158.	*Proust*, Journ. de Phys. t. 50. p. 63.

Geognostic and Geographic Situations.

It is found in the sand of the river Lipes, 200 leagues beyond Copiapu, in the desart of Atacama, which separates Chili from Peru.

Observations.

It was brought from South America by the traveller Dombey.

GENUS IV.

GENUS IV. EMERALD COPPER.

Smaragd Malachit, *Mohs*.

THIS genus contains but one species, viz. Rhomboidal Emerald Copper, or Dioptase.

1. Rhomboidal Emerald Copper, or Dioptase.

Rhomboedrischer Smaragd-Malachite, *Mohs*.

Kupfer-Schmaragd, *Werner*.

Emeraudine, *Lam.* t. ii. p. 230.—Dioptase, *Haüy*, t. iii. p. 136. *Id. Broch.* t. ii. p. 511.—Achirite, *Hermann*, in Nov. Act. Petrop. xiii. 339.—Kupfersmaragd, *Reuss*, b. iii. s. 472. *Id. Lud.* b. i. s. 233. *Id. Mohs*, b. iii. s. 297. *Id. Leonhard*, Tabel. s. 69.—Cuivre dioptase, *Brong.* t. ii. p. 225.—Dioptase, *Brard*, p. 161. *Id. Karsten*, Tabel. s. 62. *Id. Haus.* s. 136.—Cuivre dioptase, *Haüy*, Tabl. p. 91.—Kupfersmaragd, *Hoff.* b. iv. s. 158.—Dioptas, *Haus.* Handb. b. iii. s. 1032.—Emerald Copper, *Aikin*, p. 91.

External Characters.

Its colour is emerald-green, which sometimes inclines to pistachio and blackish green.

It occurs only crystallized. The primitive form is a rhomboid of 123° 58′. The only secondary form at present known, is the equiangular six-sided prism, which is rather acutely

acutely acuminated on both extremities by three planes, which are set on the alternate lateral edges.

The lateral planes are smooth.

Internally it is shining, and the lustre is pearly.

It has a threefold cleavage, and the folia are parallel to the faces of the rhomboid, of which, however, only one is very distinct.

The fracture is small conchoidal.

It is translucent, passing to semi-transparent.

It is as hard as apatite.

It is brittle, and easily frangible.

Specific gravity, 3.300, *Haüy*.—3.3, 3.4, *Mohs*.

Chemical Characters.

It becomes of a chesnut-brown colour before the blow-pipe, and tinges the flame green, but is infusible; with borax it gives a bead or globule of copper.

Constituent Parts.

Oxide of Copper,	28.57		Oxide of Copper,	55
Carbonate of Lime,	42.85		Silica, -	33
Silica, -	28.57		Water, -	12
	99.99			100
Vauquelin, in Haüy, t. iii. p. 137.			*Lowitz*, in Nova Acta Petrop. xiii.	

Geognostic and Geographic Situations.

It is found, according to Hermann, in the land of the Kirguise, 125 leagues from the Russian frontier, where it is associated with fibrous and compact malachite, calcareous-spar, and limestone.

Observations.

Observations.

1. It was brought to Petersburgh about twenty-seven years ago by General Bogdanof, who obtained it from the discoverer, Achir Mahmed, a Bucharian merchant. La Metherie considered it as a kind of emerald, and named it *Emeraudine.* Hermann names it *Achirite,* from Achir Mahmed the merchant, who first brought it into Europe.

2. It is distinguished from *Emerald* by its higher specific gravity, and inferior hardness; and from green *Tourmaline,* by colour, and inferior hardness.

ORDER V.

ORDER V.—KERATE*.

GENUS I.—CORNEOUS SILVER.

THIS genus contains one species, viz. Hexahedral Corneous Silver. * Earthy Corneous Silver.

1. Hexahedral Corneous Silver.

Hornerz, *Werner.*

Argent muriaté, *Haüy.*

Minera Argenti cornea, *Wall.* t. ii. p. 331.—Argent corné, *Romé de Lisle,* t. ii. p. 463. *Id. De Born,* t. ii. p. 420.—Hornerz, *Wern.* Pabst. b. i. s. 29. *Id. Wid.* s. 691.—Corneous Silver-ore, *Kirw.* vol. ii. p. 113.—Hornerz, *Estner,* b. iii. s. 348.—*Id. Emm.* b. ii. s. 168.—Argent corné, *Lam.* t. i. p. 130.—La Mine cornée, ou L'Argent corné ou muriaté, *Broch.* t. ii. p. 127.—Argent muriaté, *Haüy,* t. iii. p. 418. 422.—Hornerz, *Reuss,* b. iii. s. 330. *Id. Lud* b. i. s. 212. *Id. Suck.* 2ter th. s. 137. *Id. Bert.* s. 364. *Id. Mohs,* b. iii. s. 134.—Argent muriaté, *Lucas,* p. 108.—Silber Hornerz, *Leonhard,* Tabel. s. 54.—Argent muriaté, *Brong.* t. ii. p. 256. *Id. Brard,* p. 250.—Hornerz, *Karsten,* Tabel. s. 60.—Muriate of Silver, *Kid,* vol. ii. p. 91.—Argent muriaté, *Haüy,* Tabl. p. 76.—Hornsilber, *Haus.* Handb. b. iii. s. 1010.—Hornerz, *Hoff.* b. iii. s. 51.—Horn-silver, *Aikin,* p. 80.

External

* *Kerate,* from the Greek word κερας, *horn,* given to it on account of the species resembling horn in general aepcct and tenacity.

External Characters.

Its most frequent colour is pearl-grey, from which it passes on the one side into violet-blue and lavender-blue, on the other into greyish, yellowish, and greenish-white, further, into siskin-green, asparagus-green, pistachio-green, and pale leek-green. On exposure to the light it becomes brownish.

It occurs massive, in prismatic and granular concretions, in thick flakes, disseminated, in egg-shaped pieces, which are hollow in the centre, and the hollows lined with crystals. The crystals are the following:

1. Cube.
   - *a*. Perfect.
   - *b*. Truncated on the edges.
   - *c*. Truncated on the angles.
2. Octahedron.
3. Rhomboidal dodecahedron.

The crystals are small and very small, and are occasionally aggregated in rows, or in a scalar-like form.

The external surface is smooth, and sometimes marked with little hollows.

Externally it is shining, but becomes gradually duller on exposure: internally it is intermediate between shining and glistening, and the lustre is resinous.

The fracture is conchoidal, and sometimes inclines to earthy.

The fragments are indeterminate angular and blunt-edged.

It is translucent, or only feebly translucent on the edges.

It retains its colour, and becomes more shining in the streak.

It is very soft.

It

It is malleable.
It is flexible, but not elastic.
Specific gravity 4.6.

Chemical Characters.

It is fusible in the flame of a candle: before the blowpipe, on charcoal, is reducible to a metallic globule, giving out at the same time vapours of muriatic acid; and when rubbed with a piece of moistened zinc, the surface becomes covered with a thin film of metallic silver.

Constituent Parts.

Silver, -	67.75	Silver, -	76.0
Muriatic Acid,	14.75	Muriatic Acid,	16.4
Oxygen,	6.75	Oxygen,	7.6
Oxide of Iron,	6.00		100.0
Alumina,	1.75		Id. s. 12.
Sulphuric Acid,	0.25		
	97.25		
	Klaproth, Beit. b. iv. s. 13.		

Geognostic Situation.

It occurs in silver veins, and generally in their upper part. These veins traverse gneiss, mica-slate, clay-slate, grey-wacke, porphyry, and limestone, and contain, besides the corneous silver, the following metalliferous and earthy minerals, viz. silver-glance or sulphuretted silver, and iron-ochre; more rarely native silver, earthy cobalt-ochre, red silver, tile-ore, malachite, blue copper, white lead-spar, iron-pyrites, galena, atacamite, copper-green, grey copper, and

and hornstone; also calcareous-spar, heavy-spar, and quartz.

Geographic Situation.

Europe.—At Huel-Mexico in Cornwall: in France and Saxony *, in veins that traverse gneiss, mica-slate, and clay-slate, where it is associated with silver-glance or sulphureted silver, and iron-ochre, and more rarely with native silver; at Schemnitz in Hungary, in massive quartz, along with fibrous malachite, silver-glance or sulphureted silver-ore, and white lead-spar; in the mountain of Chalanches, in calcareous-spar, and accompanied with silver-glance, native silver, and more rarely with earthy cobalt-ochre, and red silver.

Asia.—In Siberia, it occurs along with native gold, common and auriferous native silver, silver-glance, malachite, blue copper, tile-ore, white lead-spar, hornstone, calcareous-spar, heavy-spar, quartz, and sometimes lithomarge. These veins appear to traverse limestone.

America.—This mineral, which is so seldom found in Europe, is very abundant in the mines of Catorce, Fresnillo, and the Cerro San Pedro, near the town of San Luis Potosi. That of Fresnillo is frequently of an olive-green colour, which passes into leek-green. In the veins of Catorce, the corneous silver is accompanied with yellow lead-spar and green lead-spar.

* Large masses of corneous silver were dug out of the Saxon mines in the sixteenth century.

* Earthy Corneous Silver-Ore (*a*).

Erdiges Hornerz, *Karsten*.

Id. Karsten, in Magazin der Naturforschender Freünde zu Berlin, b. i. s. 159. *Id. Karsten*, Tabel. s. 60.

External Characters.

Internally the colour is pale mountain-green, inclining to greyish-white; externally it has a bluish-grey tarnish.

It occurs in thick crusts.

Internally it is dull.

The fracture is coarse and fine earthy.

The fragments are blunt-angular.

It is very soft, almost friable.

The streak is shining and resinous.

It is sectile.

It is heavy.

Constituent Parts.

Silver,	- - -	24.64
Muriatic Acid,	- -	8.28
Alumina, with a trace of Copper,	- -	67.08
		100.00

Klaproth, Beit. b. i. s. 137.

Geognostic

(*a*) This mineral appears to be a mechanical mixture of corneous silver and clay, and hence it is placed beside it, but not as a variety of the species.

Geognostic and Geographic Situations.

It is found in veins that traverse transition rocks at Andreasberg in the Hartz.

Observations.

1. It sometimes occurs in a fluid form, in veins and drusy cavities, when it is said to resemble butter-milk: hence the German name *(Buttermilcherze)* given to it.

2. It appears to be an intimate mixture of corneous silver-ore and clay.

3. It was first discovered in the Hartz in the year 1576, and continued to be found until the year 1617; since that period, it has almost disappeared, and therefore is at present a very rare mineral.

GENUS II.—CORNEOUS MERCURY.

Perl Kerate, *Mohs.*

THIS Genus contains one species, viz. Pyramidal Corneous Mercury.

1. Pyramidal Corneous Mercury.

Pyramidales Perl Kerate, *Mohs.*

Quecksilber Hornerz, *Werner.*

Mercure muriaté, *Haüy.*

Woulfe, in Phil. Trans. lxvi. ii. 618.—Mercure corné, ou Mercure doux volatile, *Romé de Lisle*, t. iii. p. 161.—Quecksilber hornerz, *Wern.* Pabst. b. i. s. 7. *Id. Wid.* s. 724.—Mercury mineralized by the Vitriolic and Marine Acids, *Kirw.* vol. ii. p. 266.—Quecksilber hornerz, *Estner*, b. iii. s. 275. *Id. Emm.* b. ii. s. 136.—Mercure corné, *De Born*, t. ii. p. 399. *Id. Lam.* t. i. p. 168.—La Mine de Mercure cornée, ou le Mercure muriaté, *Broch.* t. ii. p. 101.; Mercure muriaté, t. iii. p. 447.—Quecksilber Hornerz, *Reuss*, b. i. s. 277. *Id. Lud.* b. i. s. 206.—Salziges Quecksilber, *Suck.* 2ter th. s. 112.—Quecksilber-hornerz, *Bert.* s. 434. *Id. Mohs*, b. iii. s. 91. *Id. Leonhard*, Tabel. s. 52.—Mercure muriaté, *Brong.* t. ii. p. 244. *Id. Brard*, p. 260.—Quecksilber-hornerz, *Karsten*, Tabel. s. 60.—Horn-quecksilber, *Haus.* s. 134.—Muriate of Quicksilver, *Kid*, vol. ii. p. 97.—Mercure muriaté, *Haüy*, Tabl. p. 78.—Horn-quecksilber, *Haus.* Handb. b. iii. s. 1017. —Quecksilber-hornerz, *Hoff.* b. iii. s. 25.—Horn Quicksilver, *Aikin*, p. 83.

External Characters.

Its colour is ash-grey, of various degrees of intensity, which passes into yellowish-grey, and from this into greyish-white, and even sometimes inclines to greenish-grey.

It occurs very rarely massive, almost always in small vesicles, which are crystallized in the interior.

The crystals are the following:

1. Rectangular four-sided prism, acuminated on the extremities with four planes, which are set on the lateral planes.

2. Rectangular

2. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges.
3. Double four-sided pyramid.

The crystals are always so minute, that it is with difficulty their forms can be determined. Their external surface is sometimes smooth, sometimes drusy, and is in general shining and adamantine.

Internally it is shining, with an adamantine lustre.

It has a single cleavage, which appears to be parallel with the terminal plane of the prism.

It is faintly translucent, or only translucent on the edges.

It is soft, approaching to very soft.

It is sectile, and easily frangible.

Chemical Characters.

It is totally volatilized before the blowpipe, and emits a garlic smell. It is soluble in water, and the solution mixed with lime-water gives an orange-coloured precipitate.

Constituent Parts.

Oxide of Mercury, -	76.00
Muriatic Acid, - -	16.40
Sulphuric Acid, - -	7.60
	100.00 *Klaproth.*

Geognostic Situation.

In the quicksilver mines of the Palatinate, and the Dutchy of Deux Ponts, it is accompanied with native mercury, cinnabar, ochry brown iron-ore, seldomer with fibrous malachite, massive and crystallized blue copper, massive grey copper, in cavities of an iron-shot clayey sandstone, sometimes in clay ironstone, and red iron-ore. That

at

at Idria, occurs in cavities of an indurated clay, accompanied with crystals of cinnabar; sometimes in slate-clay, which is traversed with small veins of cinnabar.

Geographic Situation.

It occurs at Horzowitz in Bohemia; Moschellandberg in Deux Ponts; Morsfeld in the Palatinate; Rutha in Upper Hessia; and at Almaden in Spain.

Observations.

It was discovered about thirty-five years ago in the mines of the Palatinate by Mr Woulfe.

ORDER VI.

ORDER VI. BARYTE.

GENUS I. LEAD-SPAR.

Blei Baryt, *Mohs.*

THIS genus contains five species, viz. 1. Tri-prismatic Lead-spar, 2. Pyramidal Lead-spar, 3. Prismatic Lead-spar, 4. Rhomboidal Lead-spar, 5. Di-prismatic Lead-spar. * Corneous Lead. Arseniat of Lead. Native Minium.

1. Tri-prismatic Lead-Spar, or Sulphate of Lead.

Tri-prismatischer Blei Baryt, *Mohs.*

Vitriol Bleierz, *Werner.*

Plomb Sulphaté, *Haüy.*

Native Vitriol of Lead, *Kirw.* vol. ii. p. 211.—Natürlicher Bleivitriol, *Emm.* b. ii. s. 413. & b. iii. s. 366.—Sulphate de Plomb, *Lam.* t. i. p. 211.—Le vitriol de Plomb natif, *Broch.* t. ii. p. 325.—Plomb sulphaté, *Haüy,* t. iii. p. 503.—Bleivitriol, *Reuss,* b. iv. 2. s. 264. *Id. Lud.* b. i. s. 264. *Id. Suck.* 2r th. s. 32. *Id. Bert.* s. 452. *Id. Mohs,* b. iii. s. 547.—Plomb sulphaté, *Lucas,* p. 121.—Bleivitriol, *Leonhard,* Tabel. s. 73. —Plomb sulphaté, *Brong.* t. ii. p. 200. *Id. Brard,* p. 275. —Bleivitriol, *Karsten,* Tabel. s. 68. *Id. Haus.* s. 140.— Sulphat of Lead, *Kid,* vol. i. p. 140.—Plomb sulphaté, *Haüy,* Tabl. p. 83.—Bleivitriol, *Haus.* Handb. b. iii. s. 1113.—Vitriol-bleierz, triolbleierz, *Hoff.* b. iv. s. 41.—Sulphat of Lead, *Aikin*, p. 113.

External Characters.

Its colours are yellowish and greyish white, and these are occasionally stained pale-yellowish, from brown iron-ochre.

It occurs massive, disseminated, and in angulo-granular distinct concretions, but most frequently crystallized.

In the primitive form, the vertical prism is 120°; the horizontal prism in the direction of the longer diagonal 70° 31′, and in the direction of the smaller diagonal 101° 32′. The following are the principal crystallizations, described according to the Wernerian method:

1. Oblique four-sided prism, acutely bevelled on the extremities, and the bevelling planes set on the acuter lateral edges. Fig. 124. Pl. 6.
   - *a.* The obtuse lateral edges more or less deeply truncated. Fig. 125. Pl. 6.
   - *b.* The angles of the bevelment bevelled, and the bevelling planes set on the lateral planes.
   - *c.* The angles of the bevelment truncated.

     When the prism No. 1. becomes lower, so that the acuter lateral edges terminate in angles, there is formed
2. A broad rectangular four-sided pyramid.

The crystals are small and very small, seldom middle sized; and occur in druses, or superimposed.

Externally it is splendent and shining; internally shining, and the lustre adamantine.

Its cleavage is in the direction of the planes of the prisms.

The fracture is small conchoidal.

The

The fragments are indeterminate angular, and rather blunt edged.

It alternates from transparent to translucent.

It is as hard as calcareous-spar.

Its streak is white.

It is rather brittle, and easily frangible.

Specific gravity, 6.300, *Klaproth*.

Chemical Characters.

It decrepitates before the blowpipe, then melts, and is soon reduced to the metallic state.

Constituent Parts.

	From Anglesey.	Wanlockhead.		Zellerfeldt.
Oxide of Lead, -	71.0	70.50	Oxide of Lead,	72.914
Sulphuric Acid,	24.8	25.75	Sulphuric Acid,	26.019
Water of crystallization,	2.0	2.25	Water, -	0.124
Oxide of Iron, -	1.0		Oxide of Iron,	0.115
			Oxide of Manganese, -	0.165
	98.8	98.05	Silica and Alumina,	trace.
				99.799

Klaproth, Beit. b. iii. s. 164. & 166.

Stromeyer, Gott. Gel. anz. 812. 204.

Geognostic and Geographic Situations.

It occurs in veins along with galena or lead-glance, and different spars of lead, at Wanlockhead in Dumfriesshire, and Lead Hills in Lanarkshire; at Pary's Mine in Anglesey, and Penzance in Cornwall. On the Continent, it is met with at Zellerfeld in the Hartz, in veins that traverse clay-slate and grey-wacke, associated with quartz, calcareous-spar, brown-spar, heavy-spar, brown iron-ore, copper-green, blue copper, green lead-spar, and white lead-spar; in in the Westerwald mountains; and in lead-mines in Andalusia in Spain.

Asia.—In Siberia.

America.—In the neighbourhood of Southampton in the United States *.

Observations.

Form, lustre, and weight, are the principal characters of this mineral. It is distinguished from *White Lead-spar* by its crystallizations and inferior specific gravity; from *Columnar Heavy Spar* and *Celestine* by its greater weight.

2. The *Bleiglas* of Dr John, in most of its varieties, appears to belong to this species.

3. A reniform variety of this mineral, named *Bleinierè*, occurs along with reniform arseniate of lead, at Nertschinsky in Siberia.

2. Pyramidal Lead-Spar, or Yellow Lead-Spar.

Pyramidal Blei-Baryt, *Mohs.*

Gelb Bleierz, *Werner.*

Plomb molybdaté, *Haüy.*

Oxide de Plomb spathique jaune, *De Born,* t. ii. p. 379.—Yellow Lead-spar, *Kirw.* vol. ii. p. 212.—Gelbes Bleierz, *Emm.* b. ii. s. 403.—Plomb molybdaté, *Haüy,* t. iii. p. 498.—La Mine de Plomb jaune, ou Le Plomb jaune, *Broch.* t. ii. p. 322. —Gelb Bleierz, *Reuss,* b. iv. s. 236. *Id. Mohs,* b. iii. s. 535. Plomb molybdaté, *Brong.* t. ii. p. 205.—Molybdate of Lead, *Kid.* vol. ii. p. 139.—Bleigelb, *Haus.* Handb. b. iii. s. 1100. —Gelb-bleierz, *Hoff.* b. iv. s. 36.—Molybdate of Lead, *Aikin,* p. 115.

External

* Bruce's American Mineralogical Journal, p. 150.

External Characters.

Its most frequent colour is wax-yellow; from which it passes, on the one side, into lemon-yellow and orange-yellow, on the other side, into yellowish-brown and yellowish-grey; sometimes of a colour which is intermediate between yellowish-white and greyish-white.

It occurs massive, in crusts, cellular; and crystallized in the following figures:

Its primitive form is a pyramid, in which the angles are 99° 40′, and 131° 45′ *. Fig. 126. Pl. 6. The following are its secondary figures:

1. The pyramid truncated on the angles and summits †. Fig. 127. Pl. 6.
2. The pyramid so deeply truncated on the summits, and on the common base, that the original faces disappear, when there is formed a rectangular parallelopiped, which is either tabular, or in the form of a cubical prism ‡, as in fig. 128. Pl. 6.
3. The pyramid so deeply truncated in all the angles, and on the common base, that the original faces disappear, when there is formed a regular eight-sided table ||. Fig. 129. Pl. 7., which is sometimes so thick as to appear as an eight-sided prism. Sometimes four of the terminal edges are truncated, when a twelve-sided table is formed. Fig. 130. Pl. 7.

4. Pyramid

* Plomb molybdaté primitif, Haüy.

† Plomb molybdaté epointé, Haüy.

‡ Plomb molybdaté bis-unitaire, Haüy.

|| Plomb molybdaté tri-unitaire, Haüy.

4. Pyramid deeply truncated on the summits, and on the common base, and the angles of the common base bevelled, which gives rise to the rectangular four-sided table, bevelled on the terminal edges.
5. Pyramid truncated on the lateral edges, which gives rise to the double eight-sided pyramid. When this figure is deeply truncated on the summits, there is formed
6. A regular eight-sided table, bevelled on the terminal planes.

The tables are usually broad and thin, and alternate from small to very small, but are seldom middle-sized. They frequently intersect each other, and are often closely aggregated.

Externally it is generally splendent or shining; internally it is shining or glistening, and the lustre resinous, inclining to adamantine.

The cleavage is fourfold, and the folia are in the direction of the sides of the primitive form. There is what is termed a fifth cleavage, in the direction of the common base.

The fracture is small and fine-grained uneven, or small conchoidal.

The fragments are indeterminate angular, and rather sharp edged.

It is generally translucent, or only translucent on the edges; some rare crystals are semitransparent.

It is as hard as calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity, 5.706, *Hatchet*.—6.5, 6.8, *Mohs*.

Chemical

Chemical Characters.

It decrepitates before the blowpipe, and then melts into a dark greyish-coloured mass, in which the globules of reduced lead are dispersed. With borax, it forms a brownish-yellow bead; but when in small proportions, and heated by the interior flame, it occasionally produces a glass, which is greenish-blue, and sometimes deep blue.

Constituent Parts.

Klaproth was the first who made us acquainted with the chemical composition of this ore; but we are indebted to our celebrated countryman Hatchett, for the most complete and accurate analysis of it.

Oxide of Lead,	64.42
Molybdic Acid,	34.25
	98.67

Klaproth, Beit. b. ii. s. 275.

Oxide of Lead,	58.40
Molybdic Acid,	38.00
Oxide of Iron,	2.08
Silica, - -	0.28
	96.66

Hatchett, Phil. Trans. for 1796.

Geognostic and Geographic Situations.

Europe.—It occurs at Bleiberg in Carinthia, in a compact limestone, which is much traversed by veins of calcareous spar, and is associated with galena, white, black, and green lead-spar, calamine, malachite, calcareous-spar, and fluor-spar; also in the Maukeriz, near Brixlegg in the Tyrol, along with brown iron-ore, and red copper-ore; at Annaberg in Austria, and Rezbanya in Transylvania.

America.

America.—In Pennsylvania, at the Perkiomen lead-mine, and at the Southampton lead-mine in Massachusets *; in compact limestone at Zimapan in Mexico.

Observations.

This mineral is well characterized by its colour, crystallization, fracture, lustre, hardness, and weight. It is distinguished from the yellow varieties of *Green Lead-spar*, by form of its crystals, and inferior specific gravity, and fracture; from *White Lead-spar*, by the form of its crystals, and colours.

3. Prismatic Lead-Spar, or Red Lead-Spar.

Prismatischer Blei-Baryt, *Mohs.*

Roth-Bleierz, *Werner.*

Plomb chromaté, *Haüy.*

Minera Plumbi rubra, *Wall.* t. ii. p. 309.—Rothes Bleierz, *Werner,* Pabst. b. i. s. 127. *Id. Wid.* s. 861.—Red Lead-spar, *Kirw.* vol. ii. p. 214.—Oxide de Plomb spathique rouge, *De Born,* t. ii. p. 376.—Rothes Bleierz, *Emm.* b. ii. s. 399.—Oxide rouge de Plomb, *Lam.* t. i. p. 287.—Plomb chromaté, *Haüy,* t. iii. p. 476.—La Mine de Plomb rouge, ou Le Plomb rouge, *Broch.* t. ii. p. 318.—Rothbleierz, *Mohs,* b. iii. s. 527. Plomb chromé, *Brong.* t. ii. p. 205.—Kallochrom, *Haus.* s. 139. —Chromate of Lead, *Kid,* vol. ii. p. 143.—Plomb chromaté, *Haüy,* Tabl. p. 81.—Kallochrom, *Haus.* Handb. b. iii. s. 1084. —Rothbleierz, *Hoff.* b. iv. s. 33.—Chromate of Lead, *Aikin,* p. 116.

External Characters.

Its only colour is hyacinth-red, which is more or less deep or pale.

It

* Cleaveland's Mineralogy.

It seldom occurs massive, generally in flakes; and crystallized:

1. Long slightly oblique four-sided prism.
2. The preceding figure, in which the terminal planes are set obliquely on the lateral edges.
3. The prism acutely and obliquely bevelled on the extremities, the bevelling planes set on the lateral edges.
4. The prism acuminated with four planes, which are set on the lateral planes.
5. The prism truncated on the lateral edges; sometimes bevelled on two opposite lateral edges.

The crystals are generally small, thin, and always superimposed.

The lateral planes formed by bevelment are longitudinally streaked, the other planes smooth, and are shining or splendent.

Internally it is shining or splendent, and the lustre is adamantine.

The cleavage is double, and the folia appear to be in the direction of the planes of an oblique four-sided prism.

The fracture is small-grained uneven, sometimes passing into imperfect and small conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is more or less translucent.

It gives a streak, which is of a colour intermediate between lemon-yellow and orange-yellow.

It is harder than gypsum, but softer than calcareous spar.

It is almost sectile, and easily frangible.

Specific gravity, 6.056, *Brisson*.—6.0–6.1, *Mohs*.

Chemical

Chemical Characters.

Before the blowpipe, it crackles and melts into a grey slag. With borax, it is partly reduced. It does not effervesce with acids.

Constituent Parts.

Oxide of Lead,	-	63.96
Chromic Acid,	-	36.40
		100.36

Vauquelin, Journ. des Mines, n. 34. 737

Geognostic and Geographic Situations.

It occurs in veins in gneiss, in the gold mines of Beresofsk, in the Uralian Mountains. In these mines, it is associated with brown iron-ore, cubes of iron-pyrites, native gold, green lead-spar, galena, and quartz. It is reported to have been found at Tarnowitz in Silesia, in secondary rocks; and I understand it has been brought from Mexico and Brazil *.

Use.

In Russia, a very beautiful and costly orange-yellow colour is prepared from it, and which is used by painters.

Observations.

1. It is distinguished from *Red Orpiment*, by the form of its crystals, its colour, cleavage, and superior weight; from *Red Silver*, by its colour, form, inferior specific gravity,

* Heuland.

vity, and yellow-coloured streak; and from *Cinnabar*, by the colour of its streak.

2. It was first made known to European naturalists in the year 1766 by M. Laxman. *Lehmann.*

3. The red lead-spar is sometimes accompanied with a mineral having a yellowish or liver-brown colour, with botryoidal and stalactitic forms, and is also a compound of oxide of lead and chromic acid. Green-coloured crystals sometimes accompany the red lead-spar, which are said to be compounds of oxides of lead and of chrome.

4. Rhomboidal Lead-Spar.

Rhomboedrisches Blei Baryt, *Mohs.*

This species contains two subspecies, viz. Green Lead-Spar and Brown Lead-Spar.

First Subspecies.

Green Lead-Spar.

Grün Bleierz, *Werner.*

Plomb phosphaté, *Haüy.*

Minera Plumbi viridis, *Wall.* t. ii. p. 308.—Grün Bleyerz, *Wern.* Pabst. b. i. s. 123. *Id. Wid.* s. 857.—Phosphorated Lead-ore, *Kirw.* vol. ii. p. 207.—Oxide de Plomb spathique verte, Phosphaté de Plomb, *De Born*, t. ii. p. 377.—Grün Bleyerz, *Emm.* b. ii. s. 394.—Plomb phosphaté, *Haüy*, t. iii. p. 490.—La Mine de Plomb verte, ou le Plomb verte, *Broch.* t. ii. p. 314.—Grünbleierz, *Reuss*, b. iv. s. 216. *Id. Lud.* b. i. s. 262. *Id.*

Id. Suck. 2ter th. s. 331. *Id. Bert.* s. 455. *Id. Mohs*, b. iii. s. 517. *Id. Leonhard*, Tabel. s. 72.—Plomb phosphaté, *Brong.* t. ii. p. 200. *Id. Brard*, p. 271.—Gemeines Phosphorblei, (in part), *Karst.* Tabel. s. 68.—Phosphate of Lead, *Kid*, vol. ii. p. 141.—Plomb phosphaté, *Haüy*, Tabl. p. 82.—Grünbleiers, *Hoff.* b. iv. s. 27.—Phosphate of Lead, *Aikin*, p. 112.

External Characters.

Its colour is grass green, which passes on the one side through pistachio-green, blackish, olive, oil, and siskin green, into sulphur-yellow; on the other side, through asparagus-green, yellowish-white, into greenish-white. Some varieties approach to leek-green. The olive and pistachio green colours are the most common. Sometimes several colours occur together in the same specimen, even in the same crystal.

It seldom occurs massive, sometimes stalactitic, reniform and botryoidal, sometimes in distinct concretions, which are granular or prismatic; but most commonly crystallized. The primitive form is a di-rhomboid, or a flat equiangular double six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other. The angles are 141° 47′ and 81° 46′. The following are the secondary forms:

1. Equiangular six-sided prism *. Fig. 131. Pl. 7.
2. Six-sided prism, truncated on all the lateral edges, thus forming a twelve-sided prism †. Fig. 132. Pl. 7.
3. Six-sided prism, flatly acuminated on the extremities

* Plomb phosphaté prismatique, Haüy.

† Plomb phosphaté peridodecaedre, Haüy.

ties with six planes, which are set on the lateral planes *. Fig. 133. Pl. 7.

4. Six-sided prism, in which the terminal edges are truncated †. Fig. 134. Pl. 7.
5. When the six-sided prism becomes very low, an equiangular six-sided table is formed. The lateral edges of the table are sometimes truncated, and then the table appears acutely bevelled on the terminal planes, and has sometimes a lenticular appearance.
6. Sometimes the lateral planes of the six-sided prism are bent towards the extremities of the prism: when the prism is short, it appears bulging, but when long, it has an acute pyramidal form. These crystals are hollow at their ends.

The crystals are small and very small, seldom middle-sized; they are superimposed, in druses, or scalarwise or rose-like aggregated. Sometimes they form velvety or moss-like drusy crusts.

Externally it is smooth and shining, or splendent; internally glistening, and the lustre is resinous.

Cleavages are to be observed in the direction of the planes of the di-rhomboid, and also parallel with the planes of the six-sided prism.

The fracture is small-grained uneven, passing on the one hand into splintery, on the other into conchoidal.

The fragments are indeterminate angular, and blunt-edged.

It is more or less translucent, seldom nearly transparent, and is sometimes only translucent on the edges.

* Plomb phosphaté trihexaedre, Haüy.

† Plomb phosphaté annulaire, Haüy.

It is harder, than calcareous-spar, and sometimes as hard as fluor-spar.

It is brittle, and easily frangible.

Specific gravity, 6.9411, from the Breisgau, *Haüy*.—6.9–7.2, *Mohs*.

Chemical Characters.

It dissolves in acids without effervescence. Before the blowpipe, on charcoal, it usually decrepitates, then melts, and on cooling, forms a polyhedral globule, the faces of which present concentric polygons: if this globule be pulverized, and mixed with borax, and again heated, a milk-white opaque enamel is partly formed; on continuance of the heat, the globule effervesces, and at length becomes perfectly transparent, the lower part of it being studded with globules of metallic lead.

Constituent Parts.

	Zschoppau.	Hoffsgrund.	Wanlockhead.
Oxide of Lead,	78.40	77.10	80.00
Phosphoric Acid,	18.37	19.00	18.00
Muriatic Acid,	1.70	1.54	1.62
Oxide of Iron,	0.10	0.10	a trace.
	98.57	97.74	99.96

Klaproth, Beit. b. iii. s. 153.—161.

	Johangeorgenstadt.
Oxide of Lead,	76.8
Phosphoric Acid,	9.0
Muriatic Acid,	7.0
Arsenic Acid,	4.0
Water, -	1.5
	98.3

Laugier, Ann. du Mus. t. vi. p. 171.

Geognostic Situation.

It occurs in veins and beds in primitive, transition, and secondary rocks. It generally occupies the upper part of the veins; and it is associated with brown iron-ochre, galena or lead-glance, white lead-spar, heavy-spar, quartz, and

and other minerals. It appears to be a newer formation than galena, or even white lead-spar, and seems to belong principally to that formation of galena which contains but little silver.

Geographic Situation.

Europe.—It occurs along with galena or lead-glance, and other ores of lead, at Leadhills and Wanlockhead. In England, it is met with at Alston in Cumberland, Allonhead, Grasshill, and Teesdale, in Durham, and Nithisdale in Yorkshire. On the Continent, it is found in several of the mines in the Hartz; also at Zschoppau in Saxony; Prizbram in Bohemia; Hoffsgrund in the Breisgau; and Erlenbach in Alsace.

Asia.—In the lead-mines in Siberia; and in those of Beresof.

America.—In the Perkiomen mine in Pennsylvania.

Observations.

1. Green lead-spar, when it has a very pale greenish-white colour, is apt to be confounded with White Lead-spar; but we can distinguish them by the following characters:—*a.* The prisms of green lead-spar are generally equiangular, but those of white lead-spar are unequiangular. *b.* Its lustre is resinous, but that of white lead-spar is adamantine. *c.* It is harder than white lead-spar. *d.* Its crystals are often scalarwise aggregated, which is never the case with white lead-spar. *e.* Its prisms are generally shorter than those of white lead-spar; and this mineral does not effervesce with acids, which is the case with white lead-spar, and is not reduced to the metallic state before the blowpipe without addition.

2. It

2. It is distinguished from *Apatite* by its cleavage, inferior hardness, and greater specific gravity; from *Malachite*, and *Olivenite*, by its green colours, cleavage, and greater weight.

Second Subspecies.

Brown Lead-Spar.

Braun Bleierz, *Werner*.

Plomb phosphaté, *Haüy*.

Id. Wern. Pabst. b. i. s. 115. *Id. Wid.* s. 848.—Brown Lead-ore, *Kirw.* vol. ii. p. 222.—Braun Bleyerz, *Emm.* b. i. s. 283. La Mine de Plomb brune, *Broch.* t. ii. p. 305.—Braun Bleierz, *Reuss*, b. i. s. 212. *Id. Lud.* b. i. s. 260. *Id. Suck.* 2ter th. s. 323. *Id. Bert.* s. 454. *Id. Mohs*, b. iii. s. 489. *Id. Leonhard*, Tabel. s. 71.—Gemeiner Phosphorblei, *Karsten*, Tabel. (in part), s. 68.—Plomb phosphaté, *Haüy*, Tabl. p. 82.—Gemeiner Pyromorphit, *Haus.* b. iii. s. 1090.—Braun Bleierz, *Hoff.* b. iv. s. 15.—Brown Phosphate of Lead, *Aikin*, p. 113.

External Characters.

Its colour is clove-brown, of different degrees of intensity, rarely approaching to liver-brown, sometimes so pale that it inclines to white.

It occurs massive, also in distinct concretions, which are thin prismatic, and curved lamellar; and crystallized in the following figures:

1. Equiangular six-sided prism, which is sometimes bulging.
2. Preceding figure, in which the lateral planes are alternately

ternately broad and narrow, and sometimes the lateral edges are truncated.

3. Six-sided prism, converging towards both ends, and thus inclining to the pyramidal form.
4. Acute double three-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and in which the common basis is sometimes more or less deeply truncated. It originates from the bulging six-sided prism, in which the alternate lateral planes have disappeared.

The crystals are middle-sized, and small, are sometimes short and acicular, and singly imbedded, or scopiformly or globularly aggregated.

The surface of the crystals is sometimes blackish or yellowish brown, and rough.

Internally it is glistening, and the lustre is resinous.

The fracture is small and fine-grained uneven, and sometimes passes into small splintery.

The fragments are indeterminate angular.

It is feebly translucent, or translucent on the edges.

It is as hard as green lead-spar.

The streak is greyish-white.

It is rather brittle, and easily frangible.

Specific gravity, 6.974, *Wiedeman.*—6.909, from Huelgoët, *Haüy.*

Chemical Characters.

It melts pretty easily before the blowpipe without being reduced, and during cooling shoots into acicular crystals. It does not effervesce with nitric acid, but is soluble in it.

Constituent

[illegible]

[illegible]	-	[illegible]
[illegible]	-	[illegible]
[illegible]	- -	[illegible]
		[illegible]

[illegible]

Geognostic Situation.

[illegible] gneiss, clay-slate, and [illegible] malachite, [illegible] and quartz.

Geographic Situation.

Europe.—It is found at Mies in Bohemia; near Schemnitz in Hungary; Saska in the Bannat; Zschoppau in Saxony; Huelgoet and Poullaouen in Lower Brittany.

America.—Zimapan in Mexico.

5. Di-prismatic Lead-Spar.

Di-prismatischer Blei-Baryt, *Mohs.*

This species is divided into three subspecies, viz. White Lead-Spar, Black Lead-Spar, and Earthy Lead-Spar.

First

First Subspecies.

White Lead-Spar.

Weiss-Bleierz, *Werner.*

Plomb carbonaté, *Haüy.*

Minera Plumbi alba spathosa, *Wall.* t. ii. p. 307.—Mine de Plomb blanche, *Romé de Lisle,* t. iii. p. 380.—Weiss Bleyerz, *Wern.* Pabst. b. i. s. 118. *Id. Wid.* s. 852.—Plomb spathique blanc, *De Born,* t. ii. p. 368.—White Lead-ore, *Kirw.* vol. ii. p. 203.—Weiss Bleyerz, *Emm.* b. ii. s. 388.—Plomb blanc, *Lam.* t. i. p. 305.—Plomb carbonaté, *Haüy,* t. iii. p. 475.—La Mine de Plomb blanche, ou le Plomb blanc, *Broch.* t. ii. p. 309.—Weissbleierz, *Reuss,* b. iv. s. 245. *Id. Lud.* b. i. s. 261. *Id. Suck.* 2ter th. s. 326. *Id. Bert.* s. 459. *Id. Mohs,* b. iii. s. 493.—Kohlenstoffsaures Bleierz, *Hab.* s. 128.—Plomb carbonaté, *Lucas,* p. 117.—Weissbleierz, *Leonhard,* Tabel. s. 71. —Plomb carbonaté, *Brong.* t. ii. p. 198. *Id. Brard,* p. 268. —Lichter Bleispath, *Karsten,* Tabel. s. 68.—Spathiges Bleiweiss, *Haus.* s. 114.—Crystallized Carbonate of Lead, *Kid,* vol. ii. p. 136.—Plomb carbonaté, *Haüy,* Tabl. p. 81.—Bleiweiss, *Haus.* Handb. b. iii. s. 1107.—Weissbleierz, *Hoff.* b. iv. s. 21.—Carbonate of Lead, *Aikin,* p. 110.

External Characters.

Its colours are snow-white, greyish-white, greenish-white, and yellowish-white; from yellowish-white it passes into wine-yellow, isabella-yellow, and clove brown; and from greyish-white into pale-yellow, and ash-grey. It has sometimes a tempered steel tarnish. It is sometimes coloured externally yellow or brown, by yellow or brown iron-ochre; occasionally green, by earthy malachite, and blue, by earthy blue copper.

It

It occurs massive, disseminated, in membranes, and seldom reticulated; but most commonly crystallized:

1. Very oblique four-sided prism, flatly bevelled on the extremities, the bevelling planes set on the obtuse lateral edges *. Fig. 135. Pl. 7. This is the primitive form: the angle of the vertical prism is 117° 4′; of the horizontal prism in the smaller diagonal 109° 30′.
2. Unequiangular six-sided prism, in which the terminal edges are truncated †. Fig. 136. Pl. 7.
3. Unequiangular six-sided prism, acutely acuminated with six planes, which are set on the lateral planes ‡, Fig. 137. Pl. 7. Sometimes the acumination ends in a line, and the prism is occasionally so broad, that it appears like a bevelled six-sided table.
4. Acute double six-sided pyramid, which is either perfect, as in Fig. 138. Pl. 7. ||, or is truncated on the common base.
5. Unequiangular six-sided prism, acuminated with four planes, two of which are set on the lateral planes, bounded by the obtuse lateral edges, but the other two are set on the acuter lateral edges. Fig. 139. Pl. 7. §.
6. Acute oblique double four-sided pyramid, in which the lateral planes of the one are set on the lateral planes

* Plomb carbonaté octaedre, Haüy.

† Plomb carbonaté annulaire, Haüy.

‡ Plomb carbonaté trihexaedre, Haüy.

|| Plomb carbonaté bipyramidal, Haüy.

§ Plomb carbonatè sexoctonal, Haüy.

planes of the other. It is the preceding figure without the prism.

7. Long acicular and capillary crystals, which are columnarly aggregated.

9. It occurs also in twin and triple crystals.

The crystals arc usually small and very small; seldom middle-sized; are often long and acicular, also broad and tabular.

The crystals occur superimposed, and either single or in druses; more frequently columnarly and scopiformly, or promiscuously aggregated.

Externally, it alternates from specular splendent to glistening.

Internally, it alternates from shining to glistening, and the lustre is adamantine, sometimes inclining to semimetallic, sometimes to resinous.

Its cleavage is in the direction of the lateral planes of the horizontal and perpendicular prisms.

The fracture is small conchoidal, which sometimes passes into uneven and splintery.

The fragments are indeterminate angular, and rather sharp-edged.

It alternates from translucent to transparent; and it refracts double in a high degree.

It is harder than calcareous-spar, but not so hard as fluor-spar; it is softer than rhomboidal lead-spar.

It is brittle, and very easily frangible.

Specific gravity, 6.2, 6.6, *Mohs*.—6.480, from Lead-hills, according to *Klaproth*.—6.5586, *Haüy*.—6.255, *Karsten*.

Chemical

Chemical Characters.

It is insoluble in water. It dissolves with effervescence in muriatic and nitric acids. Before the blowpipe it decrepitates, becomes yellow, then red, and is soon reduced to a metallic globule.

Constituent Parts.

	Leadhills.	Nertschinsk. Transparent.	Nertschinsk. Translucent.
Oxide of Lead,	82	84.5	73.50
Carbonic Acid,	16	15.5	15.00
Silica, -	—	—	8.00
Alumina, -	—	—	} 2.66
Oxide of Iron, -	—	—	} 2.66
Water, -	2		
	100	100.0	100.0
	Klaproth, Beit. b. iii. s. 168.	*John's* Chem. Unters. b. ii. s. 233. 236.	

Geognostic Situation.

It occurs in veins, and sometimes also in beds, in gneiss, mica-slate, and clay-slate, foliated granular limestone, grey-wacke, and grey-wacke-slate, and secondary limestone. The veins in which it is found are generally lead veins, which contain besides this spar, galena or lead-glance, green, black and yellow lead spars, sulphat of lead, earthy lead-spar, copper and iron pyrites, malachite, blue copper, grey manganese-ore, copper-green, brown iron-ore, sparry iron, native copper, white silver-ore, blende, and calamine; and the following vein-stones, heavy-spar, fluor, calcareous spar, quartz, and sometimes mountain-cork. Of all the accompanying minerals, galena is the most frequent, and when green

green lead-spar is associated with these, the white lead rests on the galena, and the green lead on the white lead.

Geographic Situation.

Europe.—It occurs at Leadhills in Lanarkshire, in veins that traverse transition rocks, in which it is associated with galena or lead-glance, earthy white lead, green lead-spar, lead-vitriol or sulphat of lead, sparry iron, iron-pyrites, brown hematite, calamine, and blue copper; and the veinstones are quartz, lamellar heavy-spar, calcareous-spar, brown-spar, and mountain-cork. It is found also with galena or lead-glance at Allonhead and Teesdale in Durham; with the same ore at Alston in Cumberland, and Snailback in Shropshire.

On the Continent, it it met with in several mines in the Hartz; also at Johanngeorgenstadt in Saxony; Prizbram in Bohemia; Tarnowitz in Silesia; Freiburg in the Breisgau; Schemnitz in Hungary; Bleiberg in Carinthia; Huelgoët and Poullaouen in Brittany; Saska and Dognatska in the Bannat; and in the Crimea.

Asia.—In several mines, particularly those of Gazimour in Siberia, where specimens of great beauty are found.

America.—It is met with in the mines of Chili, and at the Perkiomen mine in Pennsylvania; and on Conestoga Creek, near Lancaste *.

Observations.

It is distinguished from *Calcareous-Spar* by its greater specific gravity; from *Heavy-Spar* and *Celestine*, by its form,

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* Cleaveland's Mineralogy, p. 517.

form, cleavage, lustre, and superior specific gravity; and from *Arragonite*, by its higher specific gravity.

2. Several of the varieties of Bleiglas appear to belong to this subspecies of lead-spar.

Second Subspecies.

Black Lead-Spar.

Schwarz Bleierz, *Werner*.

Id. Werner, Pabst. b. i. s. 116. *Id. Wid.* s. 850.—Black Lead-Ore, *Kirw.* vol. ii. p. 221.—Schwarz Bleyerz, *Emm.* b. ii. s. 385.—La Mine de Plomb noire, *Broch.* t. ii. p. 307.—Schwarz Bleyerz, *Reuss*, b. iv. s. 241. *Id. Lud.* b. i. s. 261. *Id. Suck.* 2ter th. s. 324. *Id. Bert.* s. 461. *Id. Mohs*, b. iii. s. 495. *Id. Leonhard*, Tabel. s. 71.—Plomb noire, *Brong.* t. ii. p. 199.—Dunkler Bleispath, *Karsten*, Tabel. s. 68.—Plomb carbonaté noire, *Haüy*, Tabl. p. 82.—Bleischwärtze, *Haus.* Handb. b. iii. s. 1111.—Schwarzbleierz, *Hoff.* b. iv. s. 18.

External Characters.

Its colour is greyish-black of different degrees of intensity, which sometimes passes into ash-grey.

It occurs massive, disseminated, corroded, cellular, and seldom crystallized, in small and very small six-sided prisms.

The surface of the crystals is sometimes drusy, sometimes smooth, and sometimes longitudinally streaked.

Externally it is generally splendent, and sometimes shining.

Internally

Internally it is only shining, sometimes passing into glistening, and the lustre is metallo-adamantine.

The fracture is small-grained uneven, which sometimes passes into imperfect conchoidal.

It alternates from translucent to opaque.

Its streak is whitish-grey.

In other characters agrees with the preceding.

Constituent Parts.

Oxide of Lead, -	79	78.5
Carbonic Acid, -	18	18.1
Carbon, -	2	1.5
	99	

Lampadius, Handb. Zu. Chem. Anal.

Geognostic Situation.

It generally occurs in the upper part of veins, associated with white lead-spar, and galena or lead-glance. Frequently this ore incrusts galena, and has resting upon it white lead-spar, and sometimes even green lead-spar. We often observe a nucleus of galena incrusted with black lead-spar, or black lead-spar forms a nucleus, which is incrusted with white lead-spar.

Geographic Situation.

Europe.—It occurs at Leadhills; at Fair Hill and Flow Edge, Durham. On the Continent, it is met with at Miess and Prizbram in Bohemia; Freyberg and Zschopau in Saxony; Schwarzleogang in Salzburg; Poullaouen in Lower Brittany in France.

Asia.—Schlangenberg in Siberia.

Third

Third Subspecies.

Earthy Lead-Spar.

Bleierde, *Werner.*

This subspecies is divided into two kinds, viz. Indurated Earthy Lead-Spar, and Friable Earthy Lead-Spar.

First Kind.

Indurated Earthy Lead-Spar.

Verhärtete Bleierde, *Werner.*

Id. Wid. s. 868.—Le Plomb terreux endurci, *Broch.* t. ii. p. 329. —Verhärtete gelb und grau Bleyerde, *Reuss*, b. iv. s. 270. & 272.—Bleierde, *Lud.* b. i. s. 265. *Id. Suck.* 2ter th. s. 345. *Id. Bert.* s. 462. *Id. Mohs*, b. iii. s. 553. *Id. Leonhard*, Tabel. s. 70.—Plomb oxydé terreux, *Brong.* t. ii. p. 197. *Id. Brard*, p. 270.—Verhärtete Bleierde, *Karsten*, Tabel. s. 68.—Erdiches Bleiweiss, *Haus.* s. 114.—Earthy Carbonate of Lead, *Kid*, vol. ii. p. 138.—Plomb carbonaté terreux, *Haüy*, Tabl. p. 82.—Feste Bleierde, *Haus.* Handb. b. iii. s. 1109.—Verhärtete Bleierde, *Hoff.* b. iv. s. 46.—Earthy Carbonate of Lead, *Aikin*, p. 111.

External Characters.

Its most frequent colour is yellowish-grey, from which it passes, on the one side, into straw-yellow and cream-yellow; on the other, into yellowish-brown. It occurs also smoke-grey, bluish-grey, and light-brownish red.

It occurs massive.

Internally

Internally it is glimmering, inclining to glistening; and the lustre is resinous *.

The fracture is small and fine-grained uneven, which passes on the one side into fine splintery, on the other into earthy.

The fragments are indeterminate angular, and blunt-edged.

Is usually opaque, or extremely faintly translucent on the edges.

It yields a brown-coloured streak.

It is soft, passing into very soft, even into friable, particularly the yellowish-grey, and yellow varieties.

Specific gravity, 5.579, *John*.

Chemical Characters.

It is very easily reduced before the blowpipe; effervesces with acids, and becomes black with sulphuret of ammonia.

Constituent Parts.

		Tarnowitz.
Oxide of Lead,	-	66.00
Carbonic Acid,	-	12.00
Water,	-	2.25
Silica,	-	10.50
Alumina,	-	4.75
Iron and Oxide of Manganese,		2.25
		97.75

John, Chem. Unt. b. ii. s. 229.

 Geognostic

* This lustre is accidental, and appears to be owing to intermixed white lead-ore or lead-vitriol.

Geognostic Situation.

The yellow-coloured varieties occur in a bed in primitive limestone, accompanied with galena or lead-glance and other ores of lead, in the Bannat; the grey-coloured varieties occur sometimes in veins, sometimes in beds, and either in transition or secondary rocks, and are usually accompanied with galena or lead-glance, white lead-spar, iron-pyrites, malachite, and quartz.

Geographic Situation.

Europe.—It is found in the lead veins of Wanlockhead and Leadhills; also at Grassfield Mine near Nenthead in Durham, and in Derbyshire. On the Continent, it is met with at Andreasberg and Zellerfeld in the Hartz, Johanngeorgenstadt in Saxony; Tarnowitz in Silesia; Chentzen in Poland; in the country of Salzburg; and at Saska in the Bannat.

Asia.—Nertschinsk in Siberia.

Second Kind.

Friable Earthy Lead-Spar.

Zerreibliche Bleierde, *Werner.*

Le Plomb terreux friable, *Broch.* t. ii. p. 328.—Zerreibliche, gelbe Bleierde, und zerreibliche grüne Bleierde, *Reuss,* b. iv. s. 268, 269. 271, 272. *Id. Mohs,* b. iii. s. 356. *Id. Leonhard,* Tabel. s. 73. *Id. Karsten,* Tabl. s. 68.—Zerreibliches Bleiweiss, *Haus.* s. 114.—Zerreibliche Bleierde, *Haus.* Hand. b. iii. s. 1110. *Id. Hoff.* b. iv. s. 45.

External

External Characters.

Its colour is yellowish-grey and straw-yellow, which sometimes approaches to sulphur-yellow and lemon-yellow.

It occurs massive, disseminated, and in crusts.

It is composed of dull dusty particles, which are feebly cohering.

It soils feebly.

It is meagre, and rough to the feel.

It is heavy.

Geognostic Situation.

It occurs on the surface or in the hollows of other minerals, and is usually accompanied with galena or lead-glance and lead-spars

Geographic Situation.

Europe.—It is found at Wanlockhead and Leadhills; Zellerfeld in the Hartz; Zschopau, and also near Freyberg in the kingdom of Saxony; in the mountains of Kracau in Poland: and at La Croix in Lothringen in France.

Asia.—The mines of Nertschinsk and Berseowskoi in Siberia.

Observations.

It is distinguished from other friable minerals by colour, meagre feel, and weight.

* Corneous

* Corneous Lead (a).

Hornblei, *Werner*.

Plomb corné, ou Muriaté de Plomb natif, *Broch.* t. ii. p. 330.—547, 548.—Hornblei, *Karsten*, Tab. 1. Ausg. s. 78.—*Chenevix*, in Nicholson's Journal, vol. v. p. 219.—Hornblei, *Reuss*, Min. b. ii. s. 261. *Id. Lud.* b. ii. s. 187. *Id. Suck.* 2ter th. s. 344. *Id. Bert.* s. 453. *Id. Leonhard*, Tabel. s. 73.—Plomb muriaté, *Brong.* t. ii. p. 203.—Hornblei, *Karst.* Tabel. 2ter Ausg. s. 68.—Hornblei, *Haus.* Handb. b. iii. s. 1104.—Muriate of Lead, *Kid*, vol. ii. p. 145. *Id. Aikin*, p. 111.

External Characters.

Its colours are greyish-white, and yellowish-grey, passing into pale wine-yellow.

It occurs crystallized, in the following figures:

1. Oblique four-sided prism.
   - *a.* Truncated on the angles.
   - *b.* Truncated on the lateral edges.
   - *c.* Bevelled on the lateral edges.
   - *d.* Truncated on the terminal edges.
   - *e.* Acuminated with four planes, which are set on the lateral planes.

Internally it is splendent, and the lustre is adamantine.

It has a threefold cleavage, the cleavages parallel to the planes of the four-sided prism.

The fracture is conchoidal.

It is more or less transparent.

It is soft; rather softer than white lead-spar.

It is sectile, and easily frangible.

Specific gravity, 6.065, *Chenevix*.

Chemical

(a) The minerals marked *, are not yet included in the Genus Lead-spar, as their characters have not been completely ascertained.

Chemical Characters.

On exposure to the blowpipe or charcoal, it melts into an orange-coloured globule, and appears reticular externally, and of a white colour when solid; when again melted it becomes white; and on increase of the heat the acid flies off, and minute globules of lead remain behind.

Constituent Parts.

Oxide of Lead,	-	85.5
Muriatic Acid,	-	8.5
Carbonic Acid,	-	6.0
		100.0

Klaproth, Beit. b. iii. s. 144.

Geographic Situation.

Europe.—In Cromford Level, near Matlock in Derbyshire; and at Hausbaden, near Badweiler in Germany *.

America.—In the neighbourhood of Southampton in the United States †.

Observations.

1. It is a very rare mineral. A good many years ago, a few specimens of it, the only ones hitherto collected in England, were found in Cromford Level, which was soon afterwards filled with water, and the spot which afforded the specimens hid from view.

2. It will probably prove but a variety of white lead-spar.

* Arseniate

* Leonhard's Taschenbuch for 1815, p. 338.

† Found by William Meade, M. D. as mentioned at p. 152. of Bruce's Mineralogical Journal.

* Arseniate of Lead.

Bleiblüthe, *Hausmann.*

This Species is divided into three Subspecies, viz. Reniform arseniate of Lead, Filamentous Arseniate of Lead, and Earthy Arseniate of Lead.

First Subspecies.

Reniform Arseniate of Lead.

Bleiniere, *Hausmann.*

Blenieire, *Reuss*, b. ii. 4. s. 225. *Id. Leonhard,* Tabel. s. 73.—Plomb arsenié, & Plomb reniforme, *Brong.* t. ii. p. 202.—Bleiniere, *Karsten*, Tabel. s. 68.—Plomb arsenié concretionné-mamelonné et compacte, *Haüy*, Tabl. p. 80.—Bleiniere, *Haus.* Handb. b. iii. s. 1097.—Reniform Arseniate of Lead, *Aikin*, p. 114.

External Characters.

Its colours on the fresh fracture are reddish-brown and brownish-red; externally ochre-yellow, and straw-yellow.

It occurs reniform and tuberose; also in curved lamellar concretions.

Internally it is shining and resinous.

The fracture is conchoidal, sometimes inclining to even and uneven.

It is opaque.

It is soft and brittle.

Specific gravity 3.933, *Karsten.*

Chemical

Chemical Characters.

It is insoluble in water. Before the blowpipe on charcoal it gives out arsenical vapours, and is more or less perfectly reduced. It colours glass of borax lemon-yellow.

Constituent Parts.

Oxide of Lead, -	35.00
Arsenic acid, -	25.00
Water, - -	10.00
Oxide of Iron, -	14.00
Silver, - -	1.15
Silica, - -	7.00
Alumina, - -	2.00
	95.15

Bindheim, in Beob. u. Endeck. de Berl. Ges. Natf. Fr. iv. s. 374.

Geographic Situation.

It has been hitherto found only in one mine near Nertschinsky in Siberia.

Second Subspecies.

Filamentous Arseniate of Lead.

Flockenerz, *Karsten.*

Plomb arsenié filamenteux, *Haüy*, t. iii. p. 465.—Flockenerz, *Karsten*, Tabel. s. 68.—Flockige Bleiblüthe, *Haus.* Handb. b. iii. s. 1098.—Arseniate of Lead, *Aikin*, p. 114.

External

External Characters.

Its colours are grass-green, wine-yellow, wax-yellow, and lemon-yellow.

It occurs massive, in granular concretions, and either in small acicular six-sided prisms, which are collected into flakes, or in very delicate capillary silky fibres, which are transparent, slightly flexible, and easily frangible.

Specific gravity 5.0, 6.4.

Constituent Parts,

Oxide of Lead,	-	69.76
Arsenic Acid,	-	26.4
Muriatic Acid,	-	1.58

Gregor.

Geographic Situation.

It occurs in the mine of Huel Unity in Gwennap in Cornwall; at St Prix, in the Department of the Soane and Loire in France.

Third Subspecies.

Earthy Arseniate of Lead.

Erdige Bleiblüthe, *Hausmann.*

Plomb arsenié terreux, *Lucas,* t. ii. p. 315.

External Characters.

Its colour is yellow.

It occurs in crusts.

Its

Its fracture is earthy.
It is friable.

Geognostic and Geographic Situations.

It occurs along with filamentous arseniate of lead at St Prix; and also near St Oisans.

* Native Minium, or Native Red Oxide of Lead.

Natürliche Menninge, } *Hausmann.*
Roth Bleioxyd, }

Smithson, in Nicholson's Journal, xvi. p. 127.—*Hänle*, in Magaz. d. Gesel. Natf. Fr. zu Berlin, iii. s. 235.—Plomb oxydé rouge, *Haüy*, Tabl. p. 80. Note 120.—Das rothe Bleioxyd, *Haus.* Handb. b. i. s. 351.—Native Minium, *Aikin*, p. 110.

External Characters.

Its colour is scarlet-red.
It occurs massive, amorphous, and pulverulent; but when examined by the lens, exhibits a crystalline structure, like that of galena, on which it generally rests.

Chemical Characters.

Before the blowpipe, on charcoal, it is first converted into litharge, and then into metallic lead.

Geognostic and Geographic Situations.

It is found in Grassington Moor, Craven; Grasshill Chapel, Wierdale, Yorkshire. On the Continent, it is found in the mine of Hausbaden, near Badenweiler, on galena, and associated with quartz.

Observations.

Observations.

This mineral, in the opinion of Mr Smithson, is produced by the decay of galena or lead-glance; and he adduces in confirmation of this idea, the description of a specimen, which is galena in the centre, but native minium towards the surface.

Genus II. BARYTE.

Hal-Baryt, *Mohs.*

This Genus contains four species, viz. 1. Rhomboidal Baryte, 2. Prismatic Baryte, 3. Di-Prismatic Baryte, 4. Axifrangible Baryte.

1. Rhomboidal Baryte, or Witherite.

Rhomboedrischer Hal-Baryt, *Mohs.*

Witherit, *Werner.*

Baryte aërée, *De Born,* t. i. p. 267.—Witherit, *Wid.* s. 554.—Barolite, *Kirw.* vol. i. p. 134.—Luft oder Kohlensaurer Baryt, *Estner,* b. ii. s. 1124.—Witerite, *Nap.* p. 387. *Id. Lam.* t. ii. p. 20.—Baryte carbonatée, *Haüy,* t. ii. p. 309.—La Witherite, *Broch.* t. i. p. 613.—Witherit, *Reuss,* b. ii. 2. s. 430. *Id. Lud.* b. i. s. 167. *Id. Suck.* 1r th. s. 693. *Id. Bert.* s. 120. *Id. Mohs,* b. ii. s. 200. *Id. Hab.* s. 93.—Baryte carbonatée, *Lucas,* p. 16. —Witherite, *Leonhard,* Tabel. s. 39.—Baryt carbonaté, *Brong.* t. i. p. 255. *Id. Brard,* p. 60.—Witherit, *Karsten,* Tabel. s. 54.

s. 54. *Id. Haus.* s. 132. *Id. Kid,* vol. i. p. 86.—Baryte carbonatée, *Haüy,* Tabl. p. 13.—Witherit, *Lenz,* b. ii. s. 881. *Id. Oken,* b. i. s. 412. *Id. Haus.* Handb. b. iii. s. 1003. *Id. Hoff.* b. iii. s. 150. *Id. Aikin,* p. 166.

External Characters.

Its colours are greyish and yellowish white, also pale bluish-grey, yellowish-grey, and pale wine-yellow.

It occurs massive, disseminated, in crusts, cellular, corroded, large globular, reniform, botryoidal, stalactitic; also in distinct concretions, which are wedge-shaped, sometimes scopiform radiated, and occasionally pass into coarse granular. More rarely crystallized.

The primitive form is a rhomboid of 88° 6′ and 91° 54′. The following are the secondary forms:

1. Equiangular six-sided prism.
   a. Truncated on the terminal edges.
   b. Acutely acuminated on the extremities with six planes, which are set on the lateral planes. Sometimes the alternate acuminating planes are larger and smaller. The apices of the acuminations are sometimes more or less deeply truncated, and in some crystals, the edges between the acuminating and lateral planes are truncated.
2. Acute double six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other.

The crystals are small, and very small, seldom middle-sized.

The prisms are sometimes scopiformly grouped, or they are in druses.

Externally

Externally it is glistening; internally it is shining on the cleavage, and glistening on the fracture, and the lustre is resinous.

The cleavage is threefold; the folia are most distinct in the direction of the alternate planes of the six-sided pyramid, less so parallel with the alternate lateral planes of the prism. The folia are sometimes floriform.

The principal fracture is uneven, inclining to splintery.

The fragments are wedge-shaped, or indeterminate angular.

It is translucent, rarely semitransparent.

It is generally harder than calcareous-spar, but not so hard as strontianite.

It is brittle, and easily frangible.

Specific gravity, 4.2–4.4, *Mohs*.—4.271, *Lichtenberg*.—4.361, *Karsten*.

Chemical Characters.

Before the blowpipe it decrepitates slightly, and melts readily into a white enamel; it is soluble, with effervescence, in diluted muriatic or nitric acid.

Constituent Parts.

Carbonate of Barytes, 98.246	Barytes, 74.5	Barytes, 79.66	Carbonate of Barytes, 96.3
Carbonate of Strontian, 1.703	Carbonic acid, 22.5	Carbonic Acid, 20.00	Carbonate of Strontian, 1.1
Alumina, with Iron, 0.048	100.0	Water, 0.33	Sulphate of Barytes, 0.9
Carbonate of Copper, 0.008	*Vauquelin.*	99.99	Silex, 0.5
100.000		*Buchols*, in Beitr. z. Chem. i. 4.	Alumina, and Oxide of Iron, 6.25
Klaproth, Beit. b. ii. s. 86.			99.05
			Aikin, Geol. Tr. v. iv. part ii. p. 442.

Geognostic

Geognostic and Geographic Situations.

It occurs in Cumberland and Durham, in lead-veins that traverse a secondary limestone, which rests on red sandstone, and in these it is associated with coralloidal arragonite, brown-spar, earthy fluor-spar, heavy-spar, and galena or lead-glance, white lead-spar, green lead-spar, copper-pyrites, blue copper, malachite, iron-pyrites, sparry iron, calamine, and blende. In these counties, it is met with at Aldstone in Cumberland; Arkendale, Welhope, and Dufton in Durham. It also occurs at Merton Fell in Westmoreland; Snailback mine in Shropshire *, and at Anglesark in Lancashire, in a vein of galena, along with heavy-spar. It is associated with sparry iron near Steinbauer, not far from Neuberg and Mariazel in Stiria: in granite in Hungary: in the Leogang in Salzburg, along with sparry iron, and copper-pyrites: in the sulphur mines of Azaro and Radussa, and in the river of Nisi, also in Sicily, along with lead-ore.

Asia.—At Schlangenberg and Zincof, in the Altain Mountains.

Uses.

It is a very active poison, and in some districts, as in Cumberland, it is employed for the purpose of destroying rats. When dissolved by muriatic acid, the solution thus obtained, is said to prove serviceable in scrofula.

Observations.

* Mr Aikin informs us, that the Witherite of Snailback occurs in masses, varying from 4 lb. to 2 or 3 cwt. imbedded in heavy-spar, contained in a thick vein of galena or lead-glance.—Vid. Geol. Trans. vol. iv. part ii. p. 438. &c.

Observations.

Cleavage, fracture, and weight, distinguish this mineral from calcareous spar, rhomb-spar, apatite, and gypsum.

2. Prismatic Baryte, or Heavy-Spar.

Prismatischer Hal-Baryt, *Mohs.*

Schwerspath, *Werner.*

This species is divided into nine subspecies, viz. 1. Earthy Heavy-Spar, 2. Compact Heavy-Spar, 3. Granular Heavy-Spar, 4. Curved Lamellar Heavy-Spar, 5. Straight Lamellar Heavy-Spar, 6. Fibrous Heavy-Spar, 7. Radiated Heavy-Spar, 8. Columnar Heavy-Spar, and, 9. Prismatic Heavy-Spar.

First Subspecies.

Earthy Heavy-Spar.

Schwerspath Erde, *Werner.*

Baryte vitriolée terreuse, *De Born*, t. i. p. 268.—Schwerspath-erde, *Wid.* s. 558.—Earthy Baroselenite, *Kirw.* vol. i. p. 138.—Schwerspath-erde, *Estner*, b. ii. s. 1143. *Id. Emm.* b. i. s. 550.—Baryta vitriolata terrea, *Nap.* p. 402.—Le Spath pesant terreux, *Broch.* t. i. p. 617.—Erdiger Baryt, *Reuss*, b. ii. 2. s. 437. *Id. Lud.* b. i. s. 168. *Id. Suk.* 1r th. s. 697. *Id. Bert.* s. 122.—Baryterde, *Mohs*, b. ii. s. 106.—Erdiger Baryt, *Leonhard*, Tabel. s. 39.—Baryte sulphatée terreux, *Brong.* t. i. p. 252.—Erdiger Baryt, *Haus.* s. 134. *Id. Karsten*, Tabel. s. 54.—Earthy Sulphate of Baryt, *Kid*, vol. i. p. 87.—Baryterde, *Lenz*, b. ii. s. 389.—Schwerspatherde, *Hoff.* b. iii. s. 156.

External

External Characters.

Its colours are yellowish and reddish white.

It is of friable consistence, and consists of feebly glimmering, nearly dull, particles, which are intermediate between scaly and dusty, that soil feebly, and are generally loose, or but feebly cohering.

It feels meagre, and rather rough.

Specific gravity, 4.0.

Constituent Parts.

It is Sulphate of Barytes.

Geognostic and Geographic Situations.

It occurs in drusy cavities in veins of heavy-spar, in Staffordshire and Derbyshire; at Freyberg in Saxony; Riegelsdorf in Hessia; and Mies in Bohemia.

Observations.

1. It is distinguished from all other earthy minerals, by its great specific gravity.

2. Some mineralogists are of opinion, that it is disintegrated compact Heavy-Spar, while others maintain that it is an original formation. The latter opinion is countenanced in those instances where the earthy heavy-spar occurs in close cavities.

Second

Second Subspecies.

Compact Heavy-Spar.

Dichter Schwerspath, *Werner.*

Baryte vitriolata compacte, *De Born,* t. i. p. 268.—Dichter Schwerspath, *Wid.* s. 559.—Compact Baroselenite, *Kirw.* vol. i. p. 138.—Dichter Schwerspath, *Estner,* b. ii. s. 1146. *Id. Emm.* b. i. s. 552.—Barite vitriolata compatta, *Nap.* p. 400. —Le Spath pesant compacte, *Broch.* t. i. p. 618.—Dichter Schwerspath, *Reuss,* b. ii. 2. s. 438. *Id. Lud.* b. i. s. 169. *Id. Suck.* 1r th. s. 698. *Id. Bert.* s. 123. *Id. Mohs,* b. ii. s. 206. *Id. Leonhard,* Tabel. s. 39.—Baryte sulphatée compacte, *Brong.* t. i. p. 252.—Dichter Baryte, *Karsten,* Tabel. s. 54. *Id. Haus.* s. 133.—Baryte sulphatée compacte, *Haüy,* Tabl. p. 13.—Dichter Baryte, *Lenz,* b. ii. s. 390.—Dichter Schwerspath, *Hoff.* b. iii. s. 158.

External Characters.

Its colours are yellowish-white, and greyish-white, which pass into yellowish-grey, and ash-grey.

It occurs massive, disseminated, reniform, semi-globular, tuberose, with cubic impressions; and in curved lamellar concretions.

Internally it is glimmering.

The fracture is intermediate, between coarse earthy, and fine-grained uneven, which sometimes passes into imperfect foliated, and more rarely into splintery.

The fragments are indeterminate angular, and blunt-edged.

It is opaque, or translucent on the edges.

It is soft.

It

It is rather sectile, and easily frangible.

Specific gravity, 4.84.

Constituent Parts.

Sulphate of Barytes,	-	83.0
Silica,	- -	6.0
Alumina,	- -	1.0
Water,	- -	2.0
Oxide of Iron,	-	4.0
		96.0

Westrumb, in Bergbaukunde, ii. s. 47.

Geognostic and Geographic Situations.

It is found in the mines of Staffordshire and Derbyshire, where it is named *Cawk*. It also occurs at Meis in Bohemia, Freyberg in Saxony, in the Hartz, and the Breisgau: also in clay-slate, near Servos in Savoy; and in Austria and Stiria.

Third Subspecies.

Granular Heavy-Spar.

Körniger Schwerspath, *Werner*.

Blättriger Schwerspath, *Wid.* s. 561.—Körniger Schwerspath, *Emm.* b. i. s. 556.—Le Spath pesant grenue, *Broch.* t. i. p. 620.—Körniger Baryt, *Reuss*, b. ii. 2. s. 441. *Id. Lud.* b. i. s. 169. *Id. Suck.* 1r th. s. 701. *Id. Bert.* s. 124. *Id. Mohs*, b. ii. s. 206. *Id. Leonhard*, Tabel. s. 39.—Baryte sulphatée grenue, *Brong.* t. i. p. 253.—Schuppiger Baryt, *Haus.* s. 133. —Körniger Baryt, *Karst.* Tabel. s. 54.—Baryte sulphatée granulaire,

granulaire, *Haüy*, Tabl. p. 13.—Körniger Baryt, *Lenz*, b. ii. s. 891.—Körniger Schwerspath, *Hoff.* b. iii. s. 160.—Granular Heavy-Spar, *Aikin*, p. 170.

External Characters.

The colours are snow, yellowish, greyish, and reddish white, and sometimes dark ash-grey. It is occasionally spotted brown and yellow on the surface.

It occurs massive, and in fine granular concretions, which are sometimes so minute as scarcely to be discernible.

Internally it is glistening, approaching to shining, and is pearly.

The fragments are indeterminate angular, and blunt-edged.

It is feebly translucent.

It is soft.

It is rather brittle, and easily frangible.

Specific gravity, 4.380, *Klaproth*.

Constituent Parts.

Sulphat of Barytes,	-	90
Silica,	-	10
		100

Klaproth, Beit. b. ii. s. 72.

Geognostic Situation.

It occurs principally in beds, along with galena, blende, copper-pyrites, and iron-pyrites.

Geographic Situation.

It occurs in beds, along with galena, blende, copper-pyrites, and iron-pyrites, at Peggau in Stiria; also in the Hartz, Harts, in beds, along with copper and iron pyrites, galena, and blende; and at Schlangenberg in Siberia, where it is associated with copper-green, and native copper.

Observations.

1. It bears a striking resemblance to Foliated Granular Limestone, from which, however, it is distinguished by the following characters:

1st, It has a lower degree of lustre.

2d, When the distinct concretions are of the same size as in the foliated granular limestone, they are not so well defined.

3d, It is more easily broken in pieces than the limestone, owing to the concretions being less intimately connected together.

4th, It is much heavier.

2. Foliated Granular Limestone, Granular Heavy-spar, and Granular Gypsum, may be distinguished from each other by the relative distinctness of the concretions: in the Foliated Granular Limestone they are well defined; in Granular Heavy-spar less so; and in Granular Gypsum still more indistinct.

Fourth Subspecies.

Curved Lamellar Heavy-Spar.

Krummschaaliger Schwerspath, *Werner.*

Le Spath pesant testacé courbe, ou le Spath lamelleux, *Broch.* t. i. p. 621.—Krummschaaliger Baryt, *Reuss,* b. ii. 2. s. 443. *Id. Lud.* b. i. s. 170. *Id. Suck.* 1r th. s. 700. *Id. Bert.* s. 124.

 Id.

Id. Mohs, b. ii. s. 207. *Id. Leonhard,* Tabel. s. 40.—Blättriger Baryt, *Karsten,* Tabel. s. 54.—Baryte sulphatée cretée, *Haüy,* Tabl. p. 13.—Krummschaaliger Schwerspath, *Hoff.* b. iii. s. 162.

External Characters.

Its principal colours are white, grey, and red: the white varieties are yellowish, greyish, and reddish white; the grey varieties are smoke and pearl grey, and there is a transition from pearl-grey into flesh-red and blood-red, and from yellowish-grey into yellowish-brown, and liver-brown. Sometimes several colours occur together, and are arranged in broad stripes.

It generally occurs massive, more frequently reniform, and long globular, with a drusy surface; the drusy surface is formed of very small, thin, and longish four-sided tables; also in reniform curved lamellar concretions, which are frequently floriform, and these are again composed of prismatic concretions. It is rarely marked with cubical impressions.

Internally it is intermediate between shining and glistening, and the lustre is pearly, inclining to resinous.

The fracture is curved foliated, which sometimes inclines to splintery, and thus approaches to the compact subspecies.

The fragments are indeterminate angular, and rather blunt-edged.

It is translucent on the edges.

It scratches calcareous-spar, but does not affect fluor.

It is brittle, and easily frangible.

Specific gravity, 4.307, *Breithaupt.*

Geognostic

Geognostic and Geographic Situations.

It is one of the most common subspecies of heavy-spar. In Scotland, it occurs in trap and sandstone rocks: in Derbyshire, it occurs in secondary limestone: it characterises a particular venigenous formation at Freyberg in Saxony, where it is associated with radiated pyrites, argentiferous galena, brown blende, calcareous-spar, and fluor-spar. It occurs in Sweden, Carinthia, and other countries.

Fifth Subspecies.

Straight Lamellar Heavy-Spar.

It is divided into three kinds, viz. Fresh Straight Lamellar Heavy-Spar, Disintegrated Straight Lamellar Heavy-Spar, and Fetid Straight Lamellar Heavy-Spar.

First Kind.

Fresh Straight Lamellar Heavy-Spar.

Geradschaaliger Schwerspath, *Werner*.

Gypsum spathosum, *Wall.* t. i. p. 168.—Spath pesant ou seleniteux, *Romé de Lisle*, t. i. p. 577.—Baryte vitriolée spathique, *De Born*, t. i. p. 270.—Var. of Blättriger Schwerspath, *Wid.* s. 561.—Gemeiner Schwerspath, *Emm.* b. i. s. 557.—Baryta vitriolata lamellare, *Nap.* p. 395.—Foliated Baroselenite, *Kirw.* vol. i. p. 140.—Le Spath pesant testacé à lames droites, ou Le Spath pesant commun, *Broch.* t. i. p. 624.—Geradschaaliger Baryt, *Reuss*, b. ii. 2. s. 445.—Frischer Geradschaaliger Baryt, *Lud.* b. i. s. 170. *Id. Suck.* 1r th. s. 702. *Id. Bert.* s. 125. *Id. Mohs*, b. ii. s. 209. *Id. Leonhard*, Tabel. s. 40. —Baryte

—Baryte sulphatée pure crystallisée, *Brong.* t. i. p. 250.—Gemeiner Baryt, *Karst.* Tabel. s. 54. *Id. Haus.* s. 133.—Baryte sulphatée, en formes determinables, *Haüy*, Tabl. p. 12.—Geradschaaliger Baryt, *Lenz*, b. ii. s. 894.—Frischer Geradschaaliger Schwerspath, *Hoff.* b. iii. s. 165.

External Characters.

Its colours are snow, milk, reddish, yellowish, and greenish white; greyish, ash, smoke, and bluish-grey; greyish-black; smalt-blue, pale sky-blue, and muddy indigo-blue; verdigris-green and olive-green; cream, honey, wax, and wine yellow; brick-red, blood-red, and brownish-red; and yellowish-brown.

It occurs generally massive; also in distinct concretions, which are straight and thin lamellar; and again collected into others which are coarse granular; and also crystallized. The primitive form is an oblique four-sided prism of 101° 53'. The following are the secondary figures:

1. Rectangular four-sided table.
   a. Perfect.
   b. In which the terminal planes are bevelled *, fig. 140. Pl. 7.
   c. In which the angles of the bevelment are truncated †, fig. 141. Pl. 7.
2. Oblique four-sided table.
   a. Perfect.
   b. Truncated on the lateral edges.
   c. Truncated on the acute terminal edges, and sometimes also on the acute angles.

d. Truncated

* Baryte sulphatée trapezienne, Haüy.

† Baryte sulphatée epointée, Haüy.

d. Truncated on the obtuse angles *.

e. Truncated on the obtuse angles and terminal edges.

f. Bevelled on the obtuse terminal edges.

3. Longish six-sided table.

a. Perfect †, fig. 142. Pl. 7.

b. Bevelled on the terminal planes.

c. Bevelled on the terminal and lateral edges.

d. Bevelled on the lateral planes, and truncated on the bevelling edges.

e. The lateral edges acutely bevelled, and the acute angles truncated.

4. Eight-sided table.

a. Perfect.

b. Bevelled on the terminal planes.

c. Slightly truncated on the lateral and terminal edges.

d. Bevelled on the lateral and terminal planes.

The crystals vary in size, from large to small; and rest on one another, or intersect one another.

Externally they are smooth and splendent; internally shining and splendent, and the lustre intermediate between resinous and pearly.

It has a distinct cleavage, in which the folia are parallel with the planes of the primitive prism, and of these, that parallel to the terminal plane is the most distinct.

The fragments are tabular and rhomboidal.

It is translucent, or transparent, and refracts double.

It scratches calcareous-spar, but is scratched by fluor-spar.

It

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* Baryte sulphatée apophane, Haüy.

† Baryte sulphatée retrecée, Haüy.

It is brittle, and easily frangible.
Specific gravity, 4.1, 4.6.

Chemical Characters.

It decrepitates briskly before the blowpipe, and, by continuance of the heat, melts into a hard white enamel. A piece exposed for a short time to the blowpipe, and then laid on the tongue, gives the flavour of sulphuretted hydrogen. When pounded, and thrown on glowing coals, it phosphoresces with a yellow light.

Constituent Parts.

Sulphat of Barytes, -	97.60
Sulphat of Strontian, -	0.85
Water, - -	0.10
Oxide of Iron, - -	0.80
Alumina, - -	0.05

Klaproth, Beit. b. ii. s. 78.

Geognostic Situation.

It is found almost always in veins, which occur in granite, gneiss, mica-slate, clay-slate, grey-wacke, limestone, and sandstone. It is often accompanied with ores, particularly the flesh-red variety, and these are, native silver, silver-glance or sulphuretted silver, copper-pyrites, lead-glance, white cobalt-ore, light red silver, native arsenic, earthy cobalt, cobalt-bloom or red cobalt, antimony, and manganese. It occurs sometimes in beds, and encrusting the walls of drusy cavities.

Geographic

Geographic Situation.

In this island, it occurs in veins in different primitive and transition rocks, and also in secondary limestone, sandstone, and trap. Beautiful crystallized varieties are found in the lead-mines of Cumberland, Durham, and Westmoreland. It is very frequent on the Continent of Europe, and also in America, particularly in mining districts.

Uses.

It is said to form a good manure for clover fields. When burnt, and finely ground, it is used in place of bone-ashes for cupels. The white varieties are employed as white colours in painting, and for pastil-pencils; and it is sometimes used as a flux for ores of particular kinds.

Second Kind.

Disintegrated Straight Lamellar Heavy-Spar.

Mulmicher oder mürber geradschaaliger
Schwerspath, *Werner.*

Mulmiger Baryt, *Reuss,* b. ii. 2. s. 455. *Id. Leonhard,* Tabel. s. 40. *Id. Karsten,* Tabel. s. 54.—Aufgelöster Baryt, *Lenz,* b. ii. s. 899.—Mulmiger geradschaaliges Schwerspath, *Hoff.* b. iii. s. 173.

External Characters.

Its colours are greyish, greenish, yellowish, and reddish white.

It

It occurs massive.

It is glistening and pearly.

The cleavage and concretions the same as in the preceding species.

It is opaque, or faintly translucent on the edges.

It is soft, passing into very soft.

It is very easily frangible.

In other characters same as the preceding.

Geognostic and Geographic Situations.

It was formerly met with in considerable quantity at Freyberg in Saxony, in a mixture of galena, blende, and iron-pyrites.

Third Kind.

Fetid Straight Lamellar Heavy-Spar, or Hepatite.

Gypsum, Lapis hepaticus, *Wall.* Syst. i. s. 165.—Baryte sulphatée fetide, *Haüy,* t. ii. p. 304.—Hepatit, *Reuss,* b. ii. 2. s. 463. *Id. Lud.* b. ii. s. 157. *Id. Suck.* 1r th. s. 714. *Id. Bert.* s. 131. *Id. Mohs,* b. ii. s. 228.—Baryte sulphatée fetide, *Lucas,* p. 15.—Hepatit, *Leonhard,* Tabel. s. 40.—Baryte sulphatée fetide, *Brong.* t. i. p. 253. *Id. Brard,* p. 59.—Hepatit, *Karsten,* Tabel. s. 54. *Id. Haus.* s. 134.—Baryte sulphatée fetide, *Haüy,* Tabl. p. 13.—Hepatit, *Lenz,* b. ii. s. 908. *Id. Oken,* b. i. s. 404. *Id. Aikin,* p. 171.

External Characters.

Its colours are greyish-white, yellowish and smoke grey, greyish and brownish black.

It

It occurs massive, disseminated, and in globular or elliptical pieces, from an inch to a foot and upwards in diameter; also in lamellar concretions, which are generally straight, sometimes curved and floriform; sometimes there is a tendency to wedge-shaped and radiated concretions.

Externally it is feebly glimmering; internally shining, and intermediate between pearly and resinous.

The fragments are indeterminate angular, and blunt-edged.

It is opaque, or translucent on the edges.

It is nearly as hard as straight lamellar heavy-spar.

It affords a greyish-white coloured streak.

It is heavy.

Chemical Characters.

It burns white before the blowpipe; and when rubbed or heated, gives out a fetid sulphureous odour.

Constituent Parts.

Sulphate of Barytes, with a trace of Sulphate of Strontian,	93.58	Sulphate of Barytes, -	92.75	Sulphate of Barytes, -	85.25
Sulphate of Lime,	3.58	Carbon and Bitumen, -	2.00	Carbon, -	0.50
Oxide of Iron,	0.87	Sulphate of Lime,	2.00	Sulphate of Lime,	6.00
Water, Carbonaceous Matter, Sulphur, and Alumina,	2.00	Oxide of Iron,	1.50	Oxide of Iron,	5.00
	100.00	Water, -	1.25	Alumina, -	1.00
John, Chem. Unt. b. ii. s. 73.		Sulphur, Oxide of Manganese, Chromic Acid, and Alumina, very small quantity.		Loss, including Moisture and Sulphur,	2.25
			99.05		100.00
		John, Chem. Unt. b. ii. s. 69.		*Klaproth*, Beit. b. v. s. 121.	

Geognostic

Geognostic and Geographic Situations.

It occurs at Buxton in Derbyshire; at Kongsberg in Norway, in veins that traverse mica-slate and hornblende-slate, along with native silver, heavy-spar, coal-blende, and iron-pyrites; and at Andrarum in Schonen, in transition alum-slate, in the form of balls. These balls are sometimes impregnated with iron-pyrites, or the iron-pyrites forms the central part.

Observations.

1. It is named *Hepatite*, from the disagreeable sulphureous odour it exhales when rubbed or exposed to heat.

2. Marggraf, Linnæus, and Cronstedt, arrange this mineral with Limestone.

Sixth Subspecies.

Fibrous Heavy-Spar.

Fasriger Schwerspath, *Werner*.

Fasriger Baryt, *Leonhard*, Tabel. s. 40. *Id. Karsten*, Tabel. s. 54. *Id. Haus.* s. 133.—Baryte sulphatée concretionnée-fibreuse, *Haüy*, Tabl. p. 13.—Fasriger Baryt, *Lenz*, b. ii. s. 900.—Fasriger Schwerspath, *Hoff.* b. iii. s. 183.

External Characters.

Its colour is pale-yellowish, and wood-brown, which sometimes passes into yellowish-grey.

It

It occurs massive and reniform; also in distinct concretions, which are scopiform prismatic or fibrous, sometimes collected into others, which are curved lamellar, and sometimes into coarse angulo-granular concretions.

Internally it is shining, and the lustre is resinous.

The fragments are splintery, and wedge-shaped.

It is translucent on the edges.

Specific gravity, 4.080, *Klaproth.*—4.239, *Noeggerath.*

Constituent Parts.

Sulphate of Barytes,	-	99.0
Trace of Iron.		
		99.0

Klaproth, Beit. b. iii. s. 288.

Geognostic and Geographic Situations.

It is found at Neu-Leiningen in the Palatinate; also in an ironstone mine in clay-slate, at Chaud-Fontaine, near Lüttich, in the Ourthe department; and at Miess in Bohemia.

Observations.

It was first described by Karsten, and analysed by Klaproth. It was sent to Klaproth as a rare variety of calamine.

Seventh

Seventh Subspecies.

Radiated Heavy-Spar, or Bolognese Spar.

Bologneser Spath, *Werner.*

Gypsum spathosum, opacum, semi-pellucidum, *Wall.* t. i. p. 169. —Var. of Blættriger Schwerspath, *Wid.* s. 561.—Bologneser-stein, *Emm.* b. iv. s. 572.—Litheosphore, *Lam.* t. i. p. 24.—Baryte sulphatée rayonnée, *Haüy,* t. ii. p. 302.—La Spath de Bologne, ou La Pierre de Bologne, *Broch.* t. i. p. 633.—Strahliger Baryt, *Reuss,* b. ii. 2. s. 460.—Bologneser Spath, *Lud.* b. i. s. 172. *Id. Suck.* 1r th. s. 712.—Kieselerdiger schwefelsaurer Baryt, *Bert.* s. 130.—Bologneser Spath, *Mohs,* b. ii. s. 227.—Strahliger Baryt, *Leonhard,* Tabel. s. 40.—Baryte sulphatée pure radiée, *Brong.* t. i. p. 251.—Strahliger Baryt, *Haus.* s. 133. *Id. Karsten,* Tabel. s. 54.—Bologna Stone, *Kid,* vol. i. p. 89.—Baryte sulphatée radiée, *Haüy,* Tabl. p. 13. —Strahliger Baryt, *Lenz,* b. ii. s. 901.—Bologneser Spath, *Hoff.* b. ii. s. 180.

External Characters.

Its principal colour is smoke-grey, which passes into ash-grey and yellowish-grey.

It occurs in roundish pieces, which have a lenticular aspect and uneven surface; also in distinct concretions, which are parallel and scopiform prismatic, and also granular.

Internally it is shining or glistening, and the lustre is pearly, inclining to resinous.

The fragments are splintery, or wedge-shaped.

It is translucent.

In other characters it agrees with the preceding.

Chemical

Chemical Characters.

It is remarkably phosphorescent when heated. This property was first observed in the year 1630, by a shoemaker named Vincenzo Casciarolo, during his search after the philosopher's stone. When the mineral is calcined, pulverised, and made into cakes, it acquires a strong phosphorescent property by exposure to light; the phosphorescence is visible, upon taking it into a dark place.

Constituent Parts.

Sulphate of Barytes, -	62.00
Lime, - -	2.00
Silica, - -	16.00
Alumina, - -	14.75
Oxide of Iron, -	0.25
Water, - -	2.00
	97.00 *Afzelius.*

Geognostic and Geographic Situations.

It occurs imbedded in marl in Monte Paterno, near Bologna: also at Rimini; and in Jutland.

Observations.

1. Its uneven surface, shows that the rounded pieces are of cotemporaneous formation with the marl in which they are contained, and not rolled pieces.

2. When rendered phosphorescent, it is known under the name of *Bolognian Phosphorus.*

Eighth

Eighth Subspecies.

Columnar Heavy-Spar.

Stängenspath, *Werner.*

Var. Blættriger Schwerspath, *Wid.* s. 561.—Stangenspath, *Emm.* b. i. s. 569.—Le Spath pesant en barres, *Broch.* t. i. p. 631. —Baryte sulphatée bacillaire, *Haüy,* t. ii. p. 302.—Stänglicher Baryt, *Reuss,* b. ii. 2. s. 458.—Stangenspath, *Lud.* b. i. s. 172. *Id. Suck.* 1r th. s. 711. *Id. Bert.* s. 130. *Id. Mohs,* b. ii. s. 225.—Stänglicher Baryt, *Leonhard,* Tabel. s. 40.—Baryte sulphatée pure bacillaire, *Brong.* t. i. p. 251. —Stänglicher Baryt, *Karsten,* Tabel. s. 54.—Stangenspath, s. 133.—Baryte sulphatée bacillaire, *Haüy,* Tabl. p. 13.—Stänglicher Baryt, *Lenz,* b. ii. s. 903.—Stangenspath, *Hoff.* b. iii. s. 178.—Columnar Heavy-spar, *Aikin,* p. 170.

External Characters.

Its colours are yellowish, greyish, and greenish white.

It occurs crystallised, in acicular oblique four-sided prisms, which are always columnarly aggregated, and intersect each other.

Externally it is frequently invested with iron-ochre, but when unsoiled, it is shining and pearly.

Its cleavage is the same as that of lamellar heavy-spar.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent.

Specific gravity 4.500.

Constituent

Constituent Parts.

Barytes, - -	63.00
Sulphuric Acid, -	33.00
Strontian Earth, -	3.10
Oxide of Iron, -	1.50
Water, -	1.20

Lampadius.

Geognostic and Geographic Situations.

It was formerly found in the vein of Lorenzgegentrum, near Freyberg in Saxony, along with ores of different kinds, and also fluor-spar, quartz, and straight and curved lamellar heavy-spar. It is also mentioned as occurring in Derbyshire.

Observations.

It has been sometimes confounded with White Lead-spar, but is distinguished from that mineral by the following characters: White Lead-Spar has an adamantine lustre, its fracture is small conchoidal, and its specific gravity is 6.558; whereas Columnar Heavy-spar has a pearly lustre, distinct cleavage, and a specific gravity of 4.500.

Ninth Subspecies.

Prismatic Heavy-Spar.

Saulenspath, *Werner.*

Sauliger Baryt, *Reuss*, b. ii. 2. s. 455.—Saulenspath, *Lud.* b. i. s. 172. *Id. Mohs*, b. ii. s. 226.—Sauliger Baryt, *Leonhard*, Tabel. s. 40.—Saulenspath, *Lenz*, b. ii. s. 905.—Saulenschwerspath, *Hoff.* b. iii. s. 174.

External Characters.

Its principal colours are smoke and yellowish grey, seldomer greenish and pearl grey; from yellowish-grey it sometimes passes into dark greyish and yellowish white; and in some crystals there are transitions from greenish-grey into olive-green, and from pearl-grey into flesh-red, and still seldomer from smoke-grey into a kind of indigo-blue.

It seldom occurs massive, or in angulo-granular, and promiscuous prismatic concretions, generally crystallized, and in the following figures:

1. Slightly oblique four-sided prism, rather acutely bevelled on the extremities, the bevelling planes set on the acuter lateral edges. Fig. 143. Pl. 7.
   a. The obtuse edges truncated.
   b. The angles of the bevelment truncated; when these truncating planes increase in magnitude, there is formed
2. An oblique four-sided prism, rather acutely acuminated on the extremities with four planes, which are set on the lateral edges. The obtuse lateral edges of the prism are sometimes truncated. Sometimes

Sometimes this acumination is surmounted by another flatter four-planed acumination. When the truncating planes on the obtuse lateral edges of the varieties (1) and (2) increase, there is formed

3. An unequiangular six-sided prism, with two opposite acuter lateral edges, and with the same terminal bevelment and acuminations as in figures 1. and 2.

   When this prism becomes broad, it passes into the tabular form. When the prism in the variety (*b*) disappears, there is formed

4. A rather flat double four-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other.

The crystals are middle-sized and small, and are generally promiscuously aggregated.

The surface of the crystals is splendent, and the lateral planes are transversely streaked.

Internally it is shining, or splendent, and the lustre is pearly, inclining to resinous.

The cleavage is more or less perfect.

It alternates from translucent to semi-transparent.

Specific gravity 4.471, *Breithaupt*.

Geognostic Situation.

It occurs in veins, along with fluor-spar, and ores of silver and cobalt; in gneiss, mica-slate, and other primitive rocks. It is rare in clay-slate, very rare in secondary rocks.

Geognostic Situation.

It occurs at Kongsberg in Norway; Mies in Bohemia;

and

and Freyberg, Marienberg, and Ehrenfriedersdorf in Saxony; Roya in Auvergne.

Observations.

The prismatic crystallizations, granular and prismatic concretions, and resinous lustre, are the principal characters of this subspecies.

3. Di-Prismatic Baryte, or Strontianite.

Di-prismatischer, Hal-Baryt, *Mohs.*

Strontian, *Werner.*

Strontian, *Wid.* s. 571. *Id. Kirw.* vol. i. p. 332. *Id. Estner,* b. ii. s. 48.—Kohlensaurer Strontianit, *Emm.* b. i. s. 310.—Strontianite, *Nap.* p. 391.—Strontites, *Hope,* Edin. Trans. for 1790. *Id. Lam.* t. ii. p. 130.—Strontiane carbonatée, *Haüy,* t. ii. p. 327—La Strontianite, *Broch.* t. i. p. 637.—Strontianit, *Reuss,* b. ii. 2. s. 416. *Id. Lud.* b. i. s. 174. *Id. Suck.* 1r th. s. 684. *Id. Bert.* s. 133. *Id. Mohs,* b. ii. s. 198. —Strontiane carbonatée, *Lucas,* p. 18.—Kohlensaurer Strontianit, *Leonhard,* Tabel. s. 41.—Strontiane carbonatée, *Brong.* t. i. p. 259. *Id. Brard,* p. 64.—Strontian, *Karsten,* Tabel. s. 54.—Strontianite, *Haus.* s. 131. *Id. Kid,* vol. i. p. 82.—Strontiane carbonatée, *Haüy,* Tabl. p. 15.—Strontianite, *Lenz,* b. ii. s. 915. *Id. Oken,* b. i. s. 411. *Id. Haus.* Handb. b. iii. s. 979.—Strontian, *Hoff.* b. iii. s. 186. *Id. Aikin,* p. 166.

External Characters.

Its colour is pale asparagus-green, which sometimes inclines to apple-green, sometimes to yellowish-white and greenish-grey. The greenish-grey variety sometimes passes into milk and yellowish white, and pale straw-yellow.

It

It occurs massive, in distinct concretions, which are scopiform, radiated and fibrous, and crystallized. The primitive form is an oblique four-sided prism, bevelled on the extremities. The vertical prism is 117° 19′; the horizontal is not determined. The secondary figures are the following:

1. Acicular six-sided prism, acutely acuminated with six planes, which are set on the lateral planes.
2. Acicular acute double six-sided pyramid.

The crystals are sometimes scopiformly and manipularly aggregated.

The lustre of the distinct concretions is shining or glistening; of the fracture glistening, and is pearly.

The cleavage is in the direction of the lateral planes of the primitive form.

The fracture is fine-grained uneven.

The fragments are wedge-shaped, or splintery.

It is more or less translucent, and sometimes semi-transparent.

It is harder than calcareous-spar, but not so hard as fluor-spar.

It is brittle, and easily frangible.

Specific gravity, 3.675, *Klaproth*.—3.644, *Kirwan*.—3.6583, 3.675, *Haüy*.—3.6, 3.8, *Mohs*.

Chemical Characters.

It is infusible before the blowpipe, but becomes white and opaque, and tinges the flame of a dark purple colour. It is soluble, with effervescence, in muriatic or nitric acid; and paper dipped in the solutions thus produced, burns with a purple flame.

Constituent

Constituent Parts.

Strontian,	61.21	69.5	62.0	74.0
Carbonic Acid,	30.20	30.0	30.0	25.0
Water,	8.50	0 5	8.0	0.5
	100.00	100.0	100.0	99.5
	Hope, Edin. Trans. for 1790.	*Klaproth*, Beit. b. i. s. 270.	*Pelletier*, Jour. des Mines, N. 21. p. 46.	*Buchols*, in Lenz Min. b. ii. s. 916.

Geognostic and Geographic Situations.

It occurs at Strontian in Argyleshire, in veins that traverse gneiss, along with galena or lead-glance, heavy-spar, and calcareous-spar; very rarely at Leogang in Salzburg; also at Braunsdorf in Saxony, along with calcareous-spar, iron and copper pyrites; and at Pisope, near Popyan in Peru.

Observations.

1. The peculiar earth which characterises this mineral was discovered by Dr Hope, and its various properties were made known to the public in his excellent memoir on Strontites, inserted in the Transactions of the Royal Society of Edinburgh for the year 1790.

2. It is characterised by its green colours, acicular crystallizations, prismatic concretions, and weight; it is distinguished from *Arragonite* by colour and greater specific gravity; from *Witherite* by colour, and inferior specific gravity.

3. According to Blumenbach, it is not poisonous like Witherite.

4. Axifrangible

4. Axifrangible Baryte, or Celestine.

Axentheilender Hal-Baryt, *Mohs.*

Zölestin, *Werner.*

This Species is divided into five Subspecies, viz. Foliated Celestine, Prismatic Celestine, Fibrous Celestine, Radiated Celestine, and Fine Granular Celestine.

First Subspecies.

Foliated Celestine.

Blättricher Celestin, *Karsten.*

Schaaliger Zölestin, *Werner.*

Strontiane sulphatée, *Haüy,* t. ii. 313.—Blättricher Schützit, *Reuss,* b. ii. 2. s. 423.—Blättricher Celestin, *Suck.* 1r th. s. 688. *Id. Bert.* s. 134. *Id. Mohs,* b. ii. s. 280.—Blättriger schwefelsaurer Strontianit, *Leonhard,* Tabel. s. 41.—Blättriger Celestin, *Karsten,* Tabel. s. 54.—Strontian sulphatée laminaire, *Haüy,* Tabl. p. 14.—Blättriger Celestin, *Lenz,* b. ii. s. 923. —Schaliger Zölestin, *Hoff.* b. iii. s. 195.

External Characters.

Its colours are milk-white, bluish-grey, smalt-blue, sky-blue; also yellowish-white, and rarely reddish-white, and pale flesh-red.

It occurs massive; also in lamellar distinct concretions, which are generally straight, or slightly curved, and in which the surfaces are smooth and shining; and crystallized in the following figures:

1. Rectangular

1. Rectangular four-sided table, in which the terminal planes are bevelled; of these, two opposite are acute, and other two opposite flatly bevelled, and the terminal edges truncated. Sometimes the edges between the bevelling planes and the lateral planes are truncated.
2. Rectangular four-sided table, bevelled on the terminal edges.

The crystals are middle-sized and small, and frequently rest on each other, or intersect each other.

Externally it is shining and splendent; internally it is shining and pearly, inclining to vitreous.

It has a threefold cleavage in which the folia are parallel with the planes of the primitive figure, and of these, that parallel with the terminal planes is the most distinct.

The fracture is uneven.

The fragments are rhomboidal, or indeterminate angular, and rather sharp-edged.

It is translucent, semi-transparent, or transparent.

It scratches calcareous-spar, but is scratched by fluor-spar.

It is rather sectile, and is very easily frangible.

Specific gravity, 3.960, *Clayfield*.—3.967, *Karsten*.—3.6–4.0, *Mohs*.

Chemical Characters.

It melts before the blowpipe into a white friable enamel, without very sensibly tinging the flame: after a short exposure to heat, it becomes opaque, and has then acquired a somewhat caustic acrid flavour, very different from that of sulphuretted hydrogen, which heavy-spar acquires in similar circumstances.—*Aikin*.

These

These characters apply also to the other subspecies.

Constituent Parts.

Strontian,	57.64	Strontian and Sulphuric Acid,	97.208	Strontian, and Sulphuric Acid,	97.601
Sulphuric Acid,	43.00	Sulphate of Barytes, -	2.222	Sulphate of Barytes, -	00.975
	100.64	Silica, -	0.254	Silica, -	00.107
Rose, in Karsten's Tabellen, s. 55.		Oxide of Iron,	0.116	Oxide of Iron, and intermixed Hydrate of Iron,	00.646
		Water, -	0.190	Water, -	00.248
		Petroleum, a minute portion.			
			99.099		99.577
		Stromeyer, in Gött. Gel. Anz. 1811, 188.		*Stromeyer*, in Gött. Gel. Anz. 1812, 12. 114.	

Geognostic and Geographic Situations.

It occurs in trap-tuff in the Calton Hill at Edinburgh *, and in red sandstone at Inverness. It is frequent along with some of the other subspecies at Aust Passage, and elsewhere in the neighbourhood of Bristol, and in the islands in the Bristol Channel, particularly in Barry Island, on the coast of Glamorganshire; also in amygdaloid at Bechely in Gloucestershire †; and it has been found on the banks of the Nidd, near Knaresborough, Yorkshire. It forms a bed, about one-fourth of a fathom thick, in a coal-mine, which appears to be connected with shell limestone, at Süntel in Hanover; and also near Karlshütte, on the road from Göttingen to Hanover; in the Canton of Aargau in Switzerland;

* It was discovered in the Calton Hill by my pupil Mr Sievright of Meggetland.

† It was discovered in the Becheley amygdaloid by my pupil Dr Daubeny.

Switzerland; in the Sysser Alp in the Tyrol; Montecchio Maggiore in the Vicentine, in vesicular cavities in basaltic amygdaloid; and Montmartre, near Paris.

Observations.

This subspecies is characterised by its tabular crystals, and lamellar concretions. It is nearly allied to *Lamellar Heavy-spar*, but is harder and lighter; and is distinguished from *Anhydrite* by crystallization, cleavage, and greater specific gravity.

Second Subspecies.

Prismatic Celestine.

Saulenformiger Zölestin, *Werner*.

Saulenformiger Zölestin, *Werner*.—Strontiane sulphatée forme determinable, (in part), *Haüy*.

External Characters.

Its colours are yellowish and milk white; the latter passes into sky-blue, and inclines to indigo-blue.

It occurs massive, also in distinct concretions, which are thick, straight, and wedge-shaped prismatic; but most frequently crystallized.

The primitive form is an oblique four-sided prism of 104° 48′, bevelled on the extremities. The following are the most frequent crystallizations:

1. Long oblique four-sided prism, flatly bevelled on the extremities, the bevelling planes set on the obtuse lateral

lateral edges *, Fig. 144. Pl. 7. Sometimes the acute edges are truncated †, Fig. 145. Pl. 7.

2. Sometimes the angles between the bevelling and lateral planes are more or less deeply truncated, and thus form a four-planed acumination, in which the acuminating planes are set on the lateral edges ‡, Fig. 146. Pl. 7.

3. Sometimes the acute edges of the preceding figure are truncated, and thus a six-sided prism is formed ||, Fig. 147. Pl. 7.

The crystals are middle-sized, and scopiformly aggregated, under an acute angle, and forming druses.

Externally it is smooth, splendent, and resinous.

Internally it is glistening and pearly, inclining to resinous.

The cleavage is the same as in the foliated subspecies.

The fracture is uneven.

The fragments are wedge-shaped and indeterminate angular.

It is translucent, or transparent.

In other characters, it agrees with the preceding subspecies.

Constituent Parts.

	Sicily.
Strontian, - -	54
Sulphuric Acid, - -	46
	100 *Vauquelin.*

Geognostic

* Strontiane sulphatée unitaire, Haüy.

† Strontiane sulphatée emousée, Haüy.

‡ Strontiane sulphatée dodecaedre, Haüy.

|| Strontiane sulphatée epointée, Haüy.

Geognostic and Geographic Situations.

It occurs in drusy cavities in a bed of sulphur, which is associated with gypsum and marl, in the valleys of Noto and Mazzara, in Sicily; in amygdaloid, along with calcareous-spar, in the neighbourhood of Greden, in the circle of the Inn; and in gypsum, near Cadiz.

Observations.

It has much the appearance of Prismatic Heavy-spar, but is distinguished from that mineral by its more distinct cleavage, inferior lustre, less regular concretions, greater sectility, easier frangibility, and inferior weight.

Third Subspecies.

Fibrous Celestine.

Fasriger Zölestin, *Werner.*

Fasriger Cœlestin, *Karsten,* Tabel. s. 54.—Strontiane sulphatée fibreuse-conjointe, *Haüy,* Tabl. p. 14.—Fasriger Cœlestin, *Lenz,* b. ii. s. 931.—Fasriger Zölestin, *Hoff.* b. iii. s. 191.

External Characters.

Its colour is intermediate between smalt-blue and pale indigo-blue, which passes on the one-side into bluish-grey, on the other into milk-white.

It occurs massive, also in distinct concretions, which are straight, parallel, and sometimes curved, fibrous.

Internally it is glistening and pearly.

It has an indistinct cleavage.

The

The fragments are splintery.

It is translucent.

Specific gravity, 3.721, *Karsten.*—3.830, *Klaproth.*

In other characters it agrees with the preceding subspecies.

Constituent Parts.

Strontian,	-	56.0
Sulphuric Acid,	-	42.0
Trace of Oxide of Iron.		
		98.0

Klaproth, Beit. b. ii. s. 97.

Geognostic and Geographic Situations.

It occurs in the red sandstone formation near Bristol; imbedded in marl, which is probably connected with gypsum, at Frankstown in Pennsylvania; and at Bouveron, near Toul, in the department of Meurthe in France.

Observations.

It resembles in external aspect *Fibrous Limestone, Fibrous Gypsum, Fibrous Anhydrite*, but is distinguished from all of them by its blue colours, and greater specific gravity. Its parallel fibrous concretions, and inferior specific gravity, distinguish it from *Fibrous Heavy-spar.*

Fourth

Observations.

Its specific gravity distinguishes it from *Granular Limestone* and *Dolomite.*

GENUS III. TUNGSTEN *, or SCHEELIUM †.

Scheel Baryt, *Mohs.*

THIS genus contains one species, viz. Pyramidal Tungsten.

1. Pyramidal Tungsten.

Pyramidaler Scheel-Baryt, *Mohs.*

Schwerstein, *Werner.*

Minera Ferri lapidea gravissima, *Wall.* t. ii. p. 254.—Wolfram de couleur blanche, *Romé de Lisle,* t. iii. p. 264.—Schwerstein, *Werner,* Pabst. b. i. s. 222.—Weisser Tungsten, *Wid.* s. 980.—Tungsten, *Kirw.* vol. ii. p. 314.—Tungstate calcaire, Mine d'Etaine blanche, *De Born,* t. ii. p. 230.—Schwerstein, *Emm.* b. ii. s. 570.—Tungstene, *Lam.* t. i. p. 402.—Scheelen calcaire,

* The name *Tungsten* was given to this mineral by the Swedes, on account of its great weight.

† Werner gave the name *Scheele* to this genus, in honour of the illustrious chemist Scheele, who discovered the peculiar metal which characterises it.

calcaire, *Haüy*, t. iv. p. 320.—La Pierre pesant, ou Le Tungstene, *Broch.* t. ii. p. 453.—Scheelerz, *Reuss*, b. iv. s. 534. *Id. Lud.* b. i. s. 303.—Kalk-Scheel, *Suck.* 2ter th. s. 459.—Schwerstein, *Bert.* s. 509. *Id. Mohs*, b. iii. s. 623.—Scheelin calcaire, *Lucas*, p. 183.—Scheelerz, *Leonhard*, Tabel. s. 81.—Scheelin calcaire, *Brong.* t. ii. p. 93. *Id. Brard*, p. 389.—Scheelerz, *Karsten*, Tabel. s. 74.—Scheelin calcaire, *Haüy*, Tabl. p. 118.—Tungsten, *Kid*, vol. ii. p. 225.—Schwerstein, *Haus.* Handb. b. iii. s. 967. *Id. Hoff.* b. iv. s. 236. *Id. Aikin*, p. 134.

External Characters.

White is the principal colour of this mineral; the following varieties of colour also sometimes occur, viz. plumb-blue, pearl-grey, greenish and ash grey, greyish and yellowish white, and this latter passes into yellowish-grey, and further into clove, broccoli, reddish, and yellowish brown, which sometimes inclines to orange-yellow and hyacinth-red.

It occurs massive, disseminated, also in distinct concretions, which are granular, seldomer wedge-shaped prismatic, and these latter traversed by others which are curved lamellar. It is sometimes crystallized.

The primitive figure is a rather acute double four-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other. The corresponding planes of the opposite pyramids meet under an angle of 113° 36′, while the adjacent planes of the same pyramid meet under an angle of 107° 26′.

The following are the secondary forms:

1. The primitive figure, in which the angles of the common base are flatly bevelled, and the bevelling planes set on the lateral edges.

a. Sometimes

a. Sometimes the edges between the lateral and bevelling planes are truncated.

b. The apices flatly acuminated with four planes, which are set on the lateral planes. The apex of this acumination is sometimes truncated.

c. The lateral edges flatly bevelled. When the bevelling planes on the angles of the common base in the figure N° 1. become so large that the original planes disappear, there is formed

2. A very acute double four-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other. In this pyramid the angles are 100° 8′, and 130° 20′. This pyramid is frequently truncated in the lateral edges.

   When the acumination on the extremities of the pyramid *b*, become so large that the original faces disappear, there is formed

3. A flat double four-sided pyramid, from which, by truncation of the apices, and rounding off of the obtuse lateral edges, there is formed

4. A kind of square lenticular figure.

5. Flat double four-sided pyramid, so deeply truncated on the summits, that it appears as a four-sided table, bevelled on the terminal planes.

The crystals are middle-sized, small and very small; they are always superimposed, sometimes in single crystals, sometimes in druses.

The lateral planes of the crystals are generally smooth; the planes of the first pyramids are slightly streaked; they are shining and splendent, and their lustre inclines to adamantine.

Internally it is shining, and the lustre is resinous, sometimes inclining to adamantine.

The

The fracture is coarse, or small-grained uneven, passing into imperfect conchoidal.

It has a nine-fold cleavage; four of the folia are parallel with the sides of the primitive figure, four parallel with the sides of the acute pyramid, and the ninth parallel with the common base of the double pyramid. Of these the last is generally the most perfect.

The fragments are indeterminate angular, and rather blunt-edged.

It is more or less translucent, seldom semitransparent.

It is harder than fluor-spar, but not so hard as apatite.

It is rather brittle, and easily frangible.

Specific gravity, 6, 6.1, *Mohs.*—6.028, *Kirwan.*—6.000, *Gellert.*—6.015, *Klaproth.*

Chemical Characters.

It crackles before the blowpipe and becomes opaque, but does not melt; with borax it forms a transparent or opaque white glass, according to the proportions of each.

Constituent Parts.

		Schlackenwald.	Cornwall.
Oxide of Tungsten,	65	77.75	75.25
Lime, -	31	17.60	18.70
Silica, -	4	3.00	1.56
Oxide of Iron, -	—	—	1.25
Oxide of Manganese,	—	—	0,75
	100	98.35	97.45
	Scheele, in n. Abhand. d. Schwd. Akad. 1781, 289.	*Klaproth*, Beit. b. iii. s. 47. & 51.	

 Geognostic

Geognostic Situation.

It occurs along with tinstone, magnetic iron-ore, and brown iron-ore, in primitive rocks. In the tinstone repositories, it is associated with wolfram, quartz, mica, fluor-spar, and steatite.

Geographic Situation.

It occurs along with wolfram and tin-ore at Pengilly in Breage in Cornwall *: at Bispberg in Sweden, in a bed of magnetic iron-ore: in fine crystals at Schlackenwald in Bohemia: at Zinwald and other places in Saxony: and in the gold-works of Schillgaden at Salzburg.

Observations.

It is distinguished from the white varieties of *Tin-ore*, by its shape, intensity, and kind of lustre, inferior hardness, inferior weight, and its becoming yellow when thrown into nitric acid: from *Yellow Lead-spar*, by colour and higher specific gravity: from *Heavy-spar*, by form, lustre, cleavage, and greater weight, and by the yellow colour it assumes when thrown into nitric acid.

GEN. IV.

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* Heuland.

Genus IV. CALAMINE *.

Zink-Baryt, *Mohs.*

This genus contains two species, viz. 1. Prismatic Calamine, and, 2. Rhomboidal Calamine.

1. Prismatic Calamine, or Electric Calamine.

Prismatischer Zink-Baryt, *Mohs.*

Zinc Oxydé, *Haüy.*

Zinc oxydé, *Haüy,* t. iv. p. 159. (in part).—Blättricher Galmei, *Reuss,* b. ii. 4. s. 349. (in part).—Electrical Calamine, *Smithson,* Phil. Trans. p. i. for 1803.—Spathiger Galmei, *Leonhard,* Tabel. s. 72.—Zinc Calamine, *Brong.* t. ii. p. 136.—Zinkglaserz, *Karsten,* Tabel. s. 70.—Zinc oxydé, *Haüy,* Tabl. p. 102. —Zinkglas, *Haus.* Handb. b. i. s. 343.—Galmei, *Hoff.* b. iv. s. 90.—Electric Calamine, *Aikin,* p. 120.

External Characters.

Its most common colours are white and yellow: from greenish-white it passes into apple-green, oil-green, and siskin-green; from greyish-white, into ash, smoke, and yellowish grey; and from this latter into isabella, straw and ochre

* Agricola says, that because the Cadmia (calamine) in the furnace, attaches itself to the iron bars in forms like a reed, (calamus), it was named *Calamine.*

ochre yellow, and into yellowish and clove brown. It has sometimes a curved striped colour delineation.

It occurs massive, disseminated, in crusts, stalactitic, reniform, botryoidal, cellular, corroded; also in distinct concretions, which are scopiform, radiated, or fibrous, granular, and curved lamellar.

It is sometimes crystallized.

Its primitive figure is an oblique four-sided prism, bevelled on the extremities, in which the lateral planes (vertical prism) have an angle of 99° 56′, and the bevelling planes (horizontal prism) an angle of 120°. The following are some of the secondary figures.

1. Six-sided prism.
2. Flat six-sided prism, bevelled on the terminal planes; the bevelling planes set on the broader lateral planes. This prism is sometimes so flat, that it appears like a longish rectangular four-sided table bevelled on the terminal planes.
3. Acute double four-sided pyramid, sometimes perfect, sometimes truncated on the summits.
4. Acute double four-sided pyramid, acuminated on both extremities, with four planes, which are set on the lateral planes, and sometimes the summits are truncated.

The crystals are small; and either solitary, or scopiformly aggregated.

Internally, the lustre alternates from glistening to dull, and the lustre is pearly, inclining to adamantine.

The fracture is small and fine-grained uneven.

The cleavage is imperfect, and in the direction of the planes of the primitive prism.

It alternates from transparent to translucent on the edges, and opaque.

The

The crystallized varieties are as hard as apatite; the massive and opaque softer.

The dark coloured varieties afford a yellowish-grey streak.

Specific gravity, 3.3, 3.6, *Mohs.*

Physical Characters.

When gently heated, it is strongly electric.

Chemical Characters.

It loses, according to Pelletier, about 12 *per cent.* by ignition; it is soluble in muriatic acid without effervescence; and the solution gelatinises on cooling.

Constituent Parts.

	Wanlockhead.	Freyburg.	Rezbanya.	Raibel in Carinthia.	England.
Oxide of Zinc,	66.00	38.00	68.30	69.025	75.00
Silica, -	33.00	50.00	25.00	30.750	25.00
Water, -		12.00	4.40		
	99	100	97.70	100.00	100.00
	Klaproth, in Crell's Annalen for 1788, 1. s. 298.	*Pelletier*, in Mem & Obs. de Chim. t. i. p. 60.	*Smithson*, in Phil. Trans. part i. for 1803.	*John*, Chem. Unter. b. iii. s. 302. & 303.	

Geognostic Situation.

It occurs in small quantities in metalliferous veins, principally along with ores of lead, in grey-wacke, grey-wacke-slate, and clay-slate; but most frequently in secondary or flœtz limestone, in imbedded masses, and irregular beds.

Geographic

Geographic Situation.

It occurs in the lead-mines at Wanlockhead; also in Leicestershire and Flintshire. On the Continent, it is met with at Tarnowitz in Silesia, Tscheren in Bohemia, Rezbanya in Hungary, Bleiberg in Carinthia, Freyburg in the Bresgau, and Stolberg in the Tyrol. It is a rare mineral in northern latitudes, and there it occurs only at Kolywan and Nertschinsky in Siberia.

Observations.

It is distinguished from *White Lead-spar* by its superior hardness, and inferior specific gravity; from *Tabular-spar, Arragonite* and *Zeolite*, by its greater specific gravity. The massive and uncrystallized varieties may be distinguished from *Indurated White Lead-spar* by inferior specific gravity, and from *Brown Iron-ore* by its greater specific gravity.

2. Rhomboidal Calamine.

Galmei, *Werner*.

Rhomboedrischer Zink-Baryt, *Mohs*.

This species is divided into three subspecies, viz. Sparry Rhomboidal Calamine, Compact Rhomboidal Calamine, and Earthy Rhomboidal Calamine.

First

First Subspecies.

Sparry Rhomboidal Calamine.

Späthiger Galmei, *Karsten.*

Minera Zinci vitrea, *Waller.* Syst. Min. t. ii. p. 215. (in part). —Blättricher Galmei, *Reuss,* b. iv. s. 349. (in part).—Spathiger Galmei, *Karsten,* Tabel. s. 70.—Zinc carbonaté, var. 1, 2. *Haüy,* Tabl. p. 103.—Edler Galmei, or Zinkspath, *Haus.* Handb. b. i. s. 345.—Calamine, *Aikin,* p. 119.

External Characters.

Its colours are greyish-white, yellowish-white, bluish-grey, greenish-grey, siskin-green, apple-green, reddish-brown, and clove-brown.

It occurs massive, botryoidal, reniform, stalactitic, tabular, cellular; also in distinct concretions, which are prismatic, granular, and curved lamellar; and crystallized.

The primitive figure is a rhomboid of about 110°. The following are some of its crystallizations:

1. Obtuse rhomboid.
2. Acute rhomboid.
3. Long four-sided table, which is either perfect, or bevelled on the terminal planes; and the angles of the bevelment sometimes more or less deeply truncated.

The crystals are small.

Internally it is shining and pearly.

The cleavages threefold, and in the direction of the planes of the primitive rhomboid.

The

The fragments are rhomboidal.
It alternates from semitransparent to opaque.
It is as hard as apatite.
Specific gravity, 4.2, 4.4, *Mohs.*

Chemical Characters.

It dissolves with effervescence in muriatic acid; it is infusible; loses about 34 *per cent.* by ignition.

Constituent Parts.

		Derbyshire.	Somersetshire.
Oxide of Zinc,	-	65.2	64.8
Carbonic Acid,	-	34.8	35.2
		100	100

Smithson, in Phil. Trans. P. I. for 1803.

Second Subspecies.

Compact Rhomboidal Calamine.

Gemeiner Galmei, *Karsten.*

Lapis calaminaris, *Wall.* Syst. Min. t. ii. p. 216.—Gemeiner Galmei, *Reuss*, b. iv. s. 345. (in part).—Gemeiner Galmei, *Karsten*, Tabel. s. 70.—Zinc carbonaté, var. 3, 4. *Haüy*, Tabl. p. 103.—Gemeiner Galmei, *Haus.* Handb. b. i. s. 347.—Compact Calamine, *Aikin*, p. 119.

External Characters.

Its colours are yellowish, ash, greenish, and smoke-grey; also cream-yellow, straw-yellow, and yellowish-brown.

It

It occurs massive, disseminated, corroded, reniform, stalactitic, and cellular; also in concentric curved lamellar concretions. Rarely in supposititious crystals, or incrusting other crystals.

Internally it is dull, or very feebly glimmering and resinous.

The fracture is coarse-grained uneven, fine splintery, even, and flat conchoidal.

It is opaque, or feebly translucent on the edges.

Chemical Character.

The same as in the preceding subspecies.

Third Subspecies.

Earthy Rhomboidal Calamine.

Zinkblüthe, *Karsten.*

Zinkblüthe, *Karsten*, Tabel. s. 70.—Zinc carbonaté, *Haüy*, Tabl. p. 103. (in part).—Zinkblüthe, *Haus.* Handb. b. i. s. 348.—Earthy Calamine, *Aikin*, p. 120.

External Characters.

Its colours are snow-white, greyish-white, and yellowish-white; sometimes with a yellowish-brown exterior.

It occurs massive, disseminated, botryoidal, flat reniform, and with impressions.

Internally it is dull.

The fracture is fine earthy.

It is opaque.

It yields to the nail.

It

It adheres to the tongue.
Specific gravity 3.358.

Chemical Characters.

The same as in the first subspecies.

Constituent Parts.

		Bleiberg in Carinthia.
Oxide of Zinc,	-	71.4
Carbonic Acid,	-	13.5
Water,	- -	15.1
		100.0

Smithson in Phil. Trans. P. I. for 1803.

Geognostic Situation of the Species.

It occurs in beds, nests, filling up or lining hollows, in transition limestone, and in secondary or flœtz limestone, and conglomerate rock; also in veins. In these repositories it is generally associated with galena or lead-glance, and occasionally with copper-pyrites, copper-green, malachite, yellow and brown blende, sparry iron, ochry-brown ironstone, brown-spar, calcareous-spar, and quartz.

Geographic Situation of the Species.

Europe.—It occurs in the Mendip Hills, at Shipham, near Cross, Somersetshire; at Allonhead in Durham; at Holywell, and elsewhere in Flintshire; and in Derbyshire. On the Continent, it is met with at Raibel and Bleiberg in Carinthia; Aachen; Namur; Chemnitz in Hungary; Medziana Gora in Poland; Beuthen and Tarnowitz in Silesia; and Iserlohn in the Dutchy of Berg.

Asia.

Asia.—Altai in Siberia.

Uses.

1. Both prismatic and rhomboïdal calamine, when purified and roasted, are used for the fabrication of brass, which is a compound of zinc and copper; and the pure metal is also employed for a variety of other purposes. The use of calamine in the composition of brass was known at a very early period; for it is mentioned by Aristotle, who also makes a distinction between the compound resulting from the mixture of copper and calamine, and that resulting from the mixture of copper and tin *.

2. The compact varieties of prismatic and rhomboidal calamine are sometimes confounded together.

GENUS V.—RED MANGANESE.

THIS Genus contains one species, viz. Rhomboidal Red Manganese.

1. Rhomboidal Red Manganese.

Langaxiger Flinz-Baryt, *Mohs.*

This species is divided into three subspecies, viz. 1. Foliated Rhomboidal Red Manganese, 2. Fibrous Rhomboidal

* Aristot. ed. Paris, 1654, vol. ii. p. 721.

dal Red Manganese, and, 3. Compact Rhomboidal Red Manganese.

First Subspecies.

Foliated Rhomboidal Red Manganese.

Blättriger Braunspath, (in part), *Hoff.* b. iii. s. 111.—Manganspath, *Hoff.* b. iii. s. 155.—Chaux carbonatée manganesifère rose, *Haüy*, Tabl. p. 5.—Manganese oxydé carbonatée, *Haüy*, Tabl. p. 111.—Rosenrod syrsatt Manganes, *Hisinger*, in Afhandling. i Fys. Kem. och Min. i. 105.

External Characters.

Its colour is bright rose-red, slightly inclining to flesh-red.

It occurs massive, disseminated, small reniform, globular, with tabular and rhomboidal impressions, and in granular distinct concretions; also crystallized in rhomboids, the dimensions of which have not been accurately determined.

Internally it is shining, inclining sometimes to glistening, sometimes to splendent, and the lustre pearly.

Its cleavage is rhomboidal, or the folia of the cleavage are in the direction of the planes of the rhomboid.

The fragments are indeterminate angular and rather sharp-edged, or rhomboidal.

It is generally translucent on the edges; in some rare varieties translucent.

Its hardness is intermediate between that of calcareous spar and fluor-spar.

It is brittle, and rather easily frangible.

Specific

Specific gravity, 3.3–3.6, *Mohs.*—3.588, *Berzelius.*—3.661–3.685, *Breithaupt.*

Chemical Character.

Before the blowpipe, without addition, it first becomes dark brown, and then melts into a dark reddish-brown bead.

Constituent Parts.

Oxide of Manganese, -	52.60
Silica, - - -	39.60
Oxide of Iron, - -	4.60
Lime, - - - -	1.50
Volatile ingredients, -	2.75
	101.5

Berzelius, in Afh. i Fys. och. Min. i. 110.

Geognostic and Geographic Situations.

It occurs in beds of specular iron-ore and magnetic iron-ore, along with compact garnet and calcareous-spar, in the gneiss hills at Langbanshytta, in Wermeland in Sweden; also at Catharinenburg in Siberia. It is found also in Saxony.

Uses.

The Siberian varieties are cut and polished, and worn as ornamental stones.

Observations.

Its bright rose-red colour, distinct concretions, and fracture, distinguish it from the other subspecies.

Second

Second Subspecies.

Fibrous Rhomboidal Red Manganese.

Fasriger Braunspath, (in part), *Hoff.* b. iii. s. 54.

External Characters.

Its colours are rose-red and flesh-red, inclining to grey and brown.

It occurs massive, and in prismatic fibrous concretions, which are straight, scopiform and stellular.

Internally it is glistening and pearly.

The fragments are splintery and wedge-shaped.

It is feebly translucent.

Geognostic and Geographic Situations.

It occurs in veins in primitive and transition rocks. It is a rare mineral, and is principally found at Kapnik in Transylvania, and at Schemnitz in Hungary.

Observations.

It is distinguished from the other subspecies by its distinct concretions: from *Fibrous Calc-sinter*, by higher lustre, more perfectly formed concretions, and particularly by its considerable specific gravity.

Third

Third Subspecies.

Compact Rhomboidal Red Manganese.

Dichtes Rothbraunstein, *Reuss*, b. iv. s. 470.—Rothstein, *Mohs*, b. ii. s. 122.—Rothbraunstein, *Leonhard*, Tabel. s. 70.—Manganese lithoide, *Brong*. t. ii. p. 110.—Roth Manganerz, *Karsten*, Tabel. s. 72.—Manganese oxydé carbonatée, *Haüy*, Tabl. p. 111. (in part).—Dichtes Rothstein, *Haus*. Handb. b. i. s. 302.—Rother Braunstein, *Hoff*. b. iv. s. 158.

External Characters.

Its principal colour is pale rose-red, which sometimes passes into dark reddish-white. Externally it has sometimes a wood-brown and yellowish-brown colour, owing to the action of the weather.

It occurs massive, disseminated, and sometimes imperfectly reniform.

Internally it is dull or glimmering.

The fracture is even, sometimes inclining to splintery.

The fragments are indeterminate angular, and rather sharp-edged.

Its hardness is intermediate between that of calcareous spar and fluor-spar.

It is brittle, and rather easily frangible.

Specific gravity 3.3–3.9, *Mohs*.

Chemical Characters.

It is infusible before the blowpipe, but becomes black by ignition.

Constituent Parts.

	Siberia.
Oxide of Manganese, -	61
Silica, - - - - -	30
Oxide of Iron, - - -	5
Alumina, - - -	2
	98

Lampadius, in Pract. Chem. Abh. b. ii. s. 209.

Geognostic and Geographic Situations.

It occurs at Kapnik in Transylvania, in veins, along with quartz, black copper-ore, sulphuret of manganese, blende, galena or lead-glance, calcareous-spar, and brown-spar; also at Langbanshytta, in Wermeland in Sweden; and Catharinenburg in Siberia.

Observations.

The pale rose-red colour, want of lustre, compact fracture, and weight, are the distinguishing characters of this mineral. It is distinguished from *Brown-Spar*, by its greater hardness, and weight.

GEN. VI.

Genus VI.—SPARRY IRON.

Kurzaxiger Flinz Baryt, *Mohs.*

Spatheisenstein, *Werner.*

Fer oxydé carbonatée, *Haüy.*

This Genus contains one species, viz. Sparry Iron.

1. Sparry Iron.

Spatheisenstein, *Werner.*

Fer oxydé carbonatée, *Haüy.*

Minera Ferri alba, *Wall.* t. ii. p. 251.—*P. J. Hjelm*, Chemisk och Mineralogisk Afhandling om huita Järnmalmer, Upsala, 1774.—Mine de Fer spathique, *Romé de Lisle*, t. iii. p. 281. —Spathiger Eisenstein, *Wern.* Pabst. b. i. s. 164. *Id. Wid.* s. 820.—Calcareous or Sparry Iron-ore, *Kirw.* vol. ii. p. 190. —Fer spathique, ou Mine de Fer blanche, *De Born*, t. ii. p. 290.—Fer spathique, *Lam.* t. i. p. 263.—Chaux carbonatée ferrifere avec Manganese, *Haüy*, t. iv. p. 117, 118.—La Mine de Fer spathique, ou le Fer spathique, *Broch.* t. ii. p. 264.— Spatheisenstein, *Reuss*, b. iv. s. 107. *Id. Lud.* b. i. s. 249. *Id. Suck.* 2ter th. s. 278. *Id. Bert.* s. 428. *Id. Mohs*, b. iii. s. 407. *Id. Hab.* s. 124. *Id. Leonhard*, Tabel. s. 66.—Fer spathique, *Brong.* t. ii. p. 175.—Spath Eisenstein, *Karsten*, Tabel. s. 66.—Eisenspath, *Haus.* s. 129.—Sparry Iron-ore, *Kid*, vol. ii. p. 188.—Fer oxydé carbonatée, *Haüy*, Tabl. p. 99. —Eisenspath, *Haus.* Handb. b. iii. s. 952.—Spatheisenstein, *Hoff.* b. iv. s. 262.—Sparry Iron-ore, *Aikin*, p. 106.

External Characters.

Its colour is pale yellowish-grey, which passes on the one side into pea-yellow and isabella-yellow, and further into yellowish and greyish white; on the other side into yellowish, clove, blackish-brown, and brownish-black. It is rarely ash and greenish grey, or reddish-brown. The lighter fresh colours change on exposure to the air, and become brown, and even black. Probably most of the colours of this mineral have been produced by alterations which have taken place since the period of its formation.

It occurs massive, disseminated, with pyramidal impressions; also in granular distinct concretions; and crystallized.

The primitive form is a rhomboid of 107°. The following are some of the principal forms:

1. Primitive rhomboid.
   - *a.* Perfect, with straight or spherical convex lateral faces.
   - *b.* Truncated on the apices.
   - *c.* Truncated on the terminal edges.
   - *d.* Rounded off on the apices and edges.

   When the truncating planes in the variety 1. *c.* become so large that the original planes disappear, there is formed
2. A still flatter rhomboid.

   From the variety 1. *d.* there arises
3. The spherical lenticular form.

   From the rhomboid with curved faces, there is formed
4. The saddle-shaped lens.

   We sometimes observe the primitive form arranged in rows, so as to form an

5. Equiangular

5. Equiangular six-sided prism, flatly acuminated with three planes, which are set on the alternate lateral planes.

The crystals are middle-sized, small, and very small.

They are seldom singly superimposed, as is the case with the lens, most generally aggregated in druses.

The planes of the lens are delicate drusy, but of all the other forms generally smooth; and the lustre varies from splendent, through shining to glistening.

Internally it is generally glistening, sometimes inclining to shining, and even to splendent; but the black variety is only glimmering, and the lustre is pearly.

It has a threefold cleavage in the direction of the planes of the primitive form, and also of those of the flat rhomboid. The folia are seldom straight, generally spherical curved.

The imperfect foliated fracture is sometimes conjoined with the splintery, and this occurs principally in the greenish-grey varieties.

The fragments are rhomboidal in the foliated varieties, but rather sharp-edged in the compact.

It is generally translucent on the edges, also translucent; but the black varieties are opaque.

The pale varieties afford a white, the darker varieties a yellowish-brown streak.

It is harder than calcareous-spar, but not so hard as fluor.

It is not particularly brittle, and is easily frangible.

Specific gravity, 3.6–3.9, *Mohs.*—3.784, *Gellert.*—3.640–3.810, *Kirwan.*—3.672, *Brisson.*—3.693, *Guyton.*—3.600–3.900, *Collet-Descotils.*

Chemical

Chemical Characters.

It blackens, and becomes magnetic before the blowpipe, but does not melt: it effervesces with muriatic acid. It dissolves with ebullition in glass of borax, and communicates to it an olive-green colour.

Constituent Parts.

	Dankerode.	Baireuth.	Baireuth.		Steinheim.
Oxide of Iron, -	57.50	58.00	59.50		63.75
Carbonic Acid, -	36.00	35.00	36.00		34.00
Oxide of Manganese,	3.50	4.25	a trace		0.75
Lime, - -	1.25	0.50	2.50		...
Magnesia, - -	-	0.75	-		0.25
Water, - - -	-	-	2.00	Loss,	1.25
	98.25	98.50	99.00		100.00
	Klaproth, Beit. b. iv. s. 115.	Ibid. s. 115.	*Buchols.*		*Klaproth*, in Magaz. Natf. Fr. b. v. s. 335.

Geognostic Situation.

It occurs in veins in granite, gneiss, mica-slate, clay-slate, and grey-wacke, and in these it is associated with ores of lead, cobalt, silver, copper, and seldomer with nickel and bismuth; more frequently with galena, grey copper-ore, iron-pyrites, and grey antimony-ore. In other veins, it is accompanied with brown, red, and black iron-ore, calcareous-spar and quartz. But the most extensive formations of this mineral are in limestone, by some referred to primitive, by others to secondary rocks, in which it is arranged in thick beds. It also occurs filling up amygdaloidal cavities in trap rocks.

Geographic

Geographic Situation.

Europe.—It occurs in small quantities in different places in England, Scotland, and Ireland; also in Saxony, Bohemia, Bayreuth, Upper Palatinate, Silesia, Coburg, Savoy, Switzerland, Sweden, and Norway: but it is only in the following countries where it is found in such quantity as to be employed as an ore of iron:—In the Fichtelgebirge; the black variety occurs in great quantity at Schmalkalden in Hessia, where it has been mined and smelted for many centuries; in the Hartz, as at Clausthal, Iberg, Blankenburg, and Stollberg, it occurs less abundantly; in Westphalia, the light-coloured is mined in great quantity; Eisenerz and Schladinrig in Stiria, affords it in considerable quantity; Hüttenberg in Carinthia, Schwatz in the Tyrol, and Jauberling in Carniola, are well known for mines of sparry iron; in many places in Salzburg, in Hungary, as Schemnitz, Schmolnitz, Dopshau, and Siowinka, it occurs in small quantity; mines of it also exist in Piedmont *, and France; and at Somorotstro, in the province of Biscay in Spain, there is a whole hill composed of this species of ironstone, which has been worked for several hundred years. It is there accompanied with red iron-ore, which renders the smelting very advantageous.

Asia.—In the mines of Catharinenburg.

America.—West Greenland; and Mexico.

Uses.

It affords an iron which is excellently suited for steel making. The black variety is said to afford the best kind of iron.

Observations.

* Magnificent lenticular crystals are brought from Traversella in Piedmont.

Ireland.

Observations.

1. Colour, cleavage, inferior translucency, hardness, and weight, characterise this mineral as long as it remains unaltered. It is distinguished from *Calcareous-spar*, *Rhomb-spar*, and *Brown-spar*, by its greater specific gravity, and hardness.

2. Cast-iron obtained from this species, or from brown iron-ore, presents a whitish colour and radiated fracture; whereas that obtained from red iron-ore, and several other ores of iron, has a dark grey colour, and a granular fracture. Further, the cast-iron obtained from this species can be converted into steel; but a great portion of that obtained from red iron-ore, &c. passes to the state of malleable iron, long before the mass in the furnace has become steel. The steel obtained from this ore is said to contain a small portion of manganese, which is supposed to be the cause of its durability in the fire, and what renders it less liable to become soft and irony.

3. It generally occurs more or less weathered. By exposure to the air, it experiences a gradual decomposition, which has a great effect on its external aspect. This decomposition at first affects only the external colour, external lustre, and the transparency; but as it advances, it also changes even the structure, hardness, solidity, and weight of the mineral. The oxidation of the iron and manganese destroys the weak combination of these metals with the carbonic acid, and there is formed a hydrate of iron, sometimes also an oxide of iron, and hydrate of manganese. The whole mass is disintegrated by the escape of the carbonic acid. This acid combining with percolating water dissolves the small portion of lime in the ore, and also portions of the still undecomposed carbonate of iron and oxide of

manganese.

manganese. A knowledge of these changes enables us to understand the very different results obtained in the analysis of specimens more or less weathered or decomposed, and also throws some light on the different results obtained in the smelting of sparry iron more or less decomposed.

4. The analysis of Hielm, published under the sanction of Bergman, is the earliest we possess of this mineral: it gives as the constituent parts, 22.38 Oxide of Iron: 24.28 Oxide of Manganese: 29.43 Carbonate of Lime; and 6.9 Water. The errors of this analysis have been pointed out and corrected by the labours of Drappier, Descotils, Berthier, Klaproth, and Bucholz.

5. It is described under the names Eisenspath, (Iron-spar), White Ironstone, and Sparry Ironstone.

ORDER VII.

ORDER VII.—HALOIDE.

THIS Order contains Six Genera, viz. 1. Limestone, 2. Apatite, 3. Fluor, 4. Aluminite, 5. Cryolite, 6. Gypsum.

GENUS I.—LIMESTONE.

Kalk-Haloide, *Mohs.*

THIS Genus contains four Species, viz. 1. Rhomb-Spar, 2. Dolomite, 3. Limestone, 4. Arragonite.

1. Rhomb-Spar.

Langaxiges Kalk-Haloid, *Mohs.*

Bitterspath, *Wid.* s. 518.—Crystallized Muricalcite, *Kirw.* vol. i. p. 92.—Bitterspath, *Emm.* b. iii. s. 353.—Spato Magnesiano, *Nap.* p. 358.—Bitterspath, *Lam.* t. ii. p. 347.—Chaux carbonatée magnesiée, *Haüy*, t. ii. p. 187.—Le Spath magnesien, ou Le Bitterspath, *Broch.* t. i. p. 560.—Bitterspath, *Reuss*, b. ii. 2. s. 330.—Rautenspath, *Lud.* b. i. s. 154.—Gemeiner Bitterspath, *Suck.* 1r th. s. 634.—Rautenspath, *Bert.* s. 113. *Id. Mohs*, b. ii. s. 96. 98.—Bitterspath, *Hab.* s. 83.—Gemeiner Bitterspath, *Leonhard*, Tabel. s. 35.—Chaux carbonatée lente, Picrite, *Brong.* t. i. p. 230.—Rhomboedrischer Dolomit, *Karsten*, Tabel. s. 50.—Gemeiner Bitterspath, *Haus.* s. 128.—Chaux carbonatée magnesifere, *Brard*, p. 38.—Rhomb-spar, *Kid*, vol. i. p. 57.—Chaux carbonatée magnesifere primitive, *Haüy*,

Haüy, Tabl. p. 5.—Rautenspath, *Lenz*, b. ii. s. 710. *Id. Oken*, b. i. s. 393.—Rautenspath, *Hoff.* b. iii. s. 60. (in part).

External Characters.

Its colours are greyish-white, yellowish-white, ash-grey and yellowish-grey, which latter passes into pea-yellow, and isabella yellow.

The ash-grey sometimes passes into greyish-black.

It occurs massive, and disseminated; and crystallized in rhomboids, in which the obtuse angle is 106° 15′. These rhomboids are sometimes rounded or truncated on the edges.

The crystals are middle-sized and small; the surface is sometimes smooth, sometimes rough, and either shining or glimmering.

Internally the lustre is splendent, between vitreous and pearly *.

It has a threefold oblique angular cleavage: the alternate angles of which measure 106° 15′ and 73° 45′ †.

The fracture is imperfect conchoidal.

The fragments are rhomboidal.

It is harder than calcareous-spar, and sometimes as hard as fluor-spar.

It is easily frangible, and brittle.

Specific gravity, 2.8, 3.2, *Mohs.*—2.880, 3.000. 2.8901, *Murray* ‡.

Chemical

* The lustre in general is stronger than that of calcareous-spar.—*Bournon.*

† Dr Wollaston.

‡ Newton-Stewart, Galloway.

Chemical Characters.

Before the blowpipe it is infusible, without addition: even when pounded, it effervesces but feebly; and dissolves slowly in muriatic acid.

Constituent Parts.

Hall, in the Tyrol.	
Carbonate of Lime,	68.00
Carbonate of Magnesia, -	25.50
Carbonate of Iron,	1.00
Water, - -	2.00
Clay intermixed,	2.00
	98.50

Klaproth, Beit. b. iv. s. 238.

Taberg, in Wermeland.	
Carbonate of Lime,	73.00
Carbonate of Magnesia, -	25.00
Oxide of Iron, mixed with Manganese,	2.25
	100.25

Klaproth, b. i. s. 306.

Near Newton-Stewart in Galloway.	
Carbonate of Lime,	56.60
Carbonate of Magnesia,	42.00
	98.60

Or by another result;

Carbonate of Lime,	56.2
Carbonate of Magnesia,	43.5
	98.9

With a trace of Manganese and Iron.—*Murray* *.

Lime,	28.00
Magnesia,	25.05
Carbonic Acid,	48.00
Oxide of Manganese,	1.05
With a trace of Iron.	

Bucholz.

Geognostic

* The above analysis was communicated to me by my friend Dr Murray.

Geognostic Situation.

It occurs imbedded in chlorite-slate, talc-slate, limestone, and serpentine, occasionally associated with asbestus and tremolite; in the salt formation, where it is imbedded in anhydrite and gypsum; in drusy cavities in compact dolomite, and in metalliferous veins.

Geographic Situation.

Europe.—It occurs imbedded in chlorite-slate on the banks of Loch Lomond; in a vein in transition rocks, along with galena, blende, copper-pyrites, and calcareous-spar, near Newton-Stewart in Galloway; in compact dolomite in the Isle of Man and the north of England; in chlorite-slate and talc in the Upper Palatanite; in the mountain of Chalance in Dauphiny, along with asbestus, talc, and chlorite; also at Brienz in Switzerland; in the mountains of Salzburg; in granular limestone, in the silver mines of Sala, and in the Taberg in Wermeland in Sweden.

America.—At Kannioak in North Greenland, imbedded in common and indurated talc; and at Guanuaxuato in Mexico, along with amethyst, common quartz, and felspar.

Observations.

1. This mineral was formerly named *Bitter-Spar*, from the magnesia contained in it, which is denominated Bitter Salt by the Germans, because obtained easily from sulphate of magnesia or Epsom salt. It was named *Muricalcite* by Kirwan, from the magnesia and lime contained in it; magnesia having been called Muriatic Earth, as being the

the base of one of the salts contained in sea-water. Werner named it *Rhomb-Spar*, from its form.

2. It is distinguished from *Calcareous-spar* by the shape of its rhomboid, superior hardness, and specific gravity, and dissolving slowly in the mineral acids.

2. Dolomite.

Kurzaxiges Kalk-Haloide, *Mohs.*

This Species contains three Subspecies, viz. 1. Dolomite, 2. Miemite, 3. Brown Spar.

First Subspecies.

Dolomite.

This Subspecies is divided into three Kinds, viz. Granular Dolomite, Columnar Dolomite, Compact Dolomite.

First Kind.

Granular Dolomite.

This is again divided into White and Brown Granular Dolomite.

* White Granular Dolomite.

Dolomite, *Saussure*, Voyages dans les Alpes, § 1929.—Biegsamer Körniger Kalkstein, *Reuss*, b. ii. 2. s. 281.—Dolomit, *Blumenb.* Nat. s. 617. *Id. Haus.* Handb. b. iii. s. 963. *Id. Hoff.* b. ii. s. 57.—Chaux carbonatée magnesifere granulaire, *Haüy*, Tabl. p. 6.

External

External Characters.

Its colours are snow-white and greyish-white, and rarely pale ash-grey.

It occurs massive; also in small and fine granular distinct concretions, which are frequently so loosely aggregated, that they can be separated by the mere pressure of the finger.

Internally it is glimmering, approaching to glistening, and the lustre is pearly.

The fracture in the large is imperfect and slaty, in the compact varieties small splintery, which passes into uneven.

The fragments are indeterminate angular, and blunt-edged.

It is faintly translucent, or only translucent on the edges.

It is as hard as fluor-spar.

It is brittle, and easily frangible.

Specific gravity, Dolomite of Alps of Carinthia, 2.835, *Klaproth.*—4.913, *Breithaupt.*

Chemical and Physical Characters.

It effervesces very feebly with acids,—a character which distinguishes it from granular limestone.

It in general phosphoresces when placed on heated iron, or when rubbed in the dark; and this property is much stronger in some varieties than in others.

Constituent

Constituent Parts.

	St Gothard.	Apennines.	Carinthia.	Antique.
[illegible] magnesia,	46.50	35.00	48.00	46.00
[illegible]	52.08	65.00	52.00	51.50
[illegible] manganese,	0.25			
[illegible]	0.50		0.20	
[illegible]	0.75			
	100	100	100.20	99.50
	Klaproth, Beit. b. iv. s. 209.	*Klaproth*, Id. s. 215.	*Klaproth*, Id. s. 219.	*Klaproth*, Id. s. 222.

Iona.

Carbonic Acid, - -	48.00
Lime, - - -	31.12
Magnesia, - -	17.06
Insoluble Matter, -	4.00

Tennant, Phil. Trans. for 1799.

Geognostic Situation.

It occurs principally in primitive mountains.

Geographic Situation.

Europe.—Beds of dolomite, containing tremolite, occur in the island of Iona. In the mountain-group of St Gothard, it occurs in beds, often of great thickness, containing imbedded crystals of tremolite, grains of quartz, and scales of mica and talc. In the Apennines, it occurs in imbedded portions, in a dark ash-grey splintery limestone: in Carinthia, it forms whole ranges of mountains: in Bareuth, it occurs in beds along with granular foliated limestone: at Sala in Sweden, it is mixed with mica, talc, and quartz: a beautiful white variety, used by ancient sculptors is found in the isle of Tenedos: veins of it are said

to

to occur traversing granite, in the valley of Sesia in Italy: and it is found loose on Monte Somma.

America.—Province of New-York, with tremolite *.

Asia.—Bengal †, with imbedded tremolite; also in Siberia.

Uses.

It appears to have been used by ancient sculptors in their finest works.

Observations.

1. It is named Dolomite, in honour of the celebrated French geologist Dolomieu.

2. The only mineral with which it is likely to be confounded, is granular foliated limestone; but a simple chemical test at once distinguishes them:—a drop of mineral acid causes a violent effervescence, when poured on granular foliated limestone, but a very feeble one with dolomite.

3. The flexible variety of dolomite was first noticed in the Borghese Palace in Rome, by Ferber: it was afterwards found on the mountain of Campo Longo, in the St Gothard group, by Fleuriau de Bellvue. It was sold at a very high price, until the publication of Fleuriau de Bellvue's experiments, by which it appeared, that the other varieties of dolomite, and also common granular limestone, could be rendered flexible, by exposing them in thin and long slabs, for six hours, to a heat of 200° of Reaumur.

* Brown

* Dr Bruce. † Sir John Murray.

* Brown Dolomite, or Magnesian Limestone of *Tennant*.

Tennant, Transactions of Royal Society of London for 1799.—*Thomson*, Annals of Philosophy for December 1814.

External Characters.

Its colours are yellowish-grey, yellowish-brown, and a colour intermediate between chesnut-brown and yellowish-brown; seldom bluish-grey.

It occurs massive, and in minute granular concretions.

Internally it is glistening or glimmering, and the lustre is between pearly and vitreous.

The fracture is splintery, and sometimes flat conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is translucent, or translucent on the edges.

It is semi-hard; it is harder than calcareous-spar.

It is brittle.

Specific gravity of the crystals, 2.886, *Tennant*.—2.771, 2.880. *Berger*.—2.791, *Thomson*.

Chemical Characters.

It dissolves slowly, and with but feeble effervescence, in nitrous acid. When deprived by heat of its carbonic acid, it is much longer of re-absorbing it from the atmosphere than common limestone.

Constituent

Constituent Parts.

Yorkshire.	Building Hill, near Sunderland.	Humbleton Hill, near Sunderland.
Lime, 29.5 to 31.07	Carbonate of Lime, 56.80	Carbonate of Lime, 51.50
Magnesia, 20.3 to 22.05	Carbonate of Magnesia, - 40.84	Carbonate of Magnesia, - 44.84
Carbonic Acid, 47.2	Carbonate of Iron, 0.36	Insoluble matter, 1.60
Alumina & Iron, 0.8 to 1.24	Insoluble matter, 2.00	Loss, - 2.06
	100.00	100.00
Tennant, Phil. Tr. for 1799.	*Thomson*, Annals of Philosophy, vol. iv. p. 416.	*Thomson*, ib. p. 417.

Geognostic Situation.

In the north of England it occurs in beds of considerable thickness, and great extent, and appears to rest on the Newcastle coal-formation; but in the Isle of Man, it occurs in a limestone which rests on grey-wacke, and contains imbedded portions of quartz, rhomb-spar, and sparry iron *. It occurs in trap-rocks in Fifeshire.

Geographic Situation.

It occurs in Nottinghamshire, Derbyshire, Northamptonshire, Leicestershire, Northumberland, and Durham †: also in Ireland, at Portumna in Galway, Ballyshannon in Donncgal, Castle Island near Killarney ‡. It has been observed among the limestone rocks near Erbefeld and Gemarek, in Westphalia ||. It also occurs in veins, as

* Berger, Geological Society Transactions, vol. ii. p. 44.

† Greenough. ‡ Greenough.

|| Bournon, Traité de Mineralogie, t. i. p. 269.

as in those of Derbyshire, where it is associated with galena *.

Use.

Like common limestone, it is burnt and made into mortar, but it remains much longer caustic than quicklime from common limestone; and this is the cause of a very important difference between magnesian and common limestone, with regard to their employment in agriculture: Lime, from magnesian limestone, is termed *hot*, and when spread upon land in the same proportion as is generally practised with common quicklime, greatly impairs the fertility of the soil; and when used in a greater quantity, is said by Mr Tennant to prevent all vegetation †.

Observations.

A flexible variety of Dolomite occurs in England. The following account contains all the information I possess in regard to it:—

Flexible

* Bournon, Traité de Mineralogie, t. i. p. 208.

† In regard to this limestone, Dr Thomson has the following remarks: "This magnesian limestone has long been burnt in prodigious quantity in the neighbourhood of Sunderland, and sent coastwise, both to the north and to the south. It goes in great abundance to Aberdeenshire. As no complaints have ever been made of its being injurious, when employed as a manure, it would be curious to know whether this circumstance be owing to the soil on which it is put, or to the small quantity of it used, in consequence of its price, occasioned by its long carriage; for it appears, from Mr Tennant's statement, that at Ferrybridge, the farmers are aware that it does not answer as a manure so well as pure carbonate of lime."—*Annals of Philosophy*, vol. iv. p. 418.

Flexible Dolomite.

External Characters.

Its colour is yellowish-grey, passing into cream-yellow. It occurs massive. It is dull. The fracture is earthy in the small, and slaty in the large. It is opaque. It yields readily to the knife, but with difficulty to the nail. In thin plates it is uncommonly flexible. Specific gravity, 2.544, *Thomson*. This is probably below the truth, as the stone is porous.

Chemical Characters.

It dissolves in acids as readily as common carbonate of lime.

Constituent Parts.

Carbonate of Lime, -	62.00
Carbonate of Magnesia,	35.96
Insoluble matter, -	1.60
Loss, - - - - -	0.44
	100.00

Thomson, Annals of Phil. vol. iv. p. 418.

Geographic Situation.

It occurs about three miles from Tinmouth Castle.

Observations.

This curious mineral was discovered by my intelligent friend Mr Nicol, Lecturer on Natural Philosophy. To that gentleman I am indebted for the following particulars in in regard to it. He finds, that its flexibility is considerably influenced by the quantity of water contained in it. When saturated with water, it is remarkably flexible; as the evaporation goes on, it becomes more and more rigid, until the water be reduced to a certain limit, when the flexibility becomes scarcely distinguishable. From this point, however, the flexibility gradually increases, as the moisture diminishes; and as soon as the water is completely exhaled, it becomes nearly as flexible as it was when saturated with that fluid.

Second Kind.

Columnar Dolomite.

Stänglicher Dolomit, *Klaproth*.

Stänglicher Dolomit, *Klaproth*, Mag. der Gesellsch. Naturf. Freunde, b. v. s. 402.

External Characters.

Its colour is pale greyish-white.

It occurs massive, and in thin, long, and straight prismatic concretions.

It has an imperfect cleavage.

The fracture is uneven.

The lustre is vitreous, inclining to pearly.

It breaks into acicular-shaped fragments.

It is feebly translucent.

It is brittle.

Specific gravity 2.765.

Constituent

Constituent Parts.

From the Mine Tschistagowskoy.

Carbonate of Lime, -	51
Carbonate of Magnesia, -	47
Carbonated Hydrate of Iron,	1
	99

Klaproth, Chem. Abhandl. s. 328.

Geognostic and Geographic Situations.

It occurs in serpentine in the mine Tschistagowskoy, on the river Mjafs, in the Government of Orenburg in Russia.

Observations.

It was at one time considered to be a variety of Strontianite; but in external characters, it is much more nearly allied to Tremolite.

Third Kind.

Compact Dolomite, or Gurhofite.

Gurhofian, *Karsten*.

Gurhofian, *Klaproth*, in Magazin der Gesellch. der Naturf. Freünde, b. i. s. 257.—Gurofian, *Karsten*, Tabel. s. 50. *Id.* *Klap*. Beit. b. v. s. 103. *Id. Lenz*, b. ii. s. 724.

External Characters.

Its colour is snow-white.

It occurs massive.

It

It is dull.

The fracture is flat conchoidal, passing to even.

The fragments are indeterminate angular, and sharp-edged.

It is slightly translucent on the edges.

It is hard, bordering on semihard.

It is brittle, and rather difficultly frangible.

Specific gravity, 2.7600, *Karsten*.

Chemical Characters.

When pounded, and thrown into diluted and heated nitrous acid, it is completely dissolved with effervescence.

Constituent Parts.

Carbonate of Lime, -	70.50
Carbonate of Magnesia,	29.50
	100.00

Klaproth, Gesellsch. N. Fr. b. i. s. 258.

Geognostic and Geographic Situations.

It occurs in veins in serpentine rocks, between Gurhof and Aggsbach, in Lower Austria.

Observations.

1. The name Gurhofit, sometimes given to this mineral, is from the place near which it was found.

2. It was at one time considered as a variety of semi-opal; but its greater weight distinguishes it from that mineral.

Second

Second Subspecies.

Miemite.

Miemite, *Klaproth.*

This subspecies is divided into two kinds, viz. Granular Miemite, and Prismatic Miemite.

First Kind.

Granular Miemite.

Magnesian Spar of *Thompson.*—Miemite, *Klaproth,* Beit. b. iii. s. 292.—Chaux carbonatée lente, Miemite, *Brong.* t. i. p. 230. —Körniger Bitterspath, *Haus.* s. 128. *Id. Leonhard,* Tabel. s. 36.—Chaux carbonatée magnesifere lenticulaire, *Haüy,* Tabl. p. 6.—Miemit, *Lenz,* b. ii. s. 716.

External Characters.

Its colour is pale asparagus-green, which passes into greenish-white.

It occurs massive, in large and coarse angulo-granular distinct concretions; and crystallized in flat double three-sided pyramids, in which the lateral planes of the one are set on the lateral edges of the other.

The crystals are middle-sized, or small; are either attached by their lateral edges, or intersect each other; and their surface is drusy.

Internally it is splendent and pearly.

It has a threefold oblique angular cleavage, in which the folia are curved.

The

The fragments are rather blunt-edged.
It is translucent.
It is semihard.
It is brittle.
Specific gravity 2.885.

Chemical Characters.

It dissolves slowly, and with little effervescence, in nitrous acid; but more rapidly, and with increased effervescence, when the acid is heated.

Constituent Parts.

Carbonate of Lime,	-	53.00
Carbonate of Magnesia,	-	42.50
Carbonate of Iron, with a little Manganese,	-	3.00
		98.50

Klaproth, Beit. b. iii. s. 296.

Geognostic and Geographic Situations.

It is found at Miemo in Tuscany, imbedded in gypsum; at Hall in the Tyrol, imbedded in muriate of soda; and Gieseké met with it in kidneys, along with wavellite, arragonite, and calcedony, in decomposed wacke, at Kannioak, in Omenaksfiord in Greenland.

Observations.

This mineral was first observed by the late Dr Thompson of Naples, who sent specimens of it to Klaproth for analysis. It is named *Miemite*, after the place where it was discovered.

Second Kind.

Prismatic Miemite.

Stänglicher Bitterspath, *Klaproth*.

Strahliger Kalkstein, *Von Schlottheim*, Hoff's Magaz. fur die Gesammte Mineralogie, b. i. s. 156.—Stänglicher Bitterspath, *Klaproth*, b. iii. s. 297. *Id. Leonhard*, Tabel. s. 36. *Id. Haus*, s. 128. *Id. Lenz*, b. ii. s. 712. *Id. Oken*, b. i. s. 393.

External Characters.

Its colour is asparagus-green, olive-green, and oil-green.

It occurs in prismatic distinct concretions, and crystallized in flat rhomboids, which are deeply truncated on all the edges.

The crystals are small, and very small, and sometimes they form only drusy crusts.

Internally it is shining and vitreous.

The fracture passes from concealed foliated to splintery.

The fragments are rather blunt-edged.

It is strongly translucent.

It is as hard as the granular miemite.

Specific gravity 2.885, *Karsten*.

Chemical Characters.

It dissolves slowly, and with but feeble effervescence, in nitrous acid.

Constituent

Constituent Parts.

Lime, - -	33.00
Magnesia, -	14.50
Oxide of Iron, -	2.50
Carbonic Acid, -	47.25
Water and Loss, -	2.75
	100

Klaproth, Beit. b. iii. s. 303.

Geognostic and Geographic Situations.

It occurs in cobalt veins that traverse sandstone at Glücksbrunn in Gotha, and at Beska in Servia, on the frontier of Turkey.

Third Subspecies.

Brown-Spar, or Pearl-Spar.

Braunspath, *Werner.*

This species is divided into two kinds, viz. Foliated Brown-Spar, and Columnar Brown-Spar.

First Kind.

Foliated Brown-Spar.

Blättriger Braunspath, *Werner.*

Spath perlé, *Romé de Lisle,* t. i. p. 605.—Braunspath, *Wid.* s. 515.—Sidero-calcite, *Kirw.* vol. i. p. 105.—Braunspath, *Estner,* b. ii. s. 999. *Id. Emm.* b. i. s. 79.—Brunispato, *Nap.* p. 356.

Constituent Parts.

Yorkshire.	Building Hill, near Sunderland.	Humbleton Hill, near Sunderland.
Lime, 29.5 to 31.07	Carbonate of Lime, 56.80	Carbonate of Lime, 51.50
Magnesia, 20.3 to 22.05	Carbonate of Magnesia, - 40.84	Carbonate of Magnesia, - 44.84
Carbonic Acid, 47.2	Carbonate of Iron, 0.36	Insoluble matter, 1.60
Alumina & Iron, 0.8 to 1.24	Insoluble matter, 2.00	Loss, - 2.06
	100.00	100.00
Tennant, Phil. Tr. for 1799.	*Thomson*, Annals of Philosophy, vol. iv. p. 416.	*Thomson*, ib. p. 417.

Geognostic Situation.

In the north of England it occurs in beds of considerable thickness, and great extent, and appears to rest on the Newcastle coal-formation; but in the Isle of Man, it occurs in a limestone which rests on grey-wacke, and contains imbedded portions of quartz, rhomb-spar, and sparry iron *. It occurs in trap-rocks in Fifeshire.

Geographic Situation.

It occurs in Nottinghamshire, Derbyshire, Northamptonshire, Leicestershire, Northumberland, and Durham †: also in Ireland, at Portumna in Galway, Ballyshannon in Donnegal, Castle Island near Killarney ‡. It has been observed among the limestone rocks near Erbefeld and Gemarek, in Westphalia ||. It also occurs in veins,

* Berger, Geological Society Transactions, vol. ii. p. 44.

† Greenough. ‡ Greenough.

|| Bournon, Traité de Mineralogie, t. i. p. 268.

The surface of the crystals is usually drusy, and is seldom shining, generally glistening or glimmering, and sometimes even dull.

Internally it alternates from shining to glistening, very rarely splendent, and the lustre is pearly.

It has a threefold oblique angular cleavage, in which the folia are parallel with the planes of the primitive rhomboid. The folia are generally spherical curved, seldom straight.

The fragments are indeterminate angular, and rather blunt-edged in the great, but in the small are rhomboidal.

It is generally translucent on the edges, rarely translucent.

It is harder than rhomb-spar, but not so hard as apatite.

It is brittle, and easily frangible.

Specific gravity 3.0, 3.2, *Mohs*.

Chemical Characters.

It hardens, and becomes dark brownish-black before the blowpipe; and effervesces feebly with acids.

Constituent Parts.

Lime, - -	43.0
Magnesia, - -	10.0
Oxide of Iron, - -	8.0
Manganese, - -	3.0
Water, and Carbonic Acid,	26.5

Berthier, Jour. des Mines, N° 103. p. 73.

Geognostic Situation.

It occurs principally in veins, when it forms either the predominating vein-stone, or is disseminated in the others. The

The most frequent accompanying vein-stone is calcareous spar; besides which, it is often associated with heavy-spar, fluor-spar, quartz, sparry-iron, galena, iron-pyrites, native silver, and various ores of silver. Very often it rests on all the minerals of which the vein is composed: hence it is said to be the newest mineral in the vein; and we frequently observe thin crusts of it investing the surface of crystals, as of calcareous-spar, fluor-spar, heavy-spar, quartz, galena, &c. These crusts seldom invest the whole crystal, generally covering only a part of it; and it is observed, that it is the same side in all the crystals of the same cavity which are encrusted with the brown-spar; and also, that when the whole side is not covered, the crust has the same height, or is on the same level in all the crystals.

Geographic Situation.

It occurs along with galena, and other ores of lead, in the lead-mines of Lead Hills and Wanlockhead in Lanarkshire; in the mines of Cumberland, Northumberland, and Derbyshire. On the Continent, it is found in Norway, Sweden, Saxony, Suabia, Piedmont, France, Hungary, and Transylvania.

Observations.

1. It is distinguished from *Calcareous-spar*, with which it has been confounded, by its colours, cleavage, inferior transparency, perfect pearly lustre, greater hardness, and higher specific gravity. It also in general effervesces less briskly with acids than calcareous-spar.

2. The straight lamellar variety has been mistaken for Heavy-spar, from which, however, it is distinguished, not only by its inferior weight, but also by its concretions being

ing very closely aggregated, which is not the case with heavy-spar.

3. In many instances the foliated Brown-spar of authors includes also varieties of rhomboidal red manganese, and of sparry-iron.

Second Kind.

Columnar Brown-Spar.

Stänglicher Braunspath, *Klaproth*.

Stänglicher Braunspath, *Klaproth*, Beit. b. iv. s. 199. *Id.* *Karsten*, Tabel. s. 50. *Id. Lenz*, b. ii. s. 723.

External Characters.

Its colours are reddish-white, rose-red, and pearl-grey.

It occurs in distinct concretions, which are wedge-shaped, columnar or prismatic, and have glimmering and longitudinally streaked surfaces.

It is splendent, and appears pearly on the fracture-surface.

It has an imperfect cleavage.

The fragments are wedge-shaped.

It is translucent.

It is brittle.

It is easily frangible.

Constituent

Constituent Parts.

Carbonate of Lime, - -	51.50
Carbonate of Magnesia, -	32.00
Carbonate of Iron, -	7.50
Carbonate of Manganese, -	2.00
Water, - - -	5.00
	98.00

Klaproth, Beit. b. iv. s. 203.

Geographic Situation.

It is found at the mine named Segen Gottes at Gersdorf in Saxony; and in that of Valenciana at Guanuaxuato in Mexico.

Observations.

It is distinguished from the other subspecies of *Brown-spar* by distinct concretions, fragments, and transparency.

3. Limestone.

Rhomboedrischer Kalk-Haloide, *Mohs.*

This species is divided into twelve subspecies, viz. 1. Foliated Limestone, 2. Compact Limestone, 3. Chalk, 4. Agaric Mineral, 5. Fibrous Limestone, 6. Calc-Tuff, 7. Peastone, 8. Slate-Spar, 9. Aphrite, 10. Lucullite, 11. Marl, 12. Bituminous Marl Slate.

First Subspecies.

Foliated Limestone.

Blättriger Kalkstein, *Werner.*

This subspecies is divided into two kinds, viz. Calcareous-spar, and Foliated Granular Limestone.

First Kind.

Calcareous-Spar, or Calc-Spar.

Kalkspath, *Werner.*

Spathum, *Wall.* t. i. p. 140.—Körniger Kalkstein, var. *Wid.* s. 427.—Common Spar, *Kirw.* vol. i. p. 86.—Kalkspath, *Estner,* b. ii. s. 941. *Id. Emm.* b. i. s. 456.—Spatho calcareo, *Nap.* p. 341.—Calcaire cristallisée, *Lam.* t. i. p. 29.—Chaux carbonâtée cristallisée, *Haüy,* t. ii. p. 127.—Le Spath calcaire, *Broch.* t. i. p. 536.—Spathiger Kalkstein, *Reuss,* b. ii. 2. s. 284.—Kalkspath, *Lud.* b. i. s. 149. *Id. Suck.* 1r th. s. 600.—Grossblättricher Kalkstein, *Bert.* s. 90.—Kalkspath, *Mohs,* b. ii. s. 31. *Id. Hab.* s. 76.—Chaux carbonatée, *Lucas,* p. 3.—Gemeiner spathiger Kalkstein, *Leonhard,* Tabel. s. 33.—Chaux carbonatée pure spathique, *Brong.* t. i. p. 189.—Chaux carbonatée, *Brard,* p. 26.—Kalkspath, *Haus.* s. 125.—Spathiger Kalkstein, *Karst.* Tabel. s. 50.—Crystallized Carbonate of Lime, *Kid,* vol. i. p. 50.—Chaux carbonatée, *Haüy,* Tabl. p. 2.—Kalkspath, *Lenz,* b. ii. s. 742. *Id. Haus.* Handb. b. iii. s. 900. *Id. Hoff.* b. iii. s. 17.—Calcareous-spar, *Aikin,* p. 158.

External

External Characters.

Its most frequent colour is white, of which the following varieties occur, viz. reddish, snow, greyish, greenish, and yellowish white. From reddish-white, it passes on the one side into pearl-grey, brick-red, flesh-red, rose-red, and brownish-red; and on the other side into pale violet-blue: from greyish-white, it passes into smoke-grey, ash-grey, yellowish-grey, and greenish-grey: from greenish-grey, it passes into apple, asparagus, olive, and leek green: from yellowish-grey, it passes into a colour intermediate between wax and ochre yellow, and into honey-yellow; and from honey-yellow, into yellowish-brown, and greyish-black.

The white and grey varieties occur more frequently in the massive, the yellow, green, and red, in those which are crystallized.

The white-coloured transparent varieties are often iridescent.

It occurs massive, disseminated, globular, botryoidal, reniform, tuberose, stalactitic, tubular, cellular, and curtain-shaped; also in distinct concretions, which are large coarse, rarely small, angulo-granular; sometimes very thick, thick and thin, prismatic, generally wedge-shaped prismatic; always straight; sometimes parallel, sometimes scopiform prismatic; and these are intersected by lamellar concretions which are fortification-wise bent, and very frequently crystallized.

Its primitive form is a rhomboid, in which the angles are 105° 5′, and 74° 55′.

The suite of crystallizations of calcareous-spar far exceeds in extent that of any other mineral hitherto discovered *. The principal varieties are by Werner, according to his method, brought under three classes or subdivisions, which not only form series amongst themselves, but are connected together in such a manner, that the last member of the third class joins with the first member of the first class, and thus the whole forms a very beautiful returning series. Each of these divisions have their characteristic crystalline form, viz.

The first an *acute double six-sided pyramid;* the second an *equiangular six-sided prism,* (including the six-sided table); and the third a *rhomboid* or *three-sided pyramid.*

I. *Acute six-sided Pyramid.*

When perfect, it is always acute, and two and two lateral planes meet under obtuser angles than the others.

It is generally obliquely streaked, but the streaks run from the acute towards the obtuse edges.

It occurs,

A. Single.

B. Double. The lateral planes of the one, set obliquely on the lateral planes of the other, so that the edge of the common base forms a zig-zag line.

These pyramids occur, either perfect, or in the following varieties:

1. The apex acuminated with three planes, which are set on the obtuse lateral edges. These are parallel with the cleavage.
2. The apex flatly acuminated with three convex faces, which are set on the acute lateral edges. The convexity

* Romé de Lisle enumerates 26 varieties of calcareous-spar—Haüy above 150,—and Bournon 642. Many more might be described.

convexity is in the direction of the axis of the double pyramid.

3. The angles on the common base of the double pyramid truncated, thus forming a transition into the six-sided prism.
4. The acute lateral edges of the double pyramid sometimes truncated, and either with straight and smooth planes, or with convex and uneven planes.
5. Twin-crystal.

The double six-sided pyramids apparently pushed into each other, in the direction of their length, in which they are either

(1) *Unchanged* in position, when the acute edges rest on the obtuse edges; or they are

(2) *Turned around* one-sixth of their periphery, so that obtuse edges are set on obtuse edges, and acute edges on acute edges; and the alternate angles on the common base have broken re-entering angles; or the angles on the common basis are truncated, and thus a transition is formed into the next following principal form.

II. *Equiangular Six-sided Prism.*

It is equiangular, but generally with alternate broad and narrow lateral planes. It originates from the pyramid N° 3.; and hence it presents the following varieties:

1. The equiangular six-sided prism, acutely acuminated with six planes, of which two and two meet under obtuse angles, and each is set obliquely on the lateral edges. Sometimes the acute acuminating edges are truncated, or they are bevelled, and the

the edges which the bevelling planes make with the broad lateral planes, truncated.

In other varieties, the apices of the acuminations are more or less deeply truncated, and sometimes so deeply, that the acuminating planes appear as truncating planes on the angles of the prism.

3. The preceding figure, in which the six-planed acumination is *flatly acuminated* with three planes, which are set on the acute edges of the six-planed acumination.

4. Six-sided prism *acutely acuminated* with three planes which are set on the alternate lateral planes. The apex of the acumination is sometimes more or less deeply truncated. Sometimes the truncation is so deep, that the remains of the acuminating planes appear as truncations on the alternate terminal edges. In other varieties, the prism becomes so short, that the acuminating planes meet and form an acute double three-sided pyramid.

5. When the planes of the flat three-planed acumination N° 3. increase so much that those of the six-planed acumination disappear, a six-sided prism is formed, *flatly acuminated* with three planes, which are set on the alternate lateral planes in an unconformable position. When the prism disappears, there is formed an obtuse double three-sided pyramid.

These prisms are often pyramidally aggregated.

6. When the prism becomes very low, it may be viewed as an equiangular six-sided table, which is sometimes aggregated in a rose-like form.

7. Sometimes the six-sided prism is truncated on the lateral edges, and thus forms a twelve-sided prism.

The

The prisms are aggregated in a pyramidal, manipular, scopiform, and tabular manner.

III. *Three-sided Pyramid.*

It is divided, according to the magnitude of the summit-angle, into the following varieties:

1. *Very obtuse three-sided pyramid*, nearly tabular. It is sometimes aggregated in a rose-like form.
2. *Flat three-sided pyramid*, in which the lateral planes of the one are set on the lateral edges of the other. The angles on the common basis are sometimes truncated, and frequently the apices of the pyramid are more or less deeply truncated. When the truncation on the apices is very deep, the crystal appears as a six-sided table, in which the terminal planes are set on alternately oblique.
3. *Acute three-sided pyramid.* This form very nearly resembles the cube.

It would extend this description too much, were we to attempt to give an account of every variety of form exhibited by these crystals; and besides, we have already enumerated the principal ones.

The crystals occur of various magnitudes, as large, small, and very small.

The lateral planes of the prisms and pyramids are generally shining, splendent and smooth; the acuminating planes frequently streaked or drusy, seldom granulated. Sometimes it occurs in extraneous external forms of shells, &c.

Internally it is generally specular splendent, or shining, sometimes glistening, and the lustre is vitreous, which inclines sometimes to resinous, and more rarely to pearly.

It has a distinct cleavage, in which the folia are generally straight, seldom spherically curved. The most distinct cleavage

cleavage is threefold, and in the direction of the planes of the primitive rhomboid; there are others less distinct in the direction of the planes of the obtuse rhomboid or double three-sided pyramid; and in the direction of the alternate lateral planes of the regular six-sided prism.

The fracture is perfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged, or they are rhomboidal.

It occurs transparent, semi-transparent, and occasionally only translucent. It refracts double *.

It is semi-hard; it scratches gypsum, but is scratched by fluor-spar.

It is brittle, and very easily frangible.

Specific gravity, 2.5, 2.8, *Mohs*.

Chemical Characters.

It is infusible before the blowpipe, but it becomes caustic, losing by complete calcination about 43 *per cent.*; effervesces violently with acids.

Constituent Parts.

	Iceland Spar.	Iceland Spar.	Iceland Spar.	From Andreasberg.
Lime,	56.15	55.50	56.50	55.9802
Carbonic Acid,	43.70	44.00	43.00	43.5635
Water,		0.50	0.50	0.1000
Oxide of Manganese, with trace of Iron,	0.15			0.3562
	100.00	100.00	100.00	100.0000
	Stromyer, Gilbert's Annalen for 1813, p. 217.	*Philips*, Phil. Mag. xiv. 290.	*Buchols*, Gehl. Journ. iv. 412.	*Stromyer*, Gilbert's An. for 1813, p. 217.

Geognostic

* The double refracting power of calcareous-spar was first observed by Erasmus Bartholin.

Geognostic Situation.

It never occurs in mountain-masses, but venigenous in almost every rock, from granite to the newest secondary formation. The oldest formation of this mineral is that in veins, where it is accompanied with felspar, rock-crystal, probably also with epidote, sphene, and chlorite. It occurs also in beds, along with augite, hornblende, garnet, and magnetic ironstone; and frequently in veins in different metalliferous formations. Thus, it is associated with nearly all the metallic minerals contained in gneiss, mica-slate, clay-slate, syenite, porphyry; seldomer in granite, more frequently, again, in grey-wacke, and along with cobalt and copper ores in the oldest secondary or flœtz limestone. Veins, almost entirely composed of calcareous-spar, abound in the newest limestone formations; and it is a common mineral, either in veins, or in cotemporaneous masses, in the various rocks of the secondary or flœtz-trap series.

An interesting geognostic character of calcareous-spar, is the uniformity of its crystallizations in particular districts. Thus, in the mines of Derbyshire, the acute six-sided pyramid and its congenerous forms are the most frequent and abundant; at Schneeberg in Saxony, and in the Upper Hartz, the prevailing forms are the regular six-sided prism and table; while in the mines of Freyberg the most frequent forms are the regular six-sided prism, acuminated with three planes, set on the lateral planes, and the flat double three-sided pyramid.

Geographic Situation.

This mineral is so common in every country, as to render any account of its geographic distribution unnecessary. It

It may, however, be remarked, that it occurs very abundantly in Fifeshire, where it occasionally appears in amygdaloidal masses, several feet square. It is probable, that the beautiful variety of calcareous-spar named *Iceland spar*, from the country where it is found, occurs in amygdaloidal rocks, because it is there associated with zeolite *. The *crystallized sandstone* of *Fontainebleau*, is calcareous-spar impregnated with granular quartz.

Second Kind.

Granular Foliated Limestone.

Blättriger Körniger Kalkstein, *Werner*.

Calcareus micans, *Wall.* t. i. p. 126.; Calcareus inæquabilis, *Id.* p. 128.; Marmor unicolor album, *Id.* p. 133.—Körniger Kalkstein, *Wid.* s. 496.—Foliated and Granular Limestone, *Kirw.* vol. i. p. 84.—Körniger Kalkstein, *Estner*, b. ii. s. 931. *Id. Emm.* b. i. s. 445.—Pierre calcaire grenue, *Broch.* t. i. p. 531.—Chaux carbonatée saccaroide; *Haüy*, t. ii. p. 164.——Körniger Kalkstein, *Reuss*, b. ii. 2. s. 273. *Id. Lud.* b. i. s. 148. *Id. Suck.* 1r th. s. 593.—Kleinblättricher Kalkstein, *Bert.* s. 89.—Körnigblattricher Kalkstein, *Mohs*, b. ii. s. 28. *Id. Hab.* s. 74.—Gemeiner körniger Kalkstein, *Leonhard*, Tabel. s. 32.—Chaux carbonatée saccaroide, *Brong.* t. i. p. 192. *Id. Brard*, p. 28.—Marmor, *Haus.* s. 126.—Körniger Kalkstein, *Karst.* Tabel. s. 50.—Marble, *Kid*, vol. i. p. 4.—Chaux carbonatée lamellaire, et Chaux carbonatée saccaroide, et Chaux

* The purest and most beautiful Iceland-spar, is found in Iceland, on the east side of the island, near the harbour of Rödefiord, where it is said to form a mass fourteen feet thick.

Chaux carbonatée sub-granulaire, *Haüy*, Tabl. p. 5.—Körniger Kalkstein, *Lenz*, b. ii. s. 739.—Körnigblättriger Kalkstein, *Hoff.* b. iii. s. 14.—Granular Limestone, *Aikin*, p. 159.

External Characters.

Its most common colour is white, of which it presents the following varieties: snow-white, yellowish-white, greyish-white, and greenish-white, seldom reddish-white: from greyish-white it passes into bluish-grey, greenish-grey, ash-grey, and smoke-grey; from reddish-white it passes into pearl-grey, and flesh-red; from yellowish-white into cream-yellow; and from greenish-white into siskin-green, and olive-green.

It has generally but one colour; sometimes, however, it is spotted, dotted, clouded, striped, and veined.

It occurs massive, and in angulo-granular distinct concretions.

Internally it alternates from shining to glistening and glimmering, and the lustre is intermediate between pearly and vitreous.

The fracture is foliated, but sometimes inclines to splintery.

The fragments are indeterminate angular, and rather blunt-edged.

It is more or less translucent.

It is as hard as calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, Carrara Marble, 2.717. Scottish, 2.716, *Kirwan*.—2.658, 2.711, *Karsten*.

Chemical

Chemical Characters.

It generally phosphoresces when pounded, or when thrown on glowing coals. It is infusible before the blowpipe. It dissolves with effervescence in acids.

Constituent Parts.

Lime, - -	56.50
Carbonic Acid, -	43.00
Water, - -	0.50
	100

Bucholz, in Neuen Journal der Chem. iv. s. 419.

Geognostic Situation.

This mineral occurs in beds, in granite, gneiss, mica-slate, clay-slate, syenite, greenstone, grey-wacke, and rarely in some of the secondary rocks. It is observed, that the varieties which occur in highly crystallized rocks are in general more crystalline than those which are found in the compact or less crystallised varieties. It frequently contains imbedded minerals of different kinds, such as quartz, mica, hornblende, tremolite, sahlite, asbestus, steatite, serpentine, galena, blende, iron-pyrites, and magnetic ironstone: of these the quartz and mica are the most frequent.

Geographic Situation.

This mineral occurs in all the great ranges of primitive rocks that occur in Europe, and in such as have been examined in Asia, Africa, and America.

Uses.

Uses.

All the varieties of this subspecies may be burnt into quicklime; but it is found, that in many of them, the concretions exfoliate and separate during the volatilization of their carbonic acid, so that by the time when they are rendered perfectly caustic, their cohesion is destroyed, and they fall into a kind of sand,—a circumstance which will always render it improper to use such varieties in a common kiln. But the most important use of this mineral is as marble. The marbles we are now to mention, have in general purer colours, more translucency, and receive a higher polish than those of compact limestone. They have been known from a very early period; and ancient statuaries have immortalised their names, by the master-pieces of art which they have executed in them. To give a full description of all the ancient and modern marbles enumerated by mineralogists, would much exceed the limits of this article; and besides, it would encroach on the more complete economical history of them, intended to be given in another work. We shall here notice only some of the more remarkable ancient marbles, and a few of the modern marbles found in this country, on the Continent of Europe, and in other countries.

Ancient, or Antique Marbles.

Under this head, we include those marbles which were made use of by the ancients, and the quarries of many of which are no longer known.

1. *Parian Marble.*—Its colour is snow-white, inclining to yellowish-white, and it is fine granular, when polished, has somewhat of a waxy appearance. It hardens by exposure

exposure to the air, which enables it to resist decomposition for ages. Varro and Pliny inform us, that it was named *Lychnites* by the ancients, from its being hewn in the quarry by the light of lamps, from λυχνις, *a lamp*; but Hill is of opinion, that the appellation is from the verb λυχνειν, *to be very bright*, or *shining*, from the shining lustre of this marble: the etymological derivation of Varro and Pliny is that which is generally adopted. Dipœnus, Scyllis, Malas, and Micciades, employed Parian marble, and were imitated by their successors. This preference was justified by the excellent qualities of this marble; for it receives with accuracy the most delicate touches of the chisel, and it retains for ages, with all the softness of wax, the mild lustre even of the original polish. The finest Grecian sculpture which has been preserved to the present time, is generally of Parian marble.—The Medicean Venus, the Diana venatrix, the colossal Minerva (called Pallas of Velletri), Ariadne (called Cleopatra), Juno (called Capitolina), &c. It is also a variety of Parian marble on which the celebrated tables at Oxford are inscribed.

2. *Pentelic Marble*, from Mount Pentelicus, near Athens. This marble very closely resembles the preceding, but is more compact, and finer granular, sometimes combined with splintery. At a very early period, when the arts had attained their full splendour, in the age of Pericles, the preference was given by the Greeks, not to the marble of Paros, but to that of Mount Pentelicus, because it was whiter, and also, perhaps, because it was found in the vicinity of Athens. The Parthenon was built entirely of Pentelic marble. Many of the Athenian statues, and the works carried on near to Athens during the administration of Pericles, (as, for example, the temples of Ceres or Eleusis), were

were executed in the marble of Pentelicus *. Among the statues of this marble in the Royal Museum in Paris, are the Torso; a Bacchus in repose; a Paris; the Discobolus reposing; the bas-relief known by the name of the Sacrifice; the throne of Saturn; and the Tripod of Apollo. It is remarked by Dr Clarke, that while the works executed in Parian marble remain perfect, those which were finished in Pentelican marble have been decomposed, and sometimes exhibit a surface as earthy and as rude as common limestone. This is principally owing to veins of extraneous substances which intersect the Pentelican quarries, and which appear more or less in all the works executed in this kind of stone.

3. *Greek White Marble,—Marmo Greco* of Italian artists. Its colour is snow-white; is fine granular; and is rather harder than the other white marbles; hence it takes a higher polish. This is one of those varieties which being found near the river Coralus in Phrygia, was called *Corallitic* or *Corallic Marble* by the ancients. The Greek marble was obtained from several islands of the Archipelago, such as Scio, Samos, &c.

4. *White Marble of Luni*, on the coast of Tuscany. It is of a snow-white colour, small granular and very compact; it takes a fine polish, and may be employed for the most delicate work: hence it is said to have been preferred by the Grecian sculptors, both to the Parian and Pentelic marbles. It is the general opinion of mineralogists, that the Belvidere Apollo is of Luni marble; but the Roman sculptors look upon it as Greek marble †. The Antinous

* Clarke's Travels, vol. iii.

† Dr Clarke says it is of Parian marble. Vid. Travels, vol. iii.

Antinous of the Capitol, preserved in the Royal Museum in Paris, is also of this marble.

5. *White Marble of Carrara.*—It is of a beautiful white colour, but is often traversed by grey veins, so that it is difficult to procure middle-sized pieces without them. It is not so subject to turn yellow as the Parian. This marble, which is almost the only one used by modern sculptors, was also quarried and wrought by the ancients. Its quarries are said to have been opened in the time of Julius Cæsar. In the centre of blocks of this marble, beautiful rock-crystals are found which are called *Carrara Diamonds* *.

6. *White Marble of Mount Hymettus* in Greece.—This marble has a greater intermixture of grey than any of the varieties already mentioned. The statue of Meleager in the Royal Museum in Paris, is of this marble.

7. *Translucent White Marble,—Marmo statuario* of the Italians.—This marble much resembles that of Paros, but differs from it in being more translucent. There are at Venice, and in several other towns in Lombardy, columns and altars of this marble. The quarries of the *marmo statuario* are unknown.

8. *Flexible White Marble.*—This is a fine granular, greyish-white coloured marble, which possesses considerable flexibility. It was dug up in the feod of Mandragone. In the Borghese Palace in Rome, there are five or six tables of it.

These are the chief white marbles which the ancients used for the purposes of architecture and sculpture.

9. *Red*

* It is said the marble quarries of Carrara are almost exhausted, and that statuary marble is in future to be procured from the island of Paros.

9. *Red antique Marble,—Roso antico* of the Italians, —*Ægyptum* of the ancients.—This marble, according to antiquaries, is of a deep blood-red colour, here and there traversed by white veins, and, if closely inspected, appears to be sprinkled over with minute white dots, as if it were strewed with sand. The Egyptian Antinous in the Royal Museum in Paris, is of this marble. But the most highly prized variety of antique red marble, is that of a very deep red, without veins, such as is seen in the Indian Bacchus in the same Museum. The white points, which are never wanting in the true red antique marble, distinguish it from others of the same colour. It is not known from whence the ancients obtained this marble: the conjecture is, that it was brought from Egypt.

10. *Green antique Marble,—Verde antico* of the Italians.—This beautiful marble is an indeterminate mixture of white marble and green serpentine. It was known to the ancients under the name *Marmor Spartam* or *Lacedæmonium*.

11. *Yellow antique Marble,—Giallo antico* of the Italians.—This marble is of a yellowish-brown, sometimes inclining to a cream-yellow colour, and is either of an uniform colour, or marked with black or deep yellow-coloured rings. It is found only in small detached pieces, and in antique inlaid-work. The Sienna marble is a good substitute for it.

12. *Antique Cipolin Marble.*—Cipolin is a name given to all such white marbles as are marked with green-coloured zones, caused by talc or chlorite. It was much used by the ancients. It takes a fine polish, but its green-coloured stripes always remain dull, and are that part of the marble which first decomposes, when exposed to the open air. There are modern Cipolins as fine as those used by the ancients.

13. *African breccia Marble,—Antique African Breccia.* —It has a black ground, in which are imbedded apparent fragments or portions of a greyish-white, of a deep red, or of a purple wine colour. This is said to be one of the most beautiful marbles hitherto found, and has a superb effect when accompanied with gilt ornaments. Its native place is not known with certainty: it is conjectured to be Africa. The pedestal of Venus leaving the Bath, and a large column, both in the Royal Museum in Paris, are of this marble.

Scottish Marbles.

The Marbles of this part of Great Britain have hitherto been but little attended to, although it is highly probable that many valuable varieties occur in the different primitive and transition districts. At present, we shall mention a few of the best known varieties.

1. *Tiree Marble.*—Of this marble there are two varieties, viz. the Red and White.

a. Red Tiree Marble.—This is one of the most highly prized of the Scottish marbles. Its colours are red, of various tints, such as rose-red, and flesh-red; also reddish-white: its lustre is glimmering; and the fracture is minute foliated, accompanied with splintery. It is very faintly translucent, or only highly translucent on the edges. It is always intermixed with different other earthy minerals, that add to its beauty, and give it a peculiar appearance. The most frequent of the imbedded minerals is common hornblende; the others are pale-green sahlite, blackish-brown mica, and green chlorite. In some varieties, the hornblende is so abundant, that at first sight they might be confounded with syenite: in others, where nearly the whole mass is of hornblende, it would be considered as a variety of hornblende rock.

b. White

b. White Tiree Marble.—Its colours are greyish-white and bluish-white: it contains scales of mica, and crystals or grains of common hornblende; which latter, when minutely diffused, give the marble a green or yellowish-green colour, and when very intimately combined with the mass, form beautiful yellowish-green spots.

2. *Iona Marble.*—Its colours are greyish-white and snow-white. Its lustre is glimmering, and fracture minute foliated, combined with splintery. It is harder than most of the other marbles. It is an intimate mixture of limestone and tremolite; for if we immerse it in an acid, the carbonate of lime will be dissolved, and the fibres of tremolite remain unaltered. It is sometimes intermixed with steatite, which gives it a green or yellow colour, in spots. These yellow or green coloured portions receive a considerable polish, and have been erroneously described as nephritic stone, and are known also under the name of *Iona* or *Icolmkill Pebbles.* The marble itself does not receive a high polish: this, with its great hardness, have brought it into disrepute with artists. Several of the varieties of Iona marble are dolomite.

3. *Skye Marble.*—In the Island of Skye, in the property of Lord Macdonald, there are several varieties of marble, deserving of attention, inclosed in porphyry, sandstone, and trap-rocks. One variety is of a greyish inclining to snow-white colour: another greyish-white, veined with ash-grey; and a third is ash-grey, or pale bluish-grey, veined with lemon-yellow or siskin-green *. Dr MacCulloch has described other varieties; and more minute details are expected from his promised work on the "Geology of the Hebrides."

* Mineralogy of Scottish Isles, vol. ii.

4. *Assynt.*—The following varieties of marble found in Sutherland, have been introduced into commerce by Mr Joplin of Gateshead.

a. White marble, which acquires a smooth surface on the polisher, but remains of a dead hue, like the marble of Iona: hence its uses as an ornamental marble are much circumscribed.

b. White mottled with grey, and capable of receiving a high polish, and is not deficient in beauty.

c. Grey coloured, and highly translucent and crystalline, and capable of being applied to the purposes of ornament in sepulchral sculpture.

d. Dove-coloured, compact, translucent, and receiving a good polish.

e. Pure white, and translucent, and capable of being used in plain ornaments, but too translucent for sculpture.

f. White, with irregular yellow marks, from being intermixed with serpentine. It is very compact.

g. White variety, with layers of slate-spar.

5. *Glen Tilt Marble.*—The limestone of Glen Tilt, first mentioned by Dr Macknight, in his description of that valley *, has of late attracted the notice of the Duke of Athole, through the suggestion of Dr MacCulloch. The marbles are white and grey, and veined or spotted with yellow or green: they vary in the size of the grain or concretion, and also in the degree and kind of polish they receive.

6. *Marble of Ballichulish.*—This marble is of a grey or white colour, and is very compact. It may be raised in blocks of considerable size.

7. *Boyne Marble.*—Its colours are grey or white, and it receives a pretty good polish.

8. *Blairgowrie*

* Wernerian Memoirs, vol. i. p. 362.

8. *Blairgowrie Marble.*—Mr Williams, in his Natural History of the Mineral Kingdom, mentions a beautiful saline marble, of a pure white colour, which occurs near Blairgowrie in Perthshire, not far from the road side. According to him, it may be raised in blocks and slabs, perfectly free of blemishes, and in every respect fit to be employed in statuary and ornamental architecture.

9. *Glenavon Marble,*—is of a white colour, and the concretions are large granular. It is mentioned by Williams as a valuable marble; but he adds, that its situation is remote, and difficult of access.

English Marbles.

Hitherto but few marbles of granular foliated limestone have been quarried in England; the greater number of varieties belonging to the flœtz or secondary limestone. One of the most remarkable of the English marbles of the present class, is that of Anglesey, named *Mona Marble,* which is not unlike the *Verde Antico.* Its colours are greenish-black, leek-green, and sometimes purple, irregularly blended with white; but they are not always seen together in the same piece. The white part is limestone: the green shades are said to be owing to serpentine and asbestus. The Black Marbles found in England, are varieties of Lucullite.

Irish Marbles.

The Black Marbles of Ireland, now so generally used by architects, are Lucullites. In the county of Waterford, different kinds of marble are known; thus at Toreen, there is a fine variegated sort, of various colours, viz. chesnut-brown, white, yellow, and blue, and which takes a good polish: a grey marble, beautifully clouded with white, susceptible of a good polish, has been found near Kilcrump, in the parish of Whitechurch, in the same county. At Loughlougher, in the county of Tipperary, a fine purple marble is found, which, when polished, is said to be beautiful. Smith describes several variegated marbles in the county of Cork; but whether these, and others now enumerated as Irish marbles, are granular limestone, I cannot discover, as I have neither met with good descriptions of them, nor seen any specimens. Thus, he mentions one with a purplish ground, and white veins and spots, found at Churchtown; a bluish and white marble from the same place; and several fine ash-coloured varieties, as that of Castle Hyde, &c. The county of Kerry affords several variegated marbles, such as that found near Tralee. Marble of various colours is found in the same county, in the islands near Dunkerron, in the river of Kenmare: some are purple and white, intermixed with yellow spots; and some beautiful specimens have been seen, of a purple colour, veined with dark-green.

French Marbles *.

A great many different kinds of marble are quarried in the different Departments of the kingdom of France, and of these we shall mention the following.

1. *Griotte Marble.*—Its colour is deep brown, with blood-red oval spots, produced by shells. This marble has obtained its name from its brownish colour, being similar to that

* As I have not seen all the varieties of foreign marble now to be described, I cannot pretend to say with certainty that the whole of them belong to the Granular Foliated Limestone. The descriptions are from Brard's Treatise on Precious Stones.

that of a variety of cherries, likewise called *griotte;* but it also sometimes contains large white veins, which traverse the other spots, and which, as destroying the harmony of the other tints, are considered as a defect. Some of the ornaments of the Triumphal Arch of the Carousel, are made of griotte; which is now much employed in the decoration of public monuments, and of splendid furniture. It is sold at about 200 francs the cubic foot. It is found in the Department of Herault.

2. *Marble of Languedoc, or of St Beaume.*—It is of a bright red colour, and is marked with white and grey zones, formed by madrepores. The eight columns which adorn the Triumphal Arch in the Carousel at Paris, are of this marble. The quarries are at St Beaume, in the Department of Aude.

3. *Campan Marble.*—This is a mixture of granular foliated limestone and a green talcky mineral, which forms veins on its surface. There are three varieties of Campan, which, however, are often united in the same piece: the first, called *Green Campan,* is of a pale sea-green colour, and exhibits on its surface lines of a much deeper green, and forming a kind of net-work: the second, called *Isabel Campan,* is of a delicate rose-colour, and, like the first, is furnished with undulating veins of green talc: the third variety, the *Red Campan,* is of a deep red colour, with veins of a still deeper red, and in some degree resembles parts of the griotte. In order to form a correct idea of the Campan marble, properly speaking, we must imagine that these three varieties are united, so as to form large stripes, from a few inches, to two, three, or even six feet broad, which produce a very grand and pleasing effect when viewed in large masses. When, therefore, the Campan marble can be employed in the large way, it may be looked upon

as

as one of great beauty and splendour. It should not, however, be exposed to the weather, since, by so doing, the talcose substance exfoliates, and leaves hollow spaces, which renders its surface uneven and rough; but it answers extremely well in the interior of buildings, for chimney-pieces, slabs for tables, &c. There are immense quarries of this valuable marble at Campan, near Bagnere, in the High Pyrenees.

4. *Sarencolin Marble.*—It exhibits on its surface large straight zones, and angular spots, of a yellow or blood-red colour, so that at first view it bears some resemblance to the marble called Sicilian. The finer varieties have become very scarce. It is found at Sarencolin, in the High Pyrenees.

5. *Breccia Marble of the Pyrenees.*—One variety contains, in a brownish-red basis, black, grey, and red, middle-sized spots. It admits a good polish. Another variety has an orange-yellow coloured basis, containing small fragments of a snow-white colour. Both varieties are found in the High Pyrenees.

Italian Marbles.

1. *Sienna Marble, or Brocatella di Siena.*—It has a yellowish colour, and disposed in large irregular spots, surrounded with veins of bluish-red, passing sometimes into purple. It is by no means uncommon in Siena. At Montarenti, two leagues from Siena, another yellow marble is found, which is traversed by black and purplish-black veins. This is frequently employed throughout Italy.

2. *Mandelato Marble.*—It is a light red marble, with yellowish-white spots, found at Luggezana in the Veronese. Another variety, bearing the same name, occurs at Preosa. They

They are both employed for columns, and various other works.

3. *Green Marble of Florence.*—It is of a green colour, which it owes to an intermixture of steatite.

4. *Verde di Prado Marble.*—It is a green marble, marked with dark green spots, having greater intensity than the base or ground. It is found near the little town of Prado in Tuscany.

5. *Rovigo Marble.*—It is of a white colour, but is inferior in quality to those of Carrara and Genoa. It is found at Padua.

6. *Luni Marble.*—It is of a white colour, with red-coloured spots and dots. It is found at Luni, on the coast of Tuscany.

7. *Venetian Marble.*—It is white, with red and yellow spots and veins. It is found in the Venetian territory.

8. *Lago Maggiore Marble.*—It is white, with black spots and dots, and is of great beauty. It has been employed for decorating the interior of many churches in the Milanese.

9. *Breche d'Italie.*—It has a reddish-brown ground, veined with white. It is a beautiful marble, but requires much care in keeping, since it becomes soon spotted, by coming into contact with greasy substances.

10. *Bretonico Marble.*—This beautiful marble is composed of yellow, grey, and rose-coloured portions or fragments. It is found near the village of Bretonico, in the Veronese.

11. *Bergamo Marble.*—It is composed of grey and black fragments, in a green basis.

Sicilian

Sicilian Marbles.

The island of Sicily abounds in marbles. Baron Borch describes upwards of a hundred marbles. Of these, the best known in this country is that named *Sicile Antique*, or by English artists *Sicilian Jasper*. It is red, with large stripes like ribbons, white, red, and sometimes green. Among the Sicilian breccia marbles, are those of the Gallo, the one of a light grey colour, presenting elegant rose-coloured spots, of different shades; and the other also grey, veined yellow, and exhibiting on its surface white translucent spots. The breccia marble of Monte Alcano is light grey, with round rose-coloured spots. That of Taormina has a deep red ground, and presents on its surface yellow and greyish-white spots.

Spanish Marbles.

Spain abounds in beautiful marbles. The vicinity of Valencia, Cadiz, Burgos, Grenada, Molina, and Carthagena, offer a great number of them; and the Tagus, in its course, winds through hills of marble. Hence it is, that the monuments in Spain, those of the middle ages, and of modern times, are profusely decorated with indigenous marbles. The vault of the beautiful theatre at Toledo, is supported by 350 marble columns. The Mosque of Cordova, erected by Caliph Abdoulrahman III. is ornamented with 1200 columns, most of which are of Spanish marble. Among the ruins of ancient Merida, which was built twenty-eight years before the commencement of the Christian era, fragments of fine marbles are still discovered; the Church of the Escurial, and also the Palace are decorated with very beautiful marbles; and the same may be said of the principal churches in Madrid. The

The following are some of the principal marbles found in Spain.

1. *White Marble.*—Near Cordova, there is a white fine granular marble, which takes a good polish, and is very fit for sculpture. Near Filabres, three leagues from Almeria in Grenada, there is a hill of about a league in circumference, and 2000 feet in height, which is said to be entirely composed of the purest white marble, capable of the finest polish; and the rocks which surround the town of Molina in New Castile, are composed of a white marble, which has been employed in the Palace of the Alhambra at Grenada.

2. *Red Marble.*—There is a beautiful red variety, with shining red and white spots and veins, called *Red Seville Marble.* There is also a flesh-coloured variety, veined with white, from Santiago. A dull red marble, with minute black veins, is found in Meguera in Valencia, and is much used in Spain for tables. The mountains of Guipuscoa afford a red marble, veined with grey, and closely resembling that of Sarencolin.

3. *Tortosa Marble.*—Its basis or ground is violet, and it is spotted with bright yellow.

4. *Grenada Marble.*—It is of a green colour, and very much resembles the Verde Antico. It is found at Grenada.

5. *Spanish Brocatello Marble.*—This is a well known and very beautiful variety of marble.

6. *Breccia Marble.*—Several beautiful varieties of this marble occur in Spain. At Riela in Arragon, there is a beautiful breccia marble, composed of angular portions or fragments of a black marble, imbedded in a reddish-yellow base. The breccia marble of Old Castile is of a bright red, dotted with yellow and black, and incloses middle-sized

sized fragments of a pale yellow, brick-red, deep brown, and blackish-grey.

Portuguese Marbles.

Few marbles have hitherto been discovered in Portugal, and none of them equal in beauty the finer varieties found in Spain.

Swiss Marbles.

Granular foliated limestone occurs abundantly in Switzerland, but it has not hitherto been much used as a marble.

German Marbles.

Germany abounds in marbles, and affords many varieties, remarkable either for their beauty or singularity. They are quarried in great quantity, and carried to different parts of that vast country, or are exported into the neighbouring states. The varieties are so numerous, that we cannot, in the very brief view we are now taking, pretend to notice even the more remarkable of them, but must refer, for the particular descriptions, to the economical department of this work.

Norwegian Marbles.

Norway is poor in marbles, almost the only quarry of this stone being that of Gillebeck, in the district of Christiania.

Swedish Marbles.

Sweden does not afford many kinds of marble, and none of them are eminently distinguished for the beauty of their

appearance.

appearance. The principal marble is that of Fagernech, which is white, with veins of green talc.

Russian and Siberian Marbles.

The vast Empire of Russia affords a great many different kinds of marble. Georgi, in his Description of the Russian Empire, enumerates white, grey, green, blue, yellow, and red varieties; and Patrin gives the following account of the Siberian marbles. " The Uralian Mountains furnish the finest and most variegated marbles. The greater part is taken from the neighbourhood of Catharinenburg, where they are wrought, and from thence transported into Russia, particularly to Petersburgh. The late Empress caused an immense palace to be built in her capital for Orloff, her favourite, which is entirely coated with these fine marbles, both inside and outside. The Empress built the church of Isaac with the same marbles, on a vast space, near the statue of Peter the Great." Patrin found no white statuary marble in the Uralian Mountains; but in that part of the Altain Mountains which is traversed by the river Irtish, he in two places saw immense blocks of marble, perfectly white and pure, from which blocks might be hewn.

Asiatic Marbles.

At present we are very imperfectly acquainted with the marbles of Asia.

Shaw mentions a red marble from Mount Sinai: Russell, in his Natural History of Aleppo, gives an imperfect account of the marbles of Syria; and some Persian marbles are noticed by Chardin. Mr Morier, in his Journey through Persia, mentions a very beautiful marble, under the name *Marble of Tabriz*, and informs us, that the tomb of of the celebrated poet Hafitz is constructed with it, and that the wainscotting of the principal room of the Hafi-ten, near Schiraz, is likewise of this marble. Its colours are described as light green, with veins, sometimes of red, sometimes of blue, and it has great translucency. It is cut in large slabs; for Mr Morier saw some that measured nine feet in length, and five feet in breadth. He says, that it is not procured near the city of Tabriz, or taken from a quarry, but is said to be rather a petrifaction, found in large quantities, and in immense blocks, on the borders of the Lake Shahee, near the town of Meraugheh. If it is a mere calcareous deposition, formed in the way of calcareous-alabaster or calc-sinter, it must be considered, not as marble, but a variety of that mineral.

The marbles of Hindostan, Siam, and China, are almost unknown to us. Authors speak of a quarry of white marble in the neighbourhood of Pekin; and of a similar marble in the vicinity of the capital of Siam.

African Marbles.

Beds of marble occur in the Atlas Mountains, and in those ranges that bound the shores of the Red Sea *.

American Marbles.

A good many different marbles have been discovered in the United States. The principal quarries are at Stockbridge and Lanesborough, Massachussets: in Vermont and Pennsylvania: in New-York; and in Virginia. According to Professor Hall, as mentioned by Mr Kœnig, marble has been found in many places on the west side of the Green Mountains in Vermont. A few years since, a valuable

* Vid. Murray's interesting and valuable work, "Historical Account of Discoveries and Travels in Africa," for particulars in regard to the marbles of Africa.

luable quarry was opened in Middleburg, a town situated on Otter Creek, eleven miles above Vergennes. The marble is of different colours in different parts of the bed. The principal colour, however, is bluish-grey. It takes a good polish, and is in general free of admixture of any substance that might affect its polish.

Second Subspecies.

Compact Limestone.

Dichter Kalkstein, *Werner.*

This subspecies is divided into three kinds, viz. Common Compact Limestone, Blue Vesuvian Limestone, and Roestone.

First Kind.

Common Compact Limestone.

Gemeiner Dichter Kalkstein, *Werner.*

Calcareus æquabilis, *Wall.* t. i. p. 122.—Dichter Kalkstein, *Wid.* s. 494.—Compact Limestone, *Kirw.* vol. i. p. 82.—Gemeiner Dichter Kalkstein, *Emm.* b. i. s. 437.—Pietra calcarea compacta, *Nap.* p. 33.—La pierre calcaire compacte commune, *Broch.* t. i. p. 523.—Chaux carbonatée compacte, *Haüy,* t. ii. p. 166.—Gemeiner Dichter Kalkstein, *Reuss,* b. ii. 2. s. 262. *Id. Lud.* b. i. s. 146. *Id. Suck.* 1r th. s. 585. *Id. Bert.* s. 88. *Id. Mohs,* b. ii. s. 14. *Id. Hab.* s. 71. *Id. Leonhard,* Tabel. s. 32.—Chaux carbonatée compacte, *Brong.* t. i. p. 199.—Gemeiner Kalkstein, *Haus.* s. 126.—Dichter Kalkstein, *Karsten,* Tabel. s. 50.—Chaux carbonatée compacte, *Haüy,* Tabl. p. 4.—Dichter gemeiner Kalkstein, *Lenz,* b. ii. s. 732.—Gemeiner Dichter Kalkstein, *Hoff.* b. iii. s. 8.—Common Limestone, *Aikin,* p. 160.

External

External Characters.

Its most frequent colour is grey, of which the following varieties have been observed: yellowish, bluish, ash, pearl, greenish, and smoke grey; the ash-grey passes into greyish-black; the yellowish-grey into yellowish-brown, ochre-yellow, and into a colour bordering on cream-yellow. It also occurs blood-red, flesh-red, and peach-blossom-red, which latter colour is very rare.

It frequently exhibits veined, zoned, striped, clouded, and spotted coloured delineations; and sometimes also black and brown coloured arborisations.

It very rarely exhibits a beautiful play of colours, caused by intermixed portions of pearly shells.

It occurs massive, corroded, in large plates, rolled masses, and in various extraneous external shapes, of univalve, bivalve, and multivalve shells, of corals, fishes, and more rarely of vegetables, as of ferns and reeds.

Internally it is dull, seldom glimmering, which is owing to intermixed calcareous-spar.

The fracture is small and fine splintery, which sometimes passes into large and flat conchoidal, sometimes into uneven, inclining to earthy, and it occasionally inclines to straight and thick slaty.

The fragments are indeterminate angular, more or less sharp-edged, but in the slaty variety they are tabular.

It is generally translucent on the edges, sometimes opaque.

It is in general rather softer than granular foliated limestone.

It is brittle, and easily frangible.

Its streak is generally greyish-white.

Specific

Specific gravity, Splintery, 2.600, 2.720, *Brisson.*—Opalescent Shell Marble, 2.673, *Leonhard.*—2.675, *Werner.*

Chemical Characters.

It effervesces with acids, and the greater part is dissolved; and burns to quicklime, without falling to pieces.

Constituent Parts.

Rudersdorf.		Bluish-grey Limestone.		Limestone from Sweden.		Limestone from Ettersberg *.	
Lime,	53.00	Lime,	49.50	Lime,	49.25	Lime,	33.41
Carbon. acid,	42.50	Carbon. acid,	40.00	Carbon. acid,	35.00	Carbon. acid,	42.00
Silica,	1.12	Silica,	5.25	Silica,	8.75	Silica,	10.25
Alumina,	1.00	Alumina,	2.75	Alumina,	2.50	Magnesia,	9.43
Iron,	0.75	Iron,	1.37	Iron,	2.75	Iron,	2.25
Water,	1.03	Water,	1.13	Loss,	1.75	Manganese,	1.25
						Loss,	1.41
	100		100		100		100
Simon, Gehlen's Jour. iv. s. 426.		*Simon*, Ib.		*Simon*, Ib.		*Buchols*, Ib.	

Geognostic Situation.

This mineral occurs in vast abundance in nature, principally in secondary formations, along with sandstone, gypsum, and coal; and in small quantity in primitive mountains. The variegated varieties, which are frequently traversed by veins of calcareous-spar, occur principally in districts composed of grey-wacke and clay-slate. It is distinctly stratified, and the strata vary in thickness, from a few inches to many fathoms, and are from a few fathoms to many miles in extent. The strata generally incline to horizontal

* Some of the limestones in Fifeshire agree in composition with that of Ettersberg.

rizontal; sometimes, however, they are vertical, or variously convoluted, even arranged in concentric layers, thus presenting appearances illustrative of their chemical nature. Petrifactions, both of animals and vegetables, but principally of the former, abound in compact limestone: these are of corals, shells, fishes, and sometimes of amphibious animals. On a general view, it is to be considered as rich in ores of different kinds, particularly ores of lead and zinc: thus, nearly all the rich and valuable lead-mines in England are situated in limestone.

Geographic Situation.

It abounds in the sandstone and coal formations, both in Scotland and England; and in Ireland, it is a very abundant mineral in all the districts where clay-slate and red sandstone rocks occur. On the Continent of Europe, it is a very widely and abundantly distributed mineral; and forms a striking feature in many extensive tracts of country in Asia, Africa and America, as will be particularly described in the Geognostic part of this work.

Uses.

When compact limestone joins to pure and agreeable colours, so considerable a degree of hardness that it takes a good polish, it is by artists considered as a Marble; and if it contains petrifactions mineralized, it is named *shell* or *lumachella*, and *coral* or *zoophytic marble*, according as the organic remains are testaceous or coralline*. In one particular variety of lumachella

* The name *marmor*, is derived from the Greek *μαρμαιρειν*, *to shine*, or *glitter*, and was by the ancients applied, not only to limestone, but also to stones possessing agreeable colours, and receiving a good polish, such as gypsum, jasper, serpentine, and even granite and porphyry.

lumachella or shell marble, found at Bleiberg in Carinthia, the shells and fragments of shells, which belong to the nautilus tribe, are set in a brown-coloured basis, and reflect many beautiful and brilliant pearly inclining to metallic colours, principally the fire-red, green, and blue tints. It is named *opalescent* or *fire marble*. Another lumachella marble from Astracan, contains, in a reddish-brown basis, pearly shells of nautili, that reflect a very brilliant gold-yellow colour. In some compact marbles, the surface presents a beautiful arborescent appearance, and these are named *arborescent* or *dendritic marbles*. Such are those of Papenheim in Bavaria.

The *Florentine Marble*, or *Ruin Marble*, as it is sometimes called, is a compact limestone. It occurs on the Po and the Arno, and is worked into various articles at Florence. It is said to occur in balls. It presents angular figures of a yellowish-brown, on a base of a lighter tint, and which passes to greyish-white. Seen at a distance, slabs of this stone resemble drawings done in bister. "One is amused (says Brard) to observe in it kinds of ruins: there it is a Gothic castle half destroyed, here it presents ruined walls; in another place old bastions; and, what still adds to the illusion, is, that, in these sorts of natural paintings, there exists a kind of aërial perspective, which is very sensibly perceived. The lower part, or what forms the first plane, has a warm and bold tone; the second follows it, and weakens it as it increases the distance; the third becomes still fainter; while the upper part, agreeing with the first, presents in the distance a whitish zone, which terminates the horizon, then blends itself more and more as it rises, and at length reaches the top, where it forms sometimes as it were clouds. But approach close to it, all vanishes immediately, and these pretended figures, which, at a distance, seemed so well drawn, are converted into irregular marks, which present nothing to the eye." To the same compact limestone may be referred the variety called *Cottam Marble*, from being found at Cottam, near Bristol. It resembles in many respects the Landscape Marble.

In different parts of Scotland, compact limestone is cut and polished as marble: this was the case in the parish of Cummertrees in Dumfriesshire,—in Cambuslang parish, in Lanarkshire,—in Fifeshire, &c. In England, many compact limestones are cut and polished as marbles; such are the limestones of Derbyshire, Yorkshire, Devonshire, Somersetshire, and Dorsetshire. It is sometimes used as a building stone; and, in want of better materials, for paving streets, and making highways. When, by exposure to a high temperature, it is deprived of its carbonic acid, and converted into quicklime, it is used for mortar; also by the soap-maker, for rendering his alkalies caustic; by the tanner, for cleansing hides, or freeing them from hair, muscular substance, and fat; by the farmer, in the improvement of particular kinds of soil; and by the metallurgist, in the smelting of such ores as are difficultly fusible, owing to an intermixture of silica and alumina.

Second Kind.

Blue Vesuvian Limestone.

Blauer Vesuvischer Kalkstein, *Klaproth.*

Blauer Vesuvischer Kalkstein, *Klaproth,* Beit. b. v. s. 92. *Id.* *Lenz,* b. ii. s. 737.

External Characters.

Its colour is dark bluish-grey, partly veined with white.

Externally it appears as if it had been rolled; and the surface is uneven.

The fracture fine earthy, passing into splintery.

It is opaque.

It affords a white streak.

It is semi-hard in a low degree.

It is rather heavy.

Constituent Parts.

Lime, - -	58.00
Carbonic Acid, -	28.50
Water, which is somewhat ammoniacal, -	11.00
Magnesia, - -	0.50
Oxide of Iron, -	0.25
Carbon, - -	0.25
Silica, -	1.25
	99.75

Klaproth, Beit. b. v. s. 96.

From

From this analysis, it appears, that the vesuvian limestone differs remarkably in composition from common compact limestone. In common compact limestone, 100 parts of lime are combined with at least 80 parts of carbonic acid; whereas in the vesuvian limestone, 100 parts of limestone are not combined with more than 50 parts of carbonic acid. Secondly, In common limestone, independent of the water which adheres to it accidentally, as far as we know, there is no water of composition; but in the vesuvian limestone, there are 11 parts of water of composition.

Geographic Situation.

This remarkable limestone is found in loose masses amongst unaltered ejected minerals in the neighbourhood of Vesuvius.

Observations.

It is known to some collectors under the name *Compact Blue Lava* of Vesuvius; and is employed by artists in their mosaic work, to represent the sky.

Third Kind.

Roestone, or Oolite *.

Roogenstein, *Werner.*

Hammites, *Plin.* Hist. Nat. xxxvii. 10. s. 60.?—F. E. Bruckmanni, Specimen physicum sistens, Histor. Nat. Oolithe, 1721.

* *Roestone*, so named on account of its resemblance in form to the roe of fishes.

1721.—Stalactites oolithus, var. *b. c. d. Wall.* t. ii. p. 384.—Roogenstein, *Wid.* s. 511.—Oviform Limestone, *Kirw.* vol. i. p. 91.—Roogenstein, *Estner,* b. ii. s. 928. *Id. Emm.* b. i. s. 442.—Tufo oolitico, *Nap.* p. 353.—L'Oolite, *Broch.* t. i. p. 529.—Chaux carbonatée compacte globuliforme, *Haüy,* t. ii. p. 171.—Roogenstein, *Reuss,* b. ii. 2. s. 270. *Id. Lud.* b. i. s. 148. *Id. Suck.* 1r th. s. 591. *Id. Bert.* s. 89. *Id. Mohs,* b. ii. s. 26. *Id. Hab.* p. 72. *Id. Leonhard,* Tabel. s. 32.—Chaux carbonatée oolithe, *Brong.* t. i. p. 203.—Chaux carbonatée globuliforme, *Brard,* p. 31.—Erbsförmiger Kalkstein, *Karsten,* Tabel. s. 50.—Roestone, *Kid,* vol. i. p. 26.—Chaux carbonatée globuliforme, *Haüy,* Tabl. p. 4.—Roogenstein, *Lenz,* b. ii. s. 738. *Id. Hoff.* b. iii. s. 12.—Schaaliger Kalkstein, *Haus.* b. iii. s. 912.

External Characters.

Its colours are hair-brown, chesnut-brown, and reddish-brown, and sometimes yellowish-grey, and ash-grey.

It occurs massive, and in distinct concretions, which are round granular, the larger are composed of fine spherical granular, and sometimes of very thin concentric lamellar concretions.

Internally it is dull.

The fracture of the grains is fine splintery; but of the mass is round granular in the small, and slaty in the large.

The fragments in the large are blunt-edged.

It is opaque.

It is semi-hard, approaching to soft.

It is rather brittle, and very easily frangible.

Specific gravity, 2.6829, 2.6190, *Kopp.*—2.585, *Breithaupt.*

Chemical

Chemical Characters.

It dissolves with effervescence in acids.

Geognostic Situation.

It occurs along with red sandstone, and *lias* limestone.

Geographic Situation.

This rock, which, in England, is known under the names Bath-Stone, Ketton-Stone, Portland-Stone, and Oolite, extends, with but little interruption, from Somersetshire to the banks of the Humber in Lincolnshire. On the Continent of Europe, it occurs in Thuringia, the Netherlands, the mountains of Jura, and in other countries.

Uses.

The Oolite, or Roestone, particularly that of Bath and Portland, is very extensively employed in architecture; it can be worked with great ease, and has a light and beautiful appearance; but it is porous, and possesses no great durability, and should not be employed where there is much carved or ornamental work, for the fine chiselling is soon effaced by the action of the atmosphere. On account of the ease and sharpness with which it can be carved, it is much used by the English architects, who appear to have little regard for futurity. St Paul's is built of this stone, also Somerset-House. The Chapel of Henry VIII. affords a striking proof of the inattention of the architects to the choice of the stone. All the beautiful ornamental work of the exterior had mouldered away in the short comparative period of 300 years. It has recently been cased with a new front of Bath-Stone, in which the carving has been correctly

correctly copied: from the nature of the stone, we may predict, that its duration will not be longer than that of the original. Both Portland and Bath stone varies much in quality. In buildings constructed of this stone, we may frequently observe some of the stones black, and others white. The black stones are those which are more compact and durable, and preserve their coating of smoke; the white stones are decomposing, and presenting a fresh surface, as if they had been recently scraped *. Roestone is also used as a manure, but when burnt into quicklime, the marly varieties afford rather an indifferent mortar; but those mixed with sand a better mortar.

Observations.

1. It passes into Sandstone, Compact Limestone, and Marl.

2. Some naturalists, as Daubenton, Saussure, Spallanzani, and Gillet Lamont, conjecture, that Roestone is carbonate of lime, which has been granulated in the manner of gunpowder, by the action of water: the most plausible opinion is that which attributes the formation of this mineral to crystallization from a state of solution.

Third Subspecies.

Chalk.

Kreide, *Werner.*

Creta alba, *Wall.* t. i. p. 27.—Kreide, *Wid.* s. 492.—Chalk, *Kirw.* vol. i. p. 77.—Kreide, *Estner,* b. ii. s. 917. *Id. Emm.* b. i.

* Aikin.

b. i. s. 433.—Creta commune, *Nap.* p. 381.—La Craie, *Brock.* t. i. p. 521.—Craie, *Haüy,* t. ii. p. 166.—Kreide, *Reuss,* b. ii. 2. s. 259. *Id. Lud.* b. i. s. 145. *Id. Suck.* 1r th. s. 583. *Id. Bert.* s. 87. *Id. Mohs,* b. ii. s. 9. *Id. Hab.* s. 70. *Id. Leonhard,* Tabel. s. 32.—Chaux carbonatée crayeuse, *Brong.* t. i. p. 208. *Id. Brard,* p. 29.—Kreide, *Karsten,* Tabel. s. 50. *Id. Haus.* s. 126.—Chalk, *Kid,* vol. i. p. 18.—Kreide, *Lenz,* b. ii. s. 728. *Id. Oken,* b. i. s. 410. *Id. Hoff.* b. iii. s. 4.—Chalk, *Aikin,* p. 160.

External Characters.

Its colour is yellowish-white, which sometimes passes to greyish-white and snow-white. It is sometimes marked with yellowish-grey.

It occurs massive, disseminated, in crusts, and in extraneous external shapes.

It is dull.

The fracture is coarse and fine earthy.

The fragments are blunt-edged.

It is opaque.

It writes and soils very much.

It is soft, and sometimes very soft.

It is rather sectile, and easily frangible.

It adheres slightly to the tongue.

It feels very meagre, and rather rough.

Specific gravity, 2.252, *Muschenbroeck.*—2.315, *Kirwan.*—2.657, *Watson.*—2.226, *Breithaupt.*

Chemical Characters.

It effervesces strongly with acids.

Constituent

Constituent Parts.

			Chalk from Gallicia.				
Lime,	56.5		Lime,	47.00		Lime,	53
Carbonic Acid,	43.0		Carbonic Acid,	33.00		Carbonic Acid,	42
Water,	0.5		Silica,	7.00		Alumina,	2
	——		Alumina,	2.00		Water,	3
			Magnesia,	8.00			——
Buchols, in Gehlen's Journal, b. iv. s. 416.			Iron,	0.05		*Kirwan*, Min. vol. i. p. 77.	
				——			
			Hacquet.				

Geognostic Situation.

It constitutes one of the newer secondary or flœtz formations; is usually found in low situations, and frequently on sea coasts. It is stratified, and the strata in general are horizontal. It often contains flint, which is disposed either in interrupted beds in the chalk, or in globular, tuberose, or tabular masses imbedded in it. It abounds in organic remains, and these are principally of animals of the lower orders, such as echinites, belemnites, terebratulites, pinnites, &c. These petrifactions are either in the state of carbonate, or are converted into flint, which latter is by far the most frequent. It cannot be considered as a metalliferous formation, as it contains nothing but small imbedded portions of iron-pyrites. Two principal kinds of chalk occur in chalk districts: the one is named *Hard*, the other *Soft Chalk;* the hard chalk always occurs undermost, is considerably harder than the other, and rarely contains petrifactions or flint; the soft chalk, on the contrary, rests upon the other, is softer, and abounds in flint and petrifactions.

Geographic

Geographic Situation.

It abounds in the south-eastern parts of England,—extends through several provinces in France,—occupies great tracts of country in Poland and Russia,—is met with on the shores of the Baltic,—and in the islands of Zeeland and Rugen.

Uses.

The uses of this mineral are various. The more compact kinds are employed as building-stones, when they are used either in a rough state, or are sawn into blocks of the requisite size and shape: it is burnt into quicklime, and used for mortar in different countries; thus, nearly all the houses in London are cemented with chalk-mortar *: it is also employed in great quantities in the polishing of glass and metals, and whitening the roofs of rooms, in the state of *whiting* †; in constructing moulds to cast metal in; by carpenters and others as a material to mark with. When perfectly purified, and mixed with vegetable colours, it forms a kind of pastil colour: thus, with litmus, turmeric, saffron, and sap-green, it forms durable colours, but vegetable colours that contain an acid, become blue when mixed with it. The *Vienna white* known to artists is perfectly purified chalk. It is used by starch-makers and chemists to dry precipitates

* According to Smeaton, it makes as good lime as the best limestone or marble.

† In the preparation of whiting, chalk is pounded, and diffused through water, and the finer part of the sediment is then dried; by this means, the siliceous particles are separated, which, by their hardness, would scratch the surface of metallic and other substances, in the polishing of which whiting is used.—*Aikin's Chem. Dictionary.*

precipitates on, for which it is peculiarly qualified, on account of the remarkable facility with which it absorbs water. With isinglas, or white of eggs, it forms a valuable lute or cement. In the gilding of wood, it is necessary, before laying on the gold, to cover it with a succession of coats of a mixture of whiting and size. The mineral is also used as a filtering-stone; and in a purified state, it is employed as a remedy to correct acidity in the stomach, and the morbid states which arise from this.

Observations.

1. The principal characters of chalk are its colours, fracture, soiling, and low specific gravity. These, and its easy frangibility, distinguish it from *White Clay-stone;* and its meagre feel distinguishes it from the *Clays.*

2. It is conjectured that the name *Creta,* is derived from the island of Candia, (Creta of the ancients), where this mineral is said to occur. Ancient writers seem to use the word *creta* in different senses, as appears from the following observations: " The word *creta,* though applied by Wallerius and others to chalk, is generally used by the early naturalists to express clay: " Proderit sabulosis locis *cretam* ingerere; cretosis ac nimium densis, *sabulum* *;" where, as *sabulum* certainly means sand, it is nearly evident, from the reciprocal use of the substances mentioned, compared with the opposite properties of sand and clay, that *creta* signifies the latter. " Lateres non sunt e sabuloso, neque arenoso, multoque minus calculoso ducendi solo; sed e *cretoso* †." Again, it may be observed, with respect

* Columella, p. 73.

† Plin. Nat. Hist. ed. Brot. vol. vi. p. 174.

spect to the following line,

'Hinc humilem Myconem, cretosaque rura Cimoli *,'

that the Cimolian earth is described in various passages of Pliny, &c. under characters peculiar to clay.

There are two passages in which *creta* seems to be applicable to chalk: one in Horace,

——— 'creta an carbone notandi †.'

The other in Pliny: "Alia *creta* argentaria appellatur nitorem argento reddens ‡;" this being a common use of chalk at the present day.—*Kid's Mineralogy*, vol. i. p. 18, 19.

Fourth Subspecies.

Agaric Mineral, or Rock Milk.

Berg-Milch, *Werner*.

Agaricus mineralis, *Wall.* t. i. p. 30.—Bergmilch, *Wid.* s. 490. —Agaric mineral, *Kirw.* vol. i. p. 76.—Bergmilch, *Estner*, b. ii. s. 914. *Id. Emm.* b. i. s. 430.—Agaric Mineral, *Nap.* p. 333. *Id. Lam.* p. 331.—Lait de Montagne, ou l'Agaric Mineral, *Broch.* t. i. p. 519.—Chaux carbonatée spongieuse, *Haüy*, t. ii. p. 167.—Bergmilch, *Reuss*, b. ii. 2. s. 257. *Id. Lud.* b. i. s. 145. *Id. Suck.* 1r th. s. 582. *Id. Bert.* s. 87. *Id. Mohs*, b. ii. s. 8. *Id. Leonhard*, Tabel. s. 32.—Chaux carbonatée spongieuse, *Brong.* t. i. p. 210.—Montmilch, *Haus.* s. 127.—Bergmilch, *Karst.* Tabel. s. 50.—Agaric Mineral, *Kid.*

* Ovid, Metam. lib. vii.

† Horat. Sat. iii. lib. 2.

‡ Plin. Hist. Nat. ed. Brot. vol. vi. p. 184.

Kid, vol. i. p. 38.—Bergmilch, *Lenz,* b. ii. s. 727. *Id. Oken,* b. i. s. 411. *Id. Hoff.* b. iii. s. 2.

External Characters.

Its colours are snow-white, greyish-white, and yellowish-white.

It occurs frequently in crusts, also in loosely cohering tuberose pieces.

It is dull.

It is composed of fine dusty particles.

It soils strongly.

It feels meagre.

It adheres slightly to the tongue.

It is very light, almost supernatant.

Chemical Characters.

It effervesces with acids, and is completely dissolved in them.

Constituent Parts.

It is a pure Carbonate of Lime.

Geognostic and Geographic Situations.

It is found on the north side of Oxford, between the Isis and the Cherwell, and near Chipping-Norton, also in Oxfordshire *; and in the fissures of caves of limestone mountains in Switzerland, Austria, Salzburg, and other countries.

Uses.

* Kid's Mineralogy, vol. i. p. 39.

Uses.

In Switzerland, where it occurs abundantly, it is used for whitening houses.

Observations.

1. It is formed by water passing over and through limestone rocks, and afterwards depositing in holes, fissures, and on faces of rocks, the calcareous earth it had dissolved in its course.

2. It is named *Agaric Mineral*, from its sometimes adhering to rocks with the resemblance of a fungus or agaric: the name *Rock Milk* given to it by some mineralogists, is from its white appearance when oozing from the clefts of rocks; and the name *Lac Lunæ* is sometimes given to it, from the milky-like appearance it presents in a cave in Phrygia; this cave, according to the tradition of the neighbourhood, having been formerly frequented by Diana *.

Fifth Subspecies.

Fibrous Limestone.

Fasriger Kalkstein, *Werner*.

This subspecies is divided into two kinds, viz. Common Fibrous Limestone, or Satin-Spar, and Fibrous Calc-Sinter.

First

* Kid's Mineralogy, vol. i. p. 39.

First Kind.

Common Fibrous Limestone, or Satin-Spar.

Gemeiner fasriger Kalkstein, *Werner.*

Pierre calcaire fibreuse, *Broch.* t. i. p. 549.—Gemeiner fasriger Kalkstein, *Reuss,* b. ii. 2. s. 304. *Id. Mohs,* b. ii. s. 85. *Id. Leonhard,* Tabel s. 34.—Chaux carbonatée fibreuse, *Brong.* t. i. p. 218.—Fasriger Kalkstein, *Karsten,* Tabl. s. 50. —Satin-spar, *Kid,* vol. i. p. 49.—Chaux carbonatée fibreuse-conjointe, *Haüy,* Tabl. p. 4.—Gemeiner fasriger Kalkstein, *Lenz,* b. ii. s. 750. *Id. Hoff.* b. iii. s. 81.—Fibrous Carbonate of Lime, *Aikin,* p. 159.

External Characters.

Its colours are greyish, reddish, and yellowish white.

It occurs massive; also in distinct concretions, which are coarse and fine fibrous, and either straight or curved.

Its lustre is glistening or shining, and pearly.

The fragments are splintery.

It is feebly translucent.

It is as hard as calcareous-spar.

It is easily frangible.

Specific gravity 2.70, *Pepys.*

Constituent Parts.

Carbonate of Lime,	95.75	Lime, -	50.8
Carbonate of Manganese,	4.25	Carbonic Acid,	47.6
			98.4
	Holme.		*Pepys,* in Kid's Min. vol. i. p. 49.

Stromeyer says that fibrous limestone contains some *per cents.* of gypsum.

Geognostic and Geographic Situations.

It occurs in thin layers in clay-slate at Aldstone Moore in Cumberland: in layers and veins in the middle district of Scotland, as in Fifeshire. On the Continent, at Potschappel, near Dresden; and at Schneeberg, also in Saxony.

Uses.

It is sometimes cut into necklaces, crosses, and other ornamental articles.

Second Kind.

Fibrous Calc-Sinter *.

Fasriger Kalksinter, *Werner.*

Sintricher fasriger Kalkstein, *Reuss,* b. ii. 2. s. 306.—Kalksinter, *Lud.* b. i. s. 150. *Id. Suck.* 1r th. s. 618. *Id. Bert.* s. 93. *Id. Mohs,* b. ii. s. 86. *Id. Hab.* s. 78.—Fasriger Kalksinter, *Leonhard,* Tabel. s. 34.—Sintriger Kalkstein, *Karsten,* Tabel. s. 50.—Chaux carbonatée concretionnée, *Haüy,* Tabl. p. 4.—Sintricher Kalkstein, *Lenz,* b. ii. s. 751.—Fasriger Kalksinter, *Hoff.* b. iii. s. 32.

External

* This is the Alabaster of the ancients, and is by the moderns named *Calcareous Alabaster*, to distinguish it from another mineral, gypsum, which they name *Gypseous Alabaster*.

External Characters.

The principal colour is white, of which the following are the varieties, viz. yellowish, greenish, greyish, reddish, and snow white; from yellowish-white it passes into wine, wax, and honey yellow, and into a kind of reddish-brown, passing into clove-brown; from greyish-white it passes into yellowish and pearl grey, and from this latter into reddish, seldomer into flesh and peach-blossom red, and brownish-red; lastly, it passes from greenish-white into asparagus, siskin, mountain, verdigris green, and sky-blue.

The peach-blossom colour is owing to cobalt; the flesh-red to manganese; the verdigris-green to copper; the siskin-green to nickel, and the brown to iron.

It is sometimes concentrically and reniformly striped, or it is spotted or clouded.

It occurs massive, stalactitic, globular, tubular, claviform, fruticose, curtain-shaped, cock's-comb-shaped, coralloidal, reniform, and tuberose; also in distinct concretions, which are fibrous, and these are straight, seldom curved, and sometimes scopiform or stellular; also in reniform curved lamellar concretions, and seldom in large and coarse angulo-granular concretions; very rarely we observe the longish external shapes, as the stalactitic, terminated by a three-sided pyramidal crystallization.

The surface is generally rough, and seldom fine drusy.

Internally it is glimmering, which passes on the one side into dull, on the other into glistening; and the lustre is pearly.

The fracture is fine splintery.

The fragments are splintery, or wedge-shaped.

It is translucent, or only translucent on the edges.

It is nearly as hard as calcareous-spar.
It is rather brittle, and easily frangible.
Specific gravity 2.658,–2.735.

Constituent Parts.

Lime, - - -	56.0
Carbonic Acid, -	43.0
Water, - - -	1.0
	100.0

Bucholz, in Gehlen's Journal, b. iv. s. 425.

Geognostic and Geographic Situations.

It is found encrusting the roofs, walls, and floors of caves, particularly those situated in limestone rocks. It is formed from water holding carbonate of lime in solution. Nothing is more common than the presence of carbonic acid in water; and when a superabundance of this acid is present, the acid is capable of holding in solution a portion of carbonate of lime; but when the solution comes to be agitated, or exposed to the atmosphere, or to a change of temperature, the carbonic acid makes its escape, and thus deprives the water of its solvent power. Water thus impregnated with carbonate of lime, oozes slowly through rocks of any kind, until it reaches the walls and roofs of caves: there some time elapses before a drop of sufficient size to fall by its own weight is formed, and in this interval some of the calcareous particles are separated from the water, owing to the escape of the carbonic acid, and adhere to the roof. In this manner, successive particles are separated, and attached to each other, until a *stalactite* is formed.

formed. If the percolation of the water containing calcareous particles be too rapid to allow time for the formation of a stalactite, the earthy matter is deposited from it after it has fallen from the roof upon the floor of the cave; and in this case, the deposition is called a *stalagmite*. In some cases, the separation of the calcareous matter takes place both at the roof and on the floor of the cave; and in the course of time, the substance of each deposition increasing, they both meet, and form pillars, often of great magnitude, and that appear destined to support the roof of the cave. Water charged with calcareous earth also oozes through the walls of these caves, and deposites in them a crust of calc-sinter, of various forms; so that in this manner the whole comes to be encrusted with calcareous matter; and if the infiltration continues, the cave in the process of time is entirely filled up.

Caves of this kind occur in almost every country. Maccallister's Cave, in the island of Skye, and those in the limestone hills of Derbyshire, are the most striking appearances of this kind hitherto observed in Scotland and England. But the most celebrated stalactitic cave, is that of Antiparos in the Archipelago, which has been particularly described by Tournefort. Similar caves occur in Germany, France, Switzerland, Spain, in the United States of America, and other countries.

Italy, which is so rich in fine marble, is not less so in beautiful calc-sinter or calcareous alabaster: the territory of Volterra in Tuscany, alone, furnishes no fewer than twenty different varieties. Sicily is also abundant in calc-sinter; and of these, the rose-coloured variety of Trapani is much admired.

Spain is, next to Italy, the most productive country of calcareous

calcareous alabaster. The environs of Granada and Malaga are particularly remarkable for the beautiful varieties of this mineral which they afford.

Persia also abounds in highly prized varieties of calcareous alabaster.

Uses.

Calc-sinter or Calcareous Alabaster, is used for the same purposes as marble, and is cut into tables, columns, vases, drapery for marble figures, and sometimes also into statues. It was also used by the ancients in the manufacture of their unguentary vases. A vessel of this kind is mentioned in the 26th chapter of Matthew's Gospel, where it is said, "There came unto him a woman, having an *alabaster* box of precious ointment." The most beautiful calcareous alabasters, those used by the ancients, are conjectured to have been brought from the mountains of the Thebaid, situated between the Nile and the Red Sea, near the city of Alabastron. In the National Museum in Paris, there is a colossal figure of an Egyptian deity, cut in this rare kind of alabaster. Many different varieties of this mineral are described by authors: the following are enumerated by Brard.

I. *Alabaster of One Colour.*

1. *Antique white Calcareous Alabaster.*—This variety is very rare: it is now only found amongst the ruins of ancient monuments, and particularly at Ortée, not far from Rome; but we are ignorant of the place from whence the ancients procured it.

2. *Yellowish*

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* A fine *sarcophagus* of white alabaster has been lately dug up in Egypt by that skilful and enterprising explorer *Belzoni*.

2. *Yellowish-white, inclining to rose, or Oriental Alabaster.*—The Egyptian statue already mentioned, is made of this beautiful variety of alabaster. It is supposed that the Egyptians procured it from Upper Egypt; but the same variety is found at present in the vicinity of Alicant and Valencia in Spain, and of Trapani in Sicily.

3. *Alabaster of Sienna.*—Its colour is honey-yellow, and it is nearly transparent. A similar variety is found in the island of Malta, of which statues of considerable size are made.

II. *Striped Alabaster,—Onyx Marble of the Ancients.*

The ancients procured these alabasters from the mountains of Arabia, and also from several districts in Germany.

1. *Striped Alabaster from Malaga.*—Two leagues from Malaga, there is a cave filled with wax-yellow alabaster, which, when cut perpendicularly, appears agreeably striped with two different yellow colours; but when cut in another direction, it only presents large irregular spots. The Palace of Madrid is ornamented with this alabaster.

2. *Alabaster from Montreal in Sicily.*—This variety is marked with bright red and yellow stripes.

3. *Alabaster from Caputo in Sicily.*—It is marked with yellow and white stripes.

4. *Alabaster from Mount Pellegrino.*—The stripes are narrow, and of two colours; the one yellow, the other deep black.

5. *Maltese Alabaster.*—Several varieties of alabaster are quarried in Malta: amongst others, one exhibits wax-yellow and white stripes, and another black, brown, and white stripes.

III. *Spotted*

III. *Spotted Alabaster.*

These spots are often produced by the manner in which the stone is cut. There are two very rich columns of this variety, in what used to be called the Hall of the Emperor, in the National Museum in Paris. They were discovered in the year 1780, amidst the ruins of the ancient city of Gabii, four leagues from Rome.

Observations.

1. Some varieties of calc-sinter are so porous, as to allow water to percolate through them, and these are used as filtering-stones.

2. At the springs of St Philippi in Tuscany, moulds of different kinds are suspended on the walls of the basins into which the calcareous water of these springs falls: after a certain period, these become covered with a very solid incrustation of white and very fine calc-sinter, which is easily separated from them, and is found to present excellent impressions of the moulds, whatever they are. It is said that vases, and even statues, are formed in the above manner from calcareous springs, near Guanca-Velica in Peru.

3. Some of the great caves in limestone countries are formed by masses of limestone irregularly heaped on each other, and connected together by means of calc-sinter.

4. Authors differ as to the derivation of the word *Alabaster*. It does not appear to have orignated from *albus*, as some pretend, because the white varieties were rare, and it was the yellow kinds that were most highly prized by the ancients: others are of opinion, and it is the most plausible one, that it is derived from the Greek word αλαβαστρον, which is

is by some derived from *α neg.* and λαμβανειν or λαβειν, *to hold*, because the vessels made of this mineral were without handles, and very smooth, and were therefore difficult to lay hold of. Vessels used for holding ointment or perfume were made of this stone, and were named *Alabastron*. Afterwards, the name alabastron was applied to ointment vessels made of other substances. Thus, in Theocritus, Idyll. xv. lin. 114. we have χρυσεῖ αλαβαστρα, *golden alabastra*. Raphelius remarks, on Matthew xxvi. 7., that Herodotus, among the presents sent by Cambyses to the King of Æthiopia, mentions μυρου αλαβαστρον; and Cicero, Academ. lib. ii. speaks of "alabastrum unguenti plenum." Matth. xxvi. 7.; Mark xiv. 3.; Luke vii. 37.

Sixth Subspecies.

Tufaceous Limestone, or Calc-Tuff*.

Kalk-Tuff, *Werner*.

Tuff Kalkstein, *Reuss*, b. ii. 2. s. 314.—Kalk-tuff, *Lud.* b. i. s. 157. *Id. Suck.* 1r th. s. 623. *Id. Mohs*, b. ii. s. 207. *Id. Leonhard*, Tabel. s. 34.—Tuffartiger Kalkstein, *Karsten*, Tabel. s. 50.—Calcareous Tufa, *Kid*, vol. i. p. 24.—Chaux carbonatée concretionnée incrustante, *Haüy*, Tabl. p. 4.—Kalchtuff, *Lenz*, b. ii. s. 755. *Id. Hoff.* b. iii. s. 40.—Tuffa, *Aikin*, p. 161.

External

* The term *tufa*, appears to be derived from the verb τύφω, which, in its original signification, is appropriate to volcanic productions, especially to such as are of a spongy or porous texture.—*Kid.*

External Characters.

Its colour is yellowish-grey, which sometimes approaches to ochre-yellow and yellowish-brown.

It occurs massive, perforated, ramose, spongy, tubular, claviform, botryoidal, globular, cellular, and in crusts; inclosing vegetable stems and leaves; also bones of animals, as of elephants and rhinoceroses, and land shells; and also with frequent impressions of leaves, mosses, and roots. The globular variety is sometimes composed of curved lamellar concretions.

Internally it is dull, or very faintly glimmering.

The fracture is fine-grained uneven, inclining to earthy; and sometimes splintery.

The fragments are indeterminate angular.

It is opaque, or translucent on the edges.

It is sometimes semi-hard, sometimes soft, and is frequently soft, inclining to friable.

It feels rough.

It is brittle, and easily frangible.

Constituent Parts.

It is nearly pure Carbonate of Lime.

Geognostic Situation.

It occurs in beds, generally in the neighbourhood of lakes and rivers; also encrusting rocks, and enveloping animal and vegetable remains in the vicinity of calcareous springs.

Geographic Situation.

It is a frequent mineral in the neighbourhood of all the calcareous

calcareous springs in this country, as in those at Starly Burn in Fifeshire, and other places; and on the Continent of Europe it is also a frequent mineral.

Uses.

The hardest kinds are used for building-stones, and are also burnt into quicklime. It is sometimes also used as a filtering-stone.

Observations.

The substance called *Osteocolla* or *Beinbruch* by the elder mineralogists, is a conglomerate of bones and calc-tuff.

Seventh Subspecies.

Pisiform Limestone, or Pea-stone.

Erbsenstein, *Werner.*

La pierre de Pois, ou la Pisolite, *Broch.* t. ii. p. 555.—Erbsenstein, *Lud.* b. i. s. 151. *Id. Suck.* 1r th. s. 621. *Id. Bert.* s. 93. *Id. Mohs,* b. ii. s. 98. *Id. Hab.* s. 79.—Dichter Kalksinter, *Leonhard,* Tabel. s. 34.—Chaux carbonatée concretionnée, Pisolithe, *Brong.* t. i. p. 213.—Erbsförmiger Kalkstein, *Karsten,* Tabel. s. 50.—Pisolithus, or Pea-stone, *Kid,* vol. i. p. 27.—Chaux carbonatée concretionnée testacée, incrustante, &c. but excluding globuliforme, *Haüy,* Tabl. p. 4. —Erbsenstein, *Lenz,* b. ii. s. 754. *Id. Hoff.* b. iii. s. 36.—Pea-stone, *Aikin,* p. 160.

External

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[illegible] at length, the globular [illegible] became so heavy that they remain [illegible] and being agglutinated, by means of calc-si[illegible] What renders this explanation very probable,

·, is the almost constant occurrence of particles of ·and in the centre of these globular concretions. In ·re instances, the centre of the concretions is empty. ·ral resembling peastone, occurs at the Baths of St ·i in Tuscany; also at Perscheesberg in Silesia; Hungary.

Uses.

is sometimes cut into plates, for ornamental purposes.

Eighth Subspecies.

Slate-Spar.

Schieferspath, *Werner.*

·eferspath, *Wid.* s. 510.—Argentine, *Kirw.* vol. i. p. 105.—Schisto-spatho, *Nap.* p. 355.—Shifferspath, *Lam.* t. i. p. 385.—Le Spath schisteux, ou le Schieferspath, *Broch.* t. i. p. 558.—Schieferspath, *Reuss,* b. ii. s. 50. *Id. Lud.* b. i. s. 152. *Id. Suck.* 1r th. s. 626. *Id. Bert.* s. 95. *Id. Mohs,* b. ii. s. 3. *Id. Hab.* s. 81. *Id. Leonhard,* Tabel. s. 34.—Chaux carbonatée nacré argentine, *Brong.* t. i. p. 232.—Verhærteter Aphrit, *Karsten,* Tabel. s. 50.—Chaux carbonatée nacré primitive, *Haüy,* Tabl. p. 6.—Schieferspath, *Lenz,* b. ii. s. 761. *Id. Hoff.* b. iii. s. 46.

External Characters.

Its colours are greenish-white, reddish-white, yellowish-white, greyish-white, and snow-white.

It occurs massive, also in distinct concretions, which are generally curved lamellar, and sometimes coarse and large granular.

The

The lustre is intermediate between shining and glistening, and is pearly.

The fragments are either indeterminate angular and blunt-edged, or are tabular.

It is feebly translucent, or only translucent on the edges.

It is soft.

It is intermediate between sectile and brittle.

It is easily frangible.

It feels rather greasy.

Specific gravity, 2.647, *Kirwan.*—2.474, *Blumenbach.*—2.6300, *La Metherie.*—2.611, *Breithaupt.*

Chemical Characters.

It effervesces very violently with acids; but is infusible before the blowpipe.

Constituent Parts.

From Bremsgrün.		From Kongsberg.	
Lime, -	55.00	Lime, -	56.00
Carbonic Acid,	41.66	Carbonic Acid,	39.33
Oxide of Manganese,	3.00	Silica, -	1.66
		Oxide of Iron,	1.00
	Bucholz.	Water, -	2.00
			Suersen.

Geognostic Situation.

It occurs in primitive limestone, along with calcareous spar, brown-spar, fluor-spar, and galena; in metalliferous beds, associated with magnetic ironstone, galena, and blende; and in veins, along with tinstone.

Geographic

Geographic Situation.

It occurs in Glen Tilt, Perthshire; and in Assynt in Sutherland, in marble: in Cornwall; and near Granard in Ireland *. On the Continent, it is found along with tin-stone, in the Saxon Erzgebirge; along with octahedrite, in a vein at St Christophe in Dauphiny; also in Norway, in metalliferous beds, and in limestone.

Observations.

This mineral is characterised by its colour, lustre, curved lamellar concretions, its degree of hardness and translucency. It is distinguished from *Aphrite*, by its translucency, hardness, compactness, and greater weight.

Ninth Subspecies.

Aphrite.

Schaumerde, *Werner.*

This subspecies is divided into three kinds, viz. Scaly Aphrite, Slaty Aphrite, and Sparry Aphrite.

First

* Greenough.

First Kind.

Scaly Aphrite.

Schaumerde, *Werner.*

Zerreiblicher Aphrit, *Karsten.*

Shaumerde, *Emm.* b. i. s. 484.—Silvery Chalk, *Kirw.* vol. i. p. 78. —L'Ecume de Terre, *Broch.* t. i. p. 557.—Ecume de Terre des Allemands, *Haüy,* t. iv. p. 360.—Schaumerde, *Reuss,* b. ii. 2. s. 317. *Id. Lud.* b. i. s. 152. *Id. Suck.* 1r th. s. 625. *Id. Bert.* s. 95. *Id. Mohs,* b. ii. s. 6. *Id. Hab.* s. 80. *Id. Leonhard,* Tabel. s. 34.—Chaux carbonatée nacré talquese, *Brong.* t. i. p. 252.—Zerreiblicher Aphrite, *Karsten,* Tabel. s. 50. *Id. Haus.* s. 126.—Chaux carbonatée nacré lamellaire, *Haüy,* Tabl. p. 6.—Schaumkalch, *Lenz,* b. ii. s. 757.—Erdige Schaumerde, *Oken,* b. i. s. 394.—Schaumkalk, *Hoff.* b. iii. s. 46.

External Characters.

Its colours are snow, yellowish, and reddish white, sometimes passing into silver-white.

It occurs either friable or compact.

The friable varieties are composed of glistening or glimmering particles, in which the lustre is pearly. The particles are fine scaly, and feel fine, but not greasy. They are either loose, or loosely cohering.

The compact varieties are massive, disseminated, or in granular concretions, with a shining or nearly splendent lustre, which is pearly, sometimes inclining to semi-metallic.

The fragments are indeterminate angular, and blunt-edged in the great, but tabular in the small.

It

It is opaque.

It soils slightly.

It is very soft, passing into friable.

It is sectile, and uncommonly easily frangible.

It feels very fine, but not greasy.

Chemical Characters.

It effervesces most violently with acids.

Constituent Parts.

Lime, - - -	51.5
Carbonic Acid, - -	39.0
Silica, - - -	5.715
Oxide of Iron, - -	3.285
Water, - - -	1.0
	100.5 *Bucholz.*

Geognostic Situation.

It occurs in nests, disseminated, or in small veins, in the flœtz or secondary limestone, and gypsum.

Geographic Situation.

It is found in Thuringia and Hessia.

Observations.

It is characterised by its colour, lustre, low degree of hardness, inconsiderable coherence, and lightness; its want of greasy feel, distinguishes it readily from *Nacrite*, with which it has been confounded.

Second Kind.

Slaty Aphrite.

Schaumschiefer, *Friesleben.*

Schaumschiefer, *Friesleben*, Geognostiche Beiträge, b. ii. s. 232.

External Characters.

Its colours are snow-white, passing into yellowish, reddish, and silver white.

It occurs massive, seldom coarsely disseminated.

It is strongly glimmering, sometimes approaching to glistening, even to shining; and the lustre is pearly, which sometimes passes into semi-metallic.

It is slaty in the great, but undulating curved foliated in the small.

It splits very easily into extremely thin tabular fragments.

It is opaque, or very feebly translucent in the thinnest folia.

It soils pretty strongly.

It feels soft, and rather silky.

It is flexible in thin plates.

Chemical Characters.

It falls into pieces with a crackling noise, when put into water. When touched with an acid, it effervesces with great violence, and is entirely dissolved in it.

Geognostic

Geognostic and Geographic Situations.

It occurs massive, imbedded, and in veins, in the first flœtz limestone, in Thuringia and Hessia.

Observations.

1. The straight slaty variety passes into Slate-Spar, and into Scaly Aphrite.

2. Meinecke, and other old observers, described this mineral as a variety of Common Talc. It was first accurately examined and described by Friesleben.

Third Kind.

Sparry Aphrite.

Schaumspath, *Friesleben.*

Schaumspath, *Friesleben*, Geognostiche Beiträge, b. ii. s. 234.

External Characters.

Its colours are snow, yellowish, and greyish white.

It seldom occurs massive, generally disseminated; sometimes in flaky crusts, in veins, or imbedded in large crystals of selenite.

It is shining, sometimes inclining to splendent, sometimes to glistening; and the lustre is pearly, which inclines to vitreous in the splendent varieties.

The fracture is foliated, sometimes straight, sometimes curved, and the folia have a single distinct cleavage.

It is opaque; feebly translucent in thin pieces.

It occurs in large and small granular distinct concretions.

It soils slightly, with glimmering dusty particles.

It is soft.

It is sectile.

Chemical Characters.

The same as in the other kinds.

Geognostic Situation.

It occurs in flœtz or secondary limestone and gypsum. According to Friesleben, it appears to be geognostically allied to selenite; and although it differs from that mineral in colour, transparency, lustre, sectility, feel, and effervescence with acids, yet it passes into it, and also into slaty aphrite, sometimes by simple gradations, sometimes by intermixture of the two minerals; and large lenticular crystals of selenite occur, which are pure at the edges, become gradually more opaque towards the centre, and in the centre are pure sparry aphrite.

Geographic Situation.

It occurs in Thuringia.

Observations.

It was first described and named by Friesleben, in his "Geognostical Contributions."

Tenth Subspecies.

Lucullite.

This subspecies is divided into three kinds, viz. Compact Lucullite, Prismatic Lucullite, and Foliated Lucullite.

First

First Kind.

Compact Lucullite.

Dichter Lucullan, *John.*

Lapis suillus, *Wall.* t. i. p. 148.—Swinestone, *Kirw.* vol. i. p. 89. —Stinkstein, *Wid.* s. 521. *Id. Estner,* b. ii. s. 1023. *Id. Emm.* b. i. s. 487.—Pierre calcaire puante, ou Pierre puante, *Lam.* t. ii. p. 58.—Chaux carbonatée fetide, *Haüy,* t. ii. p. 188. —La pierre puante, *Broch.* t. i. p. 567.—Gemeiner Stinkstein, *Reuss,* b. ii. 2. s. 335. *Id. Lud.* b. i. s. 155. *Id. Suck.* 1r th. s. 638. *Id. Bert.* s. 111. *Id. Mohs,* b. ii. s. 126.—Gemeiner Stinkstein, *Leonhard,* Tabel. s. 36.—Chaux carbonatée fetide, *Brong.* t. i. p. 236.—Gemeiner Stinkstein, *Haus.* s. 128. *Id. Karsten,* Tabel. s. 50.—Swinestone, *Kid,* vol. i. p. 29.—Chaux carbonatée fetide, *Haüy,* Tabl. p. 6.; et Chaux carbonatée bituminifere, *Id.* p. 6.—Gemeiner Stinkstein, *Lenz,* b. ii. s. 767.—Dichter Stinkstein, *Oken,* b. i. s. 407. —Swinestone, *Aikin,* p. 162.

This kind is divided into Common Compact Lucullite or Black Marble, and Stinkstone.

a. Common Compact Lucullite, or Black Marble.

Dichter Lucullan; Schwarzer Marmor, *John,* Chemisches Laboratorium, t. ii. s. 227. *Id. Lenz,* b. ii. s. 765.

External Characters.

Its colour is greyish-black.

It occurs massive.

Internally it is strongly glimmering, inclining to glistening.

The

The fracture is fine-grained uneven, and large conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It is semi-hard.

It yields a dark ash-grey coloured streak.

It is brittle, and easily frangible.

Specific gravity 3.000, *John.*

When two pieces are rubbed against each other, a fetid urinous odour is exhaled, the intensity of which is increased when we at the same time breathe on them.

Chemical Characters.

It is infusible without addition. When exposed to a high temperature in an open crucible, it burns white. With sulphuric acid, it forms a black-coloured mass: it dissolves in nitrous and muriatic acids, but leaves an insoluble black-coloured substance. During the solution and escape of the carbonic acid, a smell resembling that of sulphuretted hydrogen is evolved.

Constituent Parts.

Lime, - - - - - -	53.38
Carbonic Acid, - - -	41.50
Black Oxide of Carbon, - -	0.75
Magnesia, and Oxide of Manganese,	0.12
Oxide of Iron, - - - -	0.25
Silica, - - - - - -	1.13
Sulphur, - - - - - -	0.25
Potash, combinations of Muriatic and Sulphuric Acids, and Water, -	2.62
	100.00

John, Chem. Laborat. b. ii. s. 240.

Geognostic

Geognostic Situation.

The geognostic relations of this mineral are still but little known: it is said to occur in beds in primitive and older secondary rocks.

Geographic Situation.

Hills of this mineral occur in the district of Assynt in Sutherland. It is the *Assynt* or *Sutherland Marble* of artists *. Varieties of it are met with at Ashford, Matlock, and Monsaldale, in Derbyshire: at Kilkenny; at Crayleath, in the county of Down; at Kilcrump, in the county of Waterford; at Churchtown, in the county of Cork; and in the county of Galway, in Ireland. The black marbles of Dinan and Namur, in the Netherlands, are of the same nature. Faujas St Fond is said to have discovered the old quarries of this mineral worked by the ancients, two leagues from Spa, not far from Aix-la-Chapelle.

Uses.

The finer varieties of this mineral have been highly prized, and used as marble from a very remote period. It was so much admired and esteemed by the Consul Lucullus, that he gave it his own name. Pliny observes: "Post hunc Lepidum ferme quadriennio L. Lucullus Consul fuit, qui nomen (ut apparet ex re) *Lucullea Marmori* dedit, admodum delectatus illo, primusque Romam invexit, atrum alioqui, cum cætera maculis aut coloribus commendentur. Nascitur autem in Nili insula, solumque horum marmorum

* Geological Transactions, vol. ii. p. 408, 409, 410.

marmorum ab amatore nomen accepit *." It is said that Marcus Scaurus ornamented his palace with columns thirty-eight feet high of lucullite; and Ferber describes busts and pedestals of it in the Capitol, and at Albani. The mausoleum of Frederick-William, father of Frederick the Great, at Potsdam, is of black marble. The Chinese cut it into bars, and use it along with other minerals in the construction of their musical instrument named *king*. The *Paragone* mentioned by Ferber as a variety of black marble, is said to be basalt. Under the title *Nero antico*, the Italians include all the fine antique lucullites, which are now very rare, and are only to be met with in polished slabs or pieces.

The finest varieties of lucullite met with in trade in this island, are the black marbles of Sutherlandshire, Kilkenny, and Galway.

Observations.

1. It is distinguished from other *Marbles* and *Limestones* by its deep black colour, the strong fetid urinous smell it emits when rubbed, and higher specific gravity.

2. It has been confounded by Boetius de Boot, and Agricola, with several other minerals, as Obsidian, Basalt, and Lydian-stone.

3. It was first described as a particular mineral by Dr John, in the Memoirs of the Society of the Friends of Natural History in Berlin, and afterwards in his work entitled Chemical Laboratory.

b. Stinkstone.

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* Plin. Hist. Nat.

b. Stinkstone, or Swinestone.

Stinkstein, *Werner.*

External Characters.

Its colours are yellowish and greyish white, smoke-grey, ash-grey, bluish-grey and brownish-grey, pitch-black, and cream-yellow, which passes into wood-brown, hair-brown, yellowish-brown, liver-brown, and blackish-brown.

It is sometimes dendritic on the surface, or clouded with greyish-black.

It occurs massive, disseminated, also in distinct concretions, which are small granular, and concentric lamellar.

Internally it is dull or glimmering.

The fracture is sometimes small splintery, sometimes imperfect conchoidal, and fine-grained uneven, which passes into earthy, or straight slaty.

The fragments are indeterminate angular, or slaty.

It is opaque, but the cream-yellow varieties are translucent on the edges.

It is semi-hard.

It affords a greyish-white coloured streak; and when rubbed, emits a fetid urinous odour.

It is brittle, and easily frangible.

Specific gravity, 2.750, slaty variety from Bottendorf.—2.677, 2.698, *Breithaupt.*

Chemical Characters.

Nearly the same as in the preceding kind.

Constituent

Constituent Parts.

	From Bottendorf.
Carbonate of Lime, -	148—149.00
Silica, - -	7.00
Alumina, - -	5.25
Oxide of Iron, - -	2.50
Oxide of Manganese, - -	1.00
Oxide of Carbon, and a little Bitumen,	0.50
Lime *, - -	1.00
Sulphur, Alkali, Salt, Water, -	3.75
	170.00

John, Chem. Laborat. t. ii. s. 242.

Geognostic Situation.

This mineral occurs in beds, in secondary limestone, and occasionally alternates with the secondary gypsum, and with beds of clay. In some places, the strata are quite straight, in others have a zig-zag direction, or are more or less deeply waved, and they are occasionally disposed in a concentric manner, like the concentric lamellar concretions of greenstone. Some strata contain angular pieces of stink-stone, which at first sight might be taken for fragments; and even whole beds occur, which are composed throughout of angular portions, either connected together by means of clay, or immediately joined without any basis. These various appearances do not seem to have been occasioned by any mechanical force acting upon the strata after their formation, but are rather to be viewed as original varieties of structure,

* I have copied the above analysis from Dr John's work; yet I do not see how it is possible that 1 part of Lime could be discovered along with 149 of Carbonate of Lime.

structure, which have taken place during the formation of the strata.

It has been also met with in beds in shell limestone, and in the coal formation.

Geographic Situation.

It occurs in the vicinity of North Berwick in East Lothian, resting on red sandstone; and in the parish of Kirbean in Galloway. On the Continent, it is a frequent rock in Thuringia and Mansfeld.

Uses.

In ancient times, it was used as a medicine in veterinary practice: at present, it is principally employed as a limestone, and when burnt, affords an excellent lime, both for mortar and manure. In some districts, as in Thuringia, it is used as a paving-stone and also cut into troughs, steps for stairs, door-posts, and other similar purposes.

Observations.

1. The names *Stinkstone* and *Swinestone* given to this mineral, are from the disagreeable odour it emits when pounded or rubbed.

2. Its fetid urinous odour distinguishes it from *Compact Limestone.*

3. It readily decays, and during its decomposition loses its colour, becomes friable, and gives out an unrespirable gas. Hence it is an unwelcome mineral in mines.

Second

Second Kind.

Prismatic Lucullite.

Stänglichter Lucullan, *John.*

Madreporit, *Klaproth*, Beit. b. iii. s. 272. *Id. Haüy*, t. iv. p. 378. *Id. Lucas*, p. 200.—Madreporstein, *Leonhard*, Tabel. s. 36.—Chaux carbonatée Madreporite, *Brong.* t. i. p. 229. —Madreporite, *Brard*, p. 413.—Stänglicher Anthraconit, *Haus.* s. 128.—Madreporstein, *Karst.* Tabel. s. 50.—Chaux carbonatée bacillaire-fasciculée gris-noiratre, *Haüy*, Tabl. p. 3.—Stänglichter Lucullan, *John*, Chem. Laborat. b. i. s. 243. *Id. Lenz*, b. ii. s. 770.—Stängliger Stinkstein, *Oken*, b. i. s. 407.

External Characters.

Its colours are greyish-black, pitch-black, smoke-grey, and hair-brown.

It occurs massive, in balls, also in distinct concretions, which are stellular and scopiform prismatic.

The external surface is sometimes delicately longitudinally streaked.

Externally it is sometimes dull, sometimes glistening: internally it is shining and splendent, and the lustre is intermediate between vitreous and resinous.

It has a threefold cleavage, and the folia are sometimes curved.

The fragments are indeterminate angular, sometimes inclining to rhomboidal.

It is translucent on the edges, or opaque.

It is semi-hard.

It

It affords a grey-coloured streak.
It is brittle, and easily frangible.
When rubbed, it emits a strongly fetid urinous smell.
Specific gravity, 2.653, 2.688, 2.703, *John*.

Chemical Characters.

When pounded and boiled in water, it gives out a hepatic odour, which continues but for a short time. The filtrated water possesses weak alkaline properties, and contains a small quantity of a muriatic and sulphuric salt. It does not appear to be affected by pure alkalies. It dissolves with effervescence in nitrous and muriatic acids, and leaves behind a coal-black or brownish-coloured residuum.

Constituent Parts.

From Stavern in Norway.		From Greenland.		From Garphytta, in Nericke in Sweden.	
Carbonic Acid,	41.50	Carbonic Acid,	41.53	Carbonic Acid,	41.75
Lime, -	53.37	Lime, -	53.00	Lime, -	54.00
Oxide of Manganese, -	0.75	Oxide of Manganese, -	1.00	Oxide of Manganese, -	0.50
Oxide of Iron,	1.25	Oxide of Iron,	0.75	Oxide of Iron,	0.75
Oxide of Carbon,	1.25	Oxide of Carbon,	1.00	Brown Oxide of Carbon, -	0.75
Sulphur, -	0.25	Sulphur, -	0.50	Sulphur, Alkali, Alkaline Muriate and Sulphate, Water,	2.25
Alumina, -	1.25	Alumina, -	0.75		
Silica, -	1.25	Silica, Alkali, Alkaline Muriate, Water, -	1.47		
Alkali, Alkaline Muriate, Water, Magnesia, Zirconia,	2.13				
	100.00		100.00		100.00
John, Chem. Laborat. b. ii. s. 246.		*John*, ib. s. 248.		*John*, ib. s. 250.	

Geognostic

Geognostic and Geographic Situations.

It occurs in balls, varying from the size of a pea to two feet in diameter, in brown dolomite, at Building Hill near Sunderland. At Stavern in Norway, it appears to occur in transition rocks: in alum-slate at Garphytta in Nericke: in Greenland: and in the Russbachthal in Salzburg.

Observations.

This mineral, which was first discovered by Von Moll, in the Russbachthal in Salzburg, was named by him *Madreporite*, on account of the resemblance of its prismatic concretions to certain lithophytes. It was first described by Schroll, and analysed by Heim *. According to Heim, it contains, Lime, 63.250, Alumina, 10.125, Silica, 12.500, Oxide of iron, 10.988. The same result is said to have been obtained in the School of Mines in Paris †; but both differ so much from the analysis of Klaproth, that we do not hesitate in considering them as erroneous. The publication of Klaproth's chemical examination, induced Von Moll to name it *Anthraconite*, on account of the carbon which it contains ‡; and Dr John, from its intimate connection, both mineralogical and chemical, with Common Lucullite and Stinkstone, arranges it in the system along with these minerals.

Third

* Von Moll's Jahrbücher der Berg und Hüttenkunde, 1ster Band, s. 291.—304.

† Haüy, Traité de Mineralogie, t. iv. p. 378, 379.

‡ Ephem. der Berg und Hütt. 2. b. ii. lief s. 305.

Third Kind.

Foliated or Sparry Lucullite.

Späthiger Lucullan, *John.*

Späthiger Lucullan, *John*, Chem. Laborat. b. ii. s. 250. *Id.* *Lenz*, b. ii. s. 772.

External Characters.

Its colours are yellowish, greyish, and greenish-white; also bluish-grey, and greyish and velvet black.

It occurs massive, disseminated, in small granular concretions, and crystallized in acute six-sided pyramids.

Internally it alternates from glimmering to shining.

The fragments are generally rhomboidal.

It is translucent, or translucent on the edges.

It is semi-hard, approaching to soft.

It is brittle, and easily frangible.

When rubbed, it emits an urinous smell.

Specific gravity 2.650, *John.*

Chemical Characters.

They agree with those of the preceding subspecies: in its solution in acids, there remains a minute black-coloured residuum.

Constituent

Constituent Parts.

From Moscau.	From Garphytta. Translucent variety.	From Garphytta. Black variety.
Carbonate of Lime, 96.50	Carbonate of Lime, 99.1	Carbonate of Lime, 95.0
Carbonate of Manganese, Magnesia and Iron, 1.50	Carbonate of Manganese, Magnesia, and Iron, 0.9	Carbonate of Manganese, Magnesia and Iron, 1.5
Oxide of Iron, 1.00	A trace of Carbon, and of an odorous substance.	Mixture of Alum-slate, and of Iron-pyrites, as constituent parts, 3.5
Lime, Alumina, Carbon, Silica, and Water, 1.00		
100.00	100.0	100.0
John, Chem. Laborat. b. iii. s. 90.	*Hisinger* and *Berzelius*, in Afhandlingar i Fysik Kemi och Mineralogi.	*Hisinger* and *Berzelius*, ib.

Geognostic and Geographic Situations.

It occurs in veins, and also in small cotemporaneous masses, in a bed of limestone in clay-slate, at Andreasberg in the Hartz: in veins of silver-ore in hornblende-slate at Kongsberg in Norway: also in transition alum-slate in larger and smaller elliptical masses, the centre of which is of iron-pyrites, and the periphery sparry lucullite, at Andrarum in Schonen, Garphytta in Nericke, and Christiania in Norway.

Eleventh Subspecies.

Marl.

Mergel, *Werner*.

This subspecies is divided into two kinds, viz. Earthy Marl and Compact Marl.

First

First Kind.

Earthy Marl.

Mergel Erde, *Werner.*

Mergel Erde, *Wid.* s. 523.—Earthy Marle, *Kirw.* vol. i. p. 94.—Mergelerde, *Estner,* b. ii. s. 1027. *Id. Emm.* b. i. s. 491.—Marna terrosa, *Nap.* p. 360.—La Marne terreuse, *Broch.* t. i. p. 569.—Erdiger Mergel, *Reuss,* b. ii. 2. s. 339.—Mergelerde, *Lud.* b. i. s. 156. *Id. Suck.* 1r th. s. 643. *Id. Bert.* s. 114. *Id. Mohs,* b. ii. s. 129.—Erdiger Mergel, *Hab.* s. 73. *Id. Leonhard,* Tabel. s. 36. *Id. Karsten,* Tabel. s. 50.—Mergel Erde, *Haus.* s. 127. *Id. Lenz,* b. ii. s. 777.—Erd Mergel, *Oken,* b. i. s. 406.—Mergelerde, *Hoff.* b. iii. s. 67.

External Characters.

Its colours are yellowish-grey, and seldom pale smoke-grey. These are the colours it exhibits when dry: when moist, and in its original repository, its colours are pale blackish-brown or brownish-black *.

It consists of fine dusty particles, which are either loose or feebly cohering.

It is dull.

The particles feel fine, or rather rough and meagre.

It soils slightly.

It is light.

* Some of the varieties have generally a brown colour, and emit an urinous smell; these are by some authors considered as Earthy Stinkstone.

Chemical Characters.

It effervesces strongly with acids. It emits a strong urinous smell when first dug up; but after exposure to the air it loses this quality.

Constituent Parts.

It is said to be composed of Lime, Alumina, Silica, and Bitumen.—*Friesleben.*

Geognostic and Geographic Situations.

It occurs in beds in the flœtz or secondary limestone and gypsum formations, along with stinkstone, in Thuringia and Mansfeld.

Observations.

1. The grey colours, dusty particles, meagre feel, and lightness, characterise this mineral. It passes into Compact Marl, when its particles become more coherent, and also into Stinkstone, and Black Clay.

2. It is sometimes mixed with mica and calcareous spar, also with iron-ochre, and seldomer with pure clay, quartz, sand, gypsum, and aphrite.

3. Masses of stinkstone and limestone, of various sizes and shapes, occur in the beds of marl-earth, which at first sight might be confounded with fragments, although, when closely examined, they prove to be of cotemporaneous formation with it.

4. It is described by some writers under the name Asche, Flozasche, Aschengebirge, and Erdiger Stink-kalk.

Second

Second Kind.

Compact or Indurated Marl.

Verhärteter Mergel, *Werner.*

Marga, *Plin.* Hist. Nat. xvii. 4. s. 6. (in part).—Verhärteter Mergel, *Wid.* s. 524.—Indurated Marl, *Kirw.* vol. i. p. 95.—Verhärteter Mergel, *Emm.* b. i. s. 493.—Marna indurita, *Nap.* p. 361.—La Marne endurcie, *Broch.* t. i. p. 571.—Argile calcifere, ou Marne, *Haüy,* t. iv. p. 445.—Verhärteter Mergel, *Reuss,* b. ii. 2. s. 341. *Id. Lud.* b. i. s. 156. *Id. Suck.* 1r th. s. 642. *Id. Bert.* s. 115. *Id. Mohs,* b. ii. s. 130. *Id. Hab.* s. 73. *Id. Leonhard,* Tabel. s. 36. *Id. Karsten,* Tabel. s. 50. *Id. Haus.* s. 127. *Id. Lenz,* b. ii. s. 779.—Stein Mergel, *Oken,* b. i. s. 407.—Verhärteter Mergel, *Hoff.* b. iii. s. 69.—Marl, *Aikin,* p. 163.

External Characters.

Its colours are yellowish-grey, smoke-grey, and muddy bluish-grey. It is sometimes spotted reddish and brownish in the rents, and marked with dendritic delineations.

It occurs massive, in blunt angular pieces, vesicular, in flattened balls; and frequently contains petrifactions of fishes and crabs, also of gryphites, belemnites, chamites, pectinites, ammonites, terebratulites, ostracites, musculites, and mytulites.

It is dull both externally and internally, and only glimmering when intermixed with foreign parts.

The fracture is generally earthy, which approaches sometimes to splintery, sometimes to conchoidal; in the great inclines to thick and straight slaty.

The fragments are angular and blunt-edged, and sometimes tabular.

It yields to the nail.

It is opaque.

It affords a greyish-white streak.

It is rather brittle, and easily frangible.

It feels meagre.

Specific gravity 2.365, 2.550, *Breithaupt*.

Chemical Characters.

Before the blowpipe it intumesces, and melts into a greenish-black slag. It effervesces briskly with acids.

Constituent Parts.

Carbonate of Lime,	-	50
Silica,	- -	12
Alumina,	- -	32
Iron and Oxide of Manganese,		2

Kirwan.

Geognostic Situation.

It occurs in beds in the secondary flœtz limestone and coal formations; also in the new secondary formations that rest upon chalk.

Geographic Situation.

It frequently occurs in the coal formation in Scotland and England, and in the secondary formations which rest upon chalk in the south of England. On the Continent of Europe, it abounds in the secondary limestone and coal formations; and also in the new formation that rests upon the

the chalk in different parts of France, as in the vicinity of Paris.

Uses.

Several different kinds of compact marl occur in nature: these are calcareous marl, in which the calcareous earth predominates; clay marl, in which the aluminous earth is in considerable quantity; and ferruginous marl, in which the mass contains a considerable intermixture of oxide of iron. This latter kind occurs in spheroidal concretions, called *septaria* or *ludi Helmontii*, that vary from a few inches to a foot and a half in diameter. When broken in a longitudinal direction, we observe the interior of the mass intersected by a number of fissures, by which it is divided into more or less regular prisms, of from three to six or more sides, the fissures being sometimes empty, but oftener filled up with another substance, which is generally calcareous spar. From these septaria are manufactured that excellent material for building under water, known by the name of *Parker's Cement* *. The calcareous and aluminous marl are used for improving particular kinds of land; also for mortar; in some kinds of pottery; and in the smelting of particular ores of iron.

Observations.

1. Its meagre feel and inferior sectility distinguish it from *Clays;* its colour, inferior hardness, and greater sectility distinguish

* These marly septaria abound in the Isle of Shepey, in the Medway, and often contain in their interior globular portions of heavy-spar, having diverging fibrous concretions. Similar septaria occur in Derbyshire, and in the county of Durham, in which latter district, the internal fissures are filled with quartz.

distinguish it from *Claystone*, and these characters, along with more considerable specific gravity, distinguish it from *Tripoli*.

2. The *Leutrite* of Lenz and Sartorius appears to be a marly sandstone.

3. The *Tutenmergel* or *Nagelkalk* is a variety of marl inclining to compact limestone, disposed in broken conical lamellar concretions, in which the surfaces are transversely streaked. It is found at Gorarp in Sweden.

4. Pliny, Vitruvius, and Varro, describe this mineral under the name *Marga*, and say it was used for improving the soil.

Twelfth Subspecies.

Bituminous Marl-Slate.

Bituminöser Mergelschiefer, *Werner*.

Bituminöser Mergelschiefer, *Wid.* s. 526.—Bituminous Marlite, *Kirw.* vol. i. p. 103.—Bituminöser Mergelschiefer, *Estner*, b. ii. s. 1035. *Id.* *Emm.* b. i. s. 498.—Schisto marno bituminoso, *Nap.* p. 363.—Le Schiste marneuse bitumineux, *Broch.* t. i. p. 574.—Bituminöser Mergelschiefer, *Reuss*, b. ii. 2. s. 376. *Id. Lud.* b. i. s. 157. *Id. Suck.* 1r th. s. 646. *Id. Bert.* s. 116. *Id. Mohs*, b. ii. s. 132. *Id. Hab.* s. 74. *Id. Leonhard*, Tabel. s. 36. *Id. Karsten*, Tabel. s. 50. *Id. Haus.* s. 127. *Id. Lenz*, b. ii. s. 786. *Id. Oken*, b. i. s. 405. *Id. Hoff.* b. iii. s. 72.

External Characters.

Its colour is intermediate between greyish-black and brownish-black.

It

It occurs massive, and frequently contains impressions of fishes and plants.

Its lustre is glimmering, glistening, or shining, and resinous.

Its fracture is straight, or curved slaty.

The fragments are slaty in the large, but indeterminate and rather sharp angular in the small.

It is opaque.

It is shining and resinous in the streak.

It is soft, and feels meagre.

It is rather sectile, and easily frangible.

Specific gravity 2.631, 2.690, *Breithaupt*.

Constituent Parts.

It is said to be a Carbonate of Lime united with Alumina, Iron, and Bitumen.

Geognostic Situation.

It occurs in secondary or flœtz limestone. It frequently contains cupreous minerals, particularly copper-pyrites, copper-glance, variegated copper-ore, and more rarely, native copper, copper green, and blue copper. It contains abundance of petrified fishes, and these are said to be most numerous in those situations where the strata are basin-shaped. Many attempts have been made to ascertain the genera and species of these animals, but hitherto with but little success. It would appear, that the greater number resemble fresh-water species, and a few the marine species. It also contains fossil remains of lizards, shells, corals, and of cryptogamous fresh-water plants.

Geographic

Geographic Situation.

Europe.—It abounds in the Hartzgebirge; also in Magdeburg and Thuringia. It is a frequent mineral in Upper and Lower Saxony: it occurs also in Franconia, Bohemia, Bavaria, Silesia, Suabia, Hesse-Cassel, and Switzerland.

America.—It is said to occur in the Cordilleras of South America.

4. Prismatic Limestone, or Arragonite.

Prismatischer Kalk-Haloide, *Mohs.*

Arragon, *Werner.*

This species is divided into two subspecies, viz. Common Arragonite, and Coralloidal Arragonite.

First Subspecies.

Common Arragonite.

Gemeiner Arragon, *Werner.*

Arragon-Spar, *Kirw.* vol. i. p. 87.—Arragon, *Estner.* b. ii. s. 1039. *Id. Emm.* b. v. s. 357.—L'Arragonite, *Broch.* t. i. p. 576. *Id. Haüy,* t. iv. p. 337.—Excentrischer Kalkstein, *Reuss,* b. ii. 2. s. 300. *Id. Lud.* b. i. s. 158.—Excentrischer Kalkstein, *Suck.* 1r th. s. 615.—Arragon, *Bert.* s. 97. *Id. Mohs,* b. ii. s. 98.—Arragonite, *Lucas,* p. 192.—Exzentrischer Kalkstein, *Leonhard,* Tabel. s. 34.—Chaux carbonatée Arragonite, *Brong.* t. i. p. 221.—Arragonite, *Brard,* p. 403.

p. 403.—Gemeiner Arragonit, *Haus.* s. 127.—Arragon, *Karsten*, Tabel. s. 50.—Arragon-Spar, *Kid*, vol. i. p. 55.—Arragonite, *Haüy*, Tabl. p. 6.—Arragonit, *Haus.* Handb. b. iii. s. 970. *Id. Hoff.* b. iii. s. 77. *Id. Aikin*, p. 161.

External Characters.

Its colours are greyish-white, greenish-white, and yellowish-white; from greenish-white it passes into greenish-grey, mountain and verdigris green; and from yellowish-white into yellowish-grey. It is sometimes violet-blue. In some crystals, green and blue colours occur together, and sometimes also grey.

It occurs massive; and in distinct concretions, which are thick, thin, and very thin prismatic, and sometimes scopiformly diverging. It is frequently crystallized.

The primitive form is di-prismatic, or is an oblique four-sided prism, bevelled on the extremities; the lateral edges are 115° 56′, and 64° 4′; and the bevelling edge 109° 28′. The following are some of its secondary figures:

1. Irregular six-sided prism, frequently with four lateral edges of about 116°, and two of 128°; or with three lateral edges of 128°, two of 116°, and one of 104°. These are formed by the grouping of several oblique four-sided prisms, bevelled on the extremities. Sometimes this prism is so flat, that it appears like a table.
2. Six-sided table.

    When, on the contrary, the long six-sided prism becomes acicular, there is formed

3. Long, and generally acicular double six-sided pyramids.

The crystals are middle-sized and small; they are generally

rally attached by their terminal planes, seldomer by their lateral planes; sometimes imbedded, and are to be observed intersecting each other.

The lateral planes of the crystals are sometimes smooth, more frequently more or less deeply streaked or grooved. The terminal planes are seldom smooth, generally uneven and rough, and sometimes also deeply notched.

The external lustre varies from dull to shining, and is vitreous: internally it is shining and glistening, and vitreous, inclining to resinous.

It has a fourfold cleavage, in which three of the cleavages are parallel with the lateral planes, and the fourth with the terminal planes.

The fracture is small and imperfect conchoidal, passing into uneven.

The fragments are indeterminate angular, and rather sharp-edged; in the prismatic varieties splintery.

It is translucent, passing into semi-transparent, and refracts double.

It is harder than calcareous-spar, but scarcely as hard as fluor-spar.

It is brittle, and easily frangible.

Specific gravity, 2.6,–3.0, *Mohs*.—2.946, *Haüy*.—2.883, 2.928, *Karsten*.—2.926, *Biot*.—2.891, *Wiedeman*.—2.912, *Bournon*.—3.00, *Kopp*.

Chemical Characters.

If we expose a small fragment to the flame of a candle, it almost immediately splits into white particles, which are dispersed around the flame. This change takes place principally with fragments of transparent crystals, fragments of the other varieties becoming merely white and friable. Fragments

Fragments of calcareous-spar, when placed in a similar situation, undergo no alteration.

It is completely soluble, with effervescence, in the nitric and muriatic acids.

Constituent Parts.

Lime, 58.5	Lime, 56.327	Lime, 54.5	Lime, 55.5
Carbon. acid, 41.5	Carb. acid, 43.045	Carbon. acid, 41.5	Carbon. acid, 43.7
100.0	Water, 0.628	Water, 3.5	Water, 0.8
		Loss, - 0.5	100.0
		100.0	
Fourcroy & Vauquelin, Annal. du Mus. t. iv. p. 405.	*Biot & Thenard*, N. Bull. des Sciences, de la Soc. Ph. t. i. n. 32.	*Buchols*, Gehlen's Jour. b. iii. s. 80.	*Holme*, Annals of Phil. vol. i. p. 384.

From Molina in Arragon.		From Bastanes.	
Carbonate of Lime,	94.5757	Carbonate of Lime,	94.8249
Carbonate of Strontian,	3.9662	Carbonate of Strontian,	4.0836
Hydrate of Iron, -	0.7060	Protoxide of Manganese, with a trace of Iron,	0.0939
Water of Crystallization,	0.3000	Water of Crystallization,	0.9831
	99.5489		99.6855

Stromeyer, in Gilbert's Annalen der Physik, xiv. 217. October 1813.

Geognostic and Geographic Situations.

Europe.—It occurs along with galena in the lead mines of Leadhills, and in secondary trap-rocks in different parts of Scotland. It is one of the many interesting minerals met with in the secondary trap-rocks of the island of Iceland, and in the trap-rocks of the Department of the Puy de Dome, of Caupenne near Dax, and at Bastanes in Bearn, all in France. The trap-rocks of Bohemia, of the Breisgau, and of Lower Italy, occasionally contain beautiful specimens

specimens of it. At Schwatz in the Tyrol, it is associated with copper-green, grey copper-ore, ochry brown iron-ore, iron-pyrites, quartz, and calcareous-spar; in Spain it occurs imbedded in gypsum, along with reddish-brown quartz crystals; near Iglo in Hungary, it is accompanied with calcareous-spar, ochry-brown iron-ore, and copper-green; near to Schemnitz in Hungary, its accompanying minerals are brown-spar, brittle silver-ore, and galena; at Salfeldt, the principal mineral with which it is grouped is compact brown iron-ore; at Leogang in Salzburg, it is superimposed on brown iron-ore, along with blue copper, and pyramidal calcareous-spar; and it is found in compact limestone at Wolfstein in the Upper Palatinate.

America.—It is found in the trap-rocks in Kannioak in North Greenland, and in the Haasen Island, also in North Greenland. Specimens of it have been met with at Guanaxuato in Mexico, but not in Peru.

Asia.—It occurs in the trap-rocks of Van Diemen's Land, and in the neighbouring islands.

Africa.—It is enumerated amongst the simple minerals contained in the trap or lava rocks of the isle of Bourbon.

Second Subspecies.

Coralloidal Arragonite.

Arragonite coralloide, *Haüy*, Tabl. p. 7.—Fasriger Kalksinter, *Hoff.* b. iii. s. 32.

External Characters.

Its most frequent colours are varieties of white.

It

It occurs massive, reniform, tuberose, coralloidal, imperfect globular; in distinct concretions, which are fibrous, generally straight, seldom curved, and stellular and scopiform; sometimes also in reniform curved lamellar, and large angulo-granular concretions.

The lustre glimmering, or glistening and pearly.

The fracture is fine splintery.

The fragments are wedge-shaped and splintery.

It is translucent, or translucent on the edges.

In other characters, agrees with the preceding subspecies.

Geognostic and Geographic Situations.

It is found in Dufton Fell in Cumberland, also in the iron mines of Stiria and Carinthia, and also at Saint Marié aux Mines.

Observations.

1. The preceding descriptions include nearly all the varieties of arragonite hitherto described by authors. To these Mohs adds the two following:

a.

1. *Colour.* Flesh-red and pearl-grey.

Form. Massive.

Distinct Concretions. These are fibrous, straight, stellular and scopiform, and are collected into others which are large angulo-granular.

Fracture—Is not visible.

Fragments. Splintery and wedge-shaped.

Observations.—Several of the varieties of the fibrous brown-spar of Hoffmann belong to this kind of arragonite.

b.

b.

2. *Colour.* White, and sometimes tile-red.

Form. Massive.

Distinct concretions. These are prismatic, sometimes straight, sometimes curved, and always parallel.

Fracture—Not visible.

Fragments. Splintery.

Observations.—This kind of arragonite is described by Haüy under the name Arragonite fibreux, and part of the common fibrous limestone of Hoffmann also belongs here.

2. All the varieties of arragonite are distinguished from *Calcareous-Spar*, by superior hardness, and specific gravity.

3. Arragonite has received different names at different periods: the common prismatic varieties have been named *Arragonian Apatite*, *Arragonian Calc-Spar*, and *Hard Calcareous-Spar;* and the pyramidal varieties have been described under the names *Iglit*, or *Igloit*.

4. The Coralloidal Arragonite has been described under the name *Flos Ferri.*

Genus II.—APATITE.

This Genus contains one Species, viz. Rhomboidal Apatite.

1. Rhomboidal

1. Rhomboidal Apatite.

Rhomboidrischer Flus Haloide, *Mohs.*

Apatit, *Werner.*

THIS Species is divided into three Subspecies, viz. Foliated Apatite, Conchoidal Apatite, and Lamellar Apatite.

First Subspecies.

Foliated Apatite.

Geminer Apatite, *Werner.*

Phosphorite, *Kirw.* vol. i. p. 128.—Gemeiner Apatit, *Wid.* s. 528.—Phosphorit, *Estner,* b. ii. s. 1049. *Id. Emm.* b. i. s. 502.—Fosforite lamellare, *Nap.* p. 367.—Apatit, *Lameth.* t. ii. p. 85.—L'Apatite, *Broch.* t. i. p. 580.—Chaux phosphatée, *Haüy,* t. ii. p. 234.—Gemeiner & Blättricher Apatit, *Reuss,* b. ii. 2. s. 355. & 362.—Apatit, *Lud.* b. i. s. 159. *Id. Suck.* 1r th. s. 655. *Id. Bert.* s. 99. *Id. Mohs,* b. ii. s. 139.—Chaux phosphatée, *Lucas,* p. 11.—Apatit, *Leonhard,* Tabel. s. 38.—Chaux phosphatée Apatite, *Brong.* t. i. p. 240.—Chaux phosphatée, *Brard,* p. 44.—Blättriger Apatit, *Haus.* s. 123.—Apatit, *Karsten,* Tabel. s. 52.—Crystallised Phosphate of Lime, *Kid,* vol. i. p. 80.—Chaux phosphatée, *Haüy,* Tabl. p. 7.—Gemeiner Apatit, *Lenz,* b. ii. s. 804.—Blättriger Apatit, *Oken,* b. i. s. 397.—Apatit, *Hoff.* b. iii. s. 84.—Blättricher Apatit, *Haus.* Handb. b. iii. s. 869.—Apatit, *Aikin,* p. 172.

External Characters.

It most frequent colours are snow-white, yellowish-white, reddish-white, and greenish-white; from greenish-white it passes

passes into mountain-green, celandine-green. leek-green, emerald-green, and olive-green. It occurs also hyacinth-red, flesh-red, rose-red, and pearl-grey, from which it passes into violet-blue, lavender-blue, and seldom into indigo-blue. Sometimes it is pale wine-yellow, and yellowish-brown. Frequently several of these colours occur in the same piece.

It sometimes occurs massive and disseminated, also in distinct concretions, which are large and small angulo-granular, and sometimes thin and straight lamellar; generally crystallized.

The primitive form is a di-rhomboid, in which the angles are 131° 49′, and 109° 28′. The following are the secondary figures:

I. Prism.

Low equiangular six-sided prism *.

a. Perfect, fig. 148. Pl. 8.

b. With truncated lateral edges †, fig. 149. Pl. 8.

c. With truncated lateral and terminal edges ‡, fig. 150. Pl. 8.

d. With truncated terminal edges ||, fig. 151. Pl. 8.

e. With truncated terminal edges and angles §, fig. 152. Pl. 8.

f. With bevelled terminal edges and truncated angles.

g. With rounded edges, so that the prism appears cylindrical.

h. Half

* Chaux phosphatée primitive, Haüy.

† Chaux phosphatée peridodecaedre, Haüy.

‡ Chaux phosphatée emarginée, Haüy.

|| Chaux phosphatée annulaire, Haüy.

§ Chaux phosphatée unibinaire, Haüy.

h. Flatly acuminated on one extremity with six planes, which are set on the lateral planes. In this figure, the apex of the acumination, all the angles, and the alternate lateral edges, are slightly truncated.

i. Acuminated on both extremities with six planes, the apices, lateral edges, and angles, occasionally truncated.

k. The preceding acumination again very flatly acuminated with six planes, which are set on the planes of the first acumination. The apices of the acuminations truncated.

II. Table.

a. Equiangular six-sided table, in which the edges and angles are sometimes truncated.

b. Eight-sided table, in which four of the terminal edges are truncated.

The crystals are small, very small, and middle-sized; and occur sometimes single, sometimes many irregularly superimposed on each other.

The lateral planes are seldom smooth, generally longitudinally streaked; the truncating and acuminating planes are smooth.

Externally it is splendent or shining; internally glistening, and the lustre is resinous.

It has a fourfold cleavage, in which three of the cleavages are parallel with the lateral planes of the prism, and one (the most perfect), with the terminal planes of the prism.

The fracture is intermediate between uneven and imperfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is generally translucent; seldom nearly transparent, when it refracts single.

It is harder than fluor-spar, but not so hard as felspar.

It is brittle, and easily frangible.

Specific gravity, 3.179, *Lowry*.—3.248, *Breithaupt*.

Physical Characters.

It becomes electric by heating, and also by being rubbed with woollen cloth.

Chemical Characters.

When thrown on glowing coals, it emits a pale grass-green phosphoric light. It dissolves very slowly in the nitric acid, and without effervescence. It gradually loses its colour, when heated before the blowpipe, but its lustre and transparency are heightened. It is infusible without addition.

Constituent Parts.

Lime, - -	55
Phosphoric Acid, and trace of Manganese,	45
	100

Klaproth, Bergm. Journ. 1788. b. i. s. 269.

Geognostic Situation.

It occurs in tinstone veins, and also imbedded in talc.

Geographic

Geographic Situation.

Europe.—It occurs in yellow foliated talc, and, along with fluor-spar, in the mine called Stena-Gwyn, in St Stephens, in Cornwall, also at St Michael's Mount, Godolphin-bal in Breage, also in Cornwall: at Schlackenwald in Bohemia, in tinstone veins, along with tungsten, wolfram, topaz, and fluor-spar; at Ehrenfriedersdorf in Saxony, along with tinstone, copper, and arsenical pyrites, fluor-spar, steatite, lithomarge, talc, and quartz; imbedded in lepidolite near Rosena in Moravia; in a mixture of quartz and felspar at Nantes, Four-au-Diable, in department of the Lower Loire; at Arendal in Norway, along with magnetic ironstone, garnet, hornblende, and limestone; in veins, on St Gothard in Switzerland; and in Estremadura in Spain, in small tables, along with lamellar apatite or phosphorite.

America.—It occurs in grains or hexahedral prisms in granite, near Baltimore in Maryland; in granite and gneiss, along with beryl, garnet, and schorl, at Germantown in Pennsylvania; in iron-pyrites at St Anthony's Nose, in the Hudson in New York; in granite, at Milford-hills, near New-Haven in Connecticut; and at Topsham in Maine, in granite.

Second Subspecies.

Conchoidal Apatite or Asparagus-Stone.

Muschlicher Apatit, *Hausmann.*

Spargelstein, *Werner.*

Chrysolith ordinaire, ou proprement dite, *De Lisle,* t. ii. p. 271. —Chrysolithe, *De Born,* t. . p. 68. 2. E. *a.* 3.—Spargelstein, *Emm.* b. iii. s. 359.—La Pierre d'Asperge, *Broch.* t. i. p. 586. —Muschlicher Apatit, *Reuss,* b. ii. 2. s. 358.—Chaux phosphatée crysolithe, *Brong.* t. i. p. 240.—Muschlicher Apatit, *Haus.* s. 123. *Id. Lenz,* b. ii. s. 808. *Id. Oken,* b. i. s. 397. *Id. Haus.* Handb. b. iii. s. 870.—Spargelstein, *Hoff.* b. ii. s. 89.

External Characters.

Its colours are mountain-green, leek-green, pistachio-green, asparagus-green, olive-green, and siskin-green, which passes into wine-yellow, bordering on orange-yellow. It also occurs sky-blue, greenish and yellow grey, and clove-brown.

It sometimes occurs massive and disseminated, also in distinct concretions, which are large granular; but most frequently crystallized, and in the following figures:

1. Equilateral, longish, six-sided prism, acuminated with six planes, which are set on the lateral planes *, fig. 153. Pl. 8.
2. Sometimes the acumination ends in a line †.

3. The

* Chaux phosphatée pyramidée, Haüy.

† Chaux phosphatée cuneiforme, Haüy.

3. The same figure, truncated on the lateral edges of the prism *, fig. 154. Pl. 8.

The crystals are middle-sized, small, and very small; sometimes longitudinally streaked, and sometimes traversed by cross rents.

Externally the crystals are splendent, and vitreous: internally shining, and resinous.

It has an imperfect cleavage.

The fracture is small and imperfect conchoidal.

The fragments are rather blunt-edged.

It alternates from transparent to translucent.

In other characters agrees with the foliated apatite.

Specific gravity, 3.200, from Utö, *Klaproth*.—3.190, from Zillerthal, *Klaproth*.

Chemical Characters.

Some varieties of this subspecies do not phosphoresce when exposed to heat.

Constituent Parts.

Apatite from Utö.	
Phosphate of Lime,	92.00
Carbonate of Lime,	6.00
Silica, -	1.00
Loss in heating,	0.50
Manganese a trace.	——
	99.50
	Klaproth, Beit. b. v. s. 181.

From Zillerthal.	
Lime, -	53.75
Phosphoric Acid,	46.25
	——
	100
	Klaproth, Beit. b. iv. s. 197.

Geognostic

* Chaux phosphatée didodecaedre, Haüy.

Geognostic and Geographic Situations.

Europe.—It occurs imbedded in gneiss near Kincardine in Ross-shire; also in beds of magnetic ironstone, along with sphene, calcareous-spar, hornblende, quartz, and augite, at Arendal in Norway; imbedded in green-talc, in the Zillerthal in Salzburg; in granite, near Nantes, and in basalt, at Mount Ferrier, in France; and in a porous ironshot limestone, near Cape de Gate, in Murcia in Spain.

America.—Imbedded in granite at Baltimore *; in gneiss at Germantown; and in mica-slate in West Greenland †.

Observations.

1. This mineral was at one time described as a kind of Schorl; afterwards as a variety of Beryl, on account of colours and figure; and some authors have arranged it with Fluor-spar, and others along with Chrysolite. Werner ascertained that it was a distinct species from any of those just enumerated, and named it *Apatite*, from the Greek word ἀπατάω, *to deceive*, on account of its having been confounded with so many other minerals. It was Klaproth who first analysed it.

2. The conchoidal subspecies has been considered by some authors as a mere variety of the common apatite; whilst others have raised it to the rank of a species: thus, many of the French mineralogists arrange it with the varieties of common apatite; while some German mineralogists describe the asparagus-green varieties under the name *Asparagus-stone*, and certain green and blue varieties under

* Gilmor, in Bruce's Mineralogical Journal, p. 228.

† Giesecké.

der the name *Moroxite*. The name moroxite given to this mineral by Karsten, is borrowed from the Morochites of Pliny, concerning which, that author says, "Est gemma, per se porracea viridisque, trita autem candicans."—*Histor. Natur.* l. xxxvii.

3. Apatite is distinguished from Beryl, Schorl, and Chrysolite, by its inferior hardness: its greater hardness and non-effervescence with acids, distinguish it from Calcareous-spar.

Third Subspecies.

Phosphorite.

Phosphorit, *Werner*.

This Subspecies is divided into two Kinds, viz. Common Phosphorite and Earthy Phosphorite.

First Kind.

Common Phosphorite.

Gemeiner Phosphorit, *Karsten*.

Gemeiner Phosphorit, *Haus.* s. 123. *Id. Karsten,* Tabel. s. 52. —Chaux phosphatée terreuse, *Haüy,* Tabl. p. 8.—Gemeiner Phosphorit, *Lenz,* b. ii. s. 801.—Dichter Phosphorit, *Haus.* Handb. b. iii. s. 872.—Phosphorit, *Hoff.* b. iii. s. 92.—Massive Apatite, *Aikin,* p. 172.

External Characters.

Its colour is yellowish-white, sometimes approaching to greyish-

greyish-white. It is occasionally spotted pale ochre-yellow and yellowish-brown.

It occurs massive, and in distinct concretions, which are thin and curved lamellar.

The surface is uneven and drusy.

It is dull or glistening.

Its cleavage is imperfect curved, and generally floriform.

The fracture is uneven.

The fragments are indeterminate angular, and rather blunt-edged.

It is opaque, or feebly translucent on the edges.

It is soft, rather brittle, and very easily frangible.

Chemical Characters.

It becomes white before the blowpipe, and, according to Proust, melts with difficulty into a white-coloured glass. When rubbed in an iron mortar, it emits a green-coloured phosphoric light; and the same effect is produced when it is pounded and thrown on glowing coals.

Constituent Parts.

Lime,	59.0
Phosphoric Acid,	34.0
Silica,	2.0
Fluoric Acid,	2.5
Muriatic Acid,	0.5
Carbonic Acid,	1.0
Oxide of Iron,	1.0
	100.0

Pelletier, Journal des Mines, N. 166.

Geognostic

Geognostic and Geographic Situations.

It occurs in crusts, and crystallized, along with apatite and quartz, at Schlackenwald in Bohemia, but most abundantly near Leigrosan, in the province of Estremadura in Spain, where it is sometimes associated with apatite, and frequently with amethyst, and forms whole beds, that alternate with limestone and quartz.

Second Kind.

Earthy Phosphorite.

Erdiger Phosphorit, *Karsten.*

Erdiger Phosphorit, *Haus.* s. 123. *Id. Karsten,* Tabel. s. 52.—Chaux phosphatée pulverulente, *Haüy,* Tabl. p. 8.—Erdiger Phosphorit, *Lenz,* b. ii. s. 802. *Id. Haus.* Handb. b. iii. s. 873.

External Characters.

Its colours are greyish-white, greenish-white, and pale greenish-grey.

It consists of dull dusty particles, which are partly loose, partly cohering, and which soil slightly, and feel meagre and rough.

Chemical Characters.

It phosphoresces when laid on glowing coals.

Constituent

Constituent Parts.

Earthy Phosphorite from Marmarosch.

Lime, - -	47.00
Phosphoric Acid, -	32.25
Fluoric Acid, -	2.50
Silica, - -	0.50
Oxide of Iron, -	0.75
Water, - -	1.00
Mixture of Quartz and Loam,	11.50
	95.50

Klaproth, Beit. b. iv. s. 373.

Geognostic and Geographic Situations.

It occurs in a vein, in the district of Marmarosch in Hungary.

Observations.

1. It was for some time described in systems of mineralogy as a variety of Fluor-spar.

2. The celebrated Prussian chemist John, has published the description and analysis of a mineral under the name *Ratofkite*, from Ratofka, near Werea in Russia, which appears to be nearly allied to this subspecies, and may possibly prove to be a new species, intermediate between fluor and apatite. The following is the description and analysis of it, as given by John, in the second continuation of his work entitled, "Chemische Untersuchungen," &c.

"Its colour is lavender-blue; and it is composed of loose dusty dull particles, that soil slightly, and are not particularly heavy. It is contained in aphrite. *Constituent Parts:* Fluate of Lime, 49.50. Phosphate of Lime,

20.00.

20.00. Muriatic Acid, 2.00. Phosphate of Iron, 3.75. Water, 10.00."

Genus III. FLUOR.

This Genus contains but one species, viz. Octahedral Fluor.

1. Octahedral Fluor.

Flus, *Werner*.

Octaedrisches Flus Haloide, *Mohs*.

It is divided into three subspecies, Compact Fluor, Foliated Fluor, and Earthy Fluor.

First Subspecies.

Compact Fluor.

Dichter Flus, *Werner*.

Fluor solidus, *Wall.* t. i. p. 542. ?—Dichter Fluss, *Wid.* s. 542.—Compact Fluor, *Kirw.* vol. i. p. 127.—Dichter Fluss, *Estner*, b. ii. s. 1067. *Id. Emm.* b. i. s. 516.—Fluorite compatta, *Nap.* p. 374.—Le Fluor compacte, *Broch.* t. i. p. 594.—Dichter Fluss, *Reuss*, b. ii. 2. s. 379. *Id. Lud.* b. i. s. 161. *Id. Suck.* 1 th. s. 663. *Id. Bert.* s. 103. *Id. Mohs*, b. ii. s. 150. *Id. Hab.* s. 89.—Chaux fluatée massive compacte, *Lucas*, p. 247.—Dichter Fluss, *Leonhard*, Tabel. s. 38.—Chaux fluatée,

fluatée compacte, *Brong*. t. i. p. 245.—Dichter Fluss, *Haus*. s. 124. *Id. Karsten,* Tabel. s. 52.—Chaux fluatée compacte, *Haüy,* Tabl. p. 9.—Dichter Fluss, *Lenz,* b. ii. s. 823. *Id. Oken,* b. i. s. 899.—Dichter Flus, *Hoff.* b. iii. s. 95.—Compact Fluor, *Aikin,* p. 175.

External Characters.

Its colours are greenish-grey and greenish-white; from greenish-grey it passes into pearl-grey, and into a colour intermediate between flesh-red and brownish-red; from greenish-white it passes into dark mountain-green, and even into greenish-black. These colours are either simple, or in flamed or spotted delineations.

It occurs massive.

Externally and internally it is dull, or feebly glimmering.

The fracture is even, which passes on the one side into small splintery, on the other into flat conchoidal.

The fragments are rather sharp-edged.

It is more or less translucent.

It is harder than calcareous-spar, but not so hard as apatite.

It is brittle, and easily frangible.

Specific gravity 3.150, 3.191, *Breithaupt.*

Chemical Characters.

The chemical characters are the same as those of the following subspecies.

Geognostic and Geographic Situations.

It is found in veins, associated with fluor-spar, at Stolberg in the Hartz: the veins traverse rocks of grey-wacke, and

and besides fluor-spar, contain heavy-spar and copper-pyrites. It has also been met with at Stripasen in Norbergs-Bergslag in Sweden.

Second Subspecies.

Foliated Fluor.

Fluss-Spath, *Werner*.

Fluor spathosus; Fluor granularis, et Fluor cristallisatus, *Wall.* t. i. p. 180. 183.—Spath fusible ou vitreux, *Romé de Lisle,* t. ii. p. 1.—Chaux fluorée, *De Born,* t. i. p. 355.—Fluss-spath, *Wid.* s. 558.—Foliated or Sparry Fluor, *Kirw.* vol. i. p. 127.—Fluss-spath, *Estner,* b. ii. s. 1070. *Id. Emm.* b. i. s. 519.—Fluorite lamellare, *Nap.* p. 375.—Fluor, *Lam.* t. i. p. 78.—Chaux fluatée cristallisée, *Haüy,* t. ii. p. 247.—Le Spath Fluor, *Broch.* t. i. p. 595.—Spathiger Fluss, *Reuss,* b. ii. 2. s. 381. *Id. Lud.* b. i. s. 162. *Id. Suck.* 1r th. s. 664. *Id. Bert.* s. 103. *Id. Mohs,* b. ii. s. 151. *Id. Hab.* s. 83.—Chaux fluatée, *Lucas,* p. 12.—Spathiger Fluss, *Leonhard,* Tabel. s. 38.—Chaux fluatée spathique, *Brong.* t. i. p. 243.—Chaux fluatée, *Brard,* p. 47.—Gemeiner, stänglicher, schaaliger, & körniger Fluss-spath, *Haus.* s. 123, 124.—Spathiger Fluss, *Karsten,* Tabel. s. 52.—Fluat of Lime, or Fluor-spar, *Kid,* vol. i. p. 73.—Chaux fluatée, *Haüy,* Tabl. p. 9.—Fluss-spath, *Lenz,* b. ii. s. 824. *Id. Hoff.* b. iii. s. 96.—Crystallised Fluor, *Aikin,* p. 175.

External Characters.

Its most common colours are white, yellow, green and blue, seldomer red, grey and brown, and least frequently black.

black. The white varieties are reddish, yellowish, greenish, and greyish; the latter passes into smoke-grey, the reddish-white into rose-red; from this into pearl-grey, violet-blue, smalt-blue, and sky-blue; from this latter into verdigris-green, celandine-green, mountain-green, emerald-green, grass-green, asparagus-green, and oil-green; further into wax, wine, honey yellow, and yellowish-brown. The violet-blue sometimes passes into bluish-black.

The colours are of all degrees of intensity, and sometimes pieces occur spotted or striped. Green cubes occur with blue angles, &c. Some colours, as sky-blue, fade by keeping, particularly in warm places.

It occurs massive, disseminated, also in distinct concretions, which are large, coarse, small, and fine granular, sometimes straight prismatic, which are traversed by others that are thick and fortification-wise curved lamellar. The striped colour delineation is in the direction of these concretions. It occurs crystallized, in the following figures:

1. Cube, which is the most frequent crystallization, and is also the fundamental figure of the species *, fig. 155. Pl. 8.
2. Cube, truncated on all the edges †, fig. 156. Pl. 8. When these truncating planes increase so much as to cause the faces of the cube to disappear, there is formed
3. The rhomboidal or garnet dodecahedron ‡, fig. 157. Pl. 8.

4. Cube,

* Chaux fluatée cubique, Haüy.

† Chaux fluatée cubo-dodecaedre, Haüy.

‡ Chaux fluatée dodecaedre, Haüy.

4. Cube, with truncated angles *, fig. 158. Pl. 8.
   When these truncating planes increase, so as to cause the faces of the cube to disappear, there is formed an
5. Octahedron, or regular double four-sided pyramid †, fig. 159. Pl. 8. This figure is sometimes truncated on the edges, as fig. 160. Pl. 8., or on the edges and angles at the same time; and varieties of it occur, in which the planes or faces are cylindrically convex ‡.
6. Cube, with bevelled edges ||, fig. 161. Pl. 8.
   When the bevelling planes enlarge so much, as to cause the original faces of the cube to disappear, a tessular crystal, with 24 triangular planes, is formed, fig. 162. Pl. 8.
7. Cube, in which all the angles are acuminated with three planes, which are set on the lateral planes.
8. Cube, in which all the angles are acuminated with six planes, which are set on the lateral planes.

The cubes vary from very large to very small; the other crystals are only small and middle sized.

The crystals are generally placed on one another, and form druses; but are seldom single.

The surface is smooth and splendent, or drusy and rough,

* Chaux fluatée cubo-octaedre, Haüy.

† Chaux fluatée primitive, Haüy.

‡ Chaux fluatée spheroidale, Haüy.

|| Chaux fluatée bordée, Haüy.

rough, as in the rhomboidal dodecahedron, and some octahedrons.

Internally the lustre is specular-splendent, or shining, and is vitreous.

It has a fourfold equiangular cleavage, which is parallel with the planes of an octahedron.

The fragments are octahedral or tetrahedral.

It alternates from translucent to transparent, and refracts single.

It is harder than calcareous-spar, but not so hard as apatite.

It is brittle, and easily frangible.

Specific gravity, 3.0943, 3.1911, *Haüy*.—3.148, *Gellert*—3.092, *Brisson*.—3.156, 3.184, *Muschenbroeck*.—3.138, 3.228, *Karsten*.

Chemical Characters.

Before the blowpipe it generally decrepitates, gradually loses its colour and transparency, and melts, without addition, into a greyish-white glass. When two fragments are rubbed against each other, they become luminous in the dark. When gently heated, or laid on glowing coal, it phosphoresces, (particularly the sky-blue, violet-blue, and green varieties,) partly with a blue, partly with a green light. When brought to a red-heat, it is deprived of its phosphorescent property. The violet-blue variety from Nertschinsky, named *Chlorophane*, when placed on glowing coals, does not decrepitate, but soon throws out a beautiful verdigris-green and apple-green light, which gradually disappears as the mineral cools, but may be again excited, if it is heated; and this may be repeated a dozen of times, provided

provided the heat is not too high. When the chlorophane is exposed to a red-heat, its phosphorescent property is entirely destroyed. Pallas mentions a pale violet-blue variety spotted with green, from Catharinenburg, which is so highly phosphorescent, that when held in the hand for some time, it throws out a pale whitish light; when placed in boiling water, a green light; and exposed to a higher temperature, a bright blue light. When sulphuric acid is added to heated fluor-spar, in the state of powder, a white penetrating vapour (the fluoric acid) is evolved, which has the property of corroding glass *.

Constituent Parts.

	Northumberland.	Gersdorf.	Gersdorf.
Lime,	67.34	67.75	65.0
Fluoric Acid,	32.66	32.25	35.0
	100.00	100.00	100.0
	Thomson, in Wern. Mem. vol. i. p. 11.	*Klaproth*, Beit. b. iv. s. 365.	*Richter*, Uber die Neueren Gegenst. v. Chem. b. iv. s. 25.

Geognostic Situation.

It occurs principally in veins, that traverse primitive, transition, and sometimes secondary rocks; also in beds,

 associated

* M. Th. de Grotthaus describes a fluor under the name *Pyro-Emerald* and *Chlorophane:* it is the violet fluor of Nertschinsky. After being exposed some time to the sun's rays, it preserves its phosphorescence for weeks. Its affinity for light is so great, that it absorbs that of a candle or the electric spark, which it gives out in the dark

associated with other minerals; in kidneys in secondary limestone; and in drusy cavities in trap-rocks. It sometimes forms the petrifying mineral in fossil organic remains: thus, it has been found penetrating and encrusting bivalve shells *; and entrochi have been described, in which the one-half was calcareous carbonate, having the natural texture of the entrochus, the other half pure violet-coloured fluor †.

Geographic Situation.

Europe.—Fluor-spar is a rare mineral in Scotland, having been hitherto found only in four places, viz. near Monaltree in Aberdeenshire, where it is contained in a small vein of galena or lead-glance which traverses granite; in gneiss in Sutherland ‡; in secondary porphyry near the village of Gourock in Renfrewshire; and in the island of Papa Stour, one of the Shetland islands, in small quantity, in a trap-rock ||. It occurs much more abundantly in England, being found in all the galena veins that traverse the coal formation in Cumberland and Durham; in great quantities, and often associated with galena, in veins or kidneys, in secondary or flœtz limestone in Derbyshire; and it is the most common vein-stone in the copper, tin, and lead veins, that traverse granite, clay-slate, &c. in Cornwall and Devonshire. It is also a frequent mineral on the Continent of Europe, being generally associated with ores of different kinds,

* Kid, vol. i. p. 74.

† Bournon describes a specimen of entrochites from Derbyshire, having the characters above described.—Vid. *Cat. Min.* p. 11.

‡ Discovered in Sutherland by Dr MacCulloch.

|| Mineralogical Travels, vol. ii. p. 207.

kinds, either in beds or veins, but principally in the latter: thus, in the Saxon Erzgebirge, it occurs in beds in primitive rocks, along with tinstone: also in veins, along with silver and lead ores, and straight lamellar heavy-spar; and in veins of another formation, along with silver-ore, cobalt, and nickel. In the lower district of the Hartz there is a remarkable formation in great veins, which can be traced for ten or twelve miles in length; in these, the fluor-spar occurs in great quantity, along with galena, iron-pyrites, copper-pyrites, much sparry iron, calcareous-spar, and quartz: at Kongsberg in Norway, in veins that traverse mica-slate and hornblende-slate, along with ores of silver, lead, zinc, copper, iron, and arsenic, and the crystals are most commonly octahedral or polyhedral: in mica-slate at Jönkoping in Oeland, in Sweden: in the Bohemian and Saxon Erzgebirge, in veins, along with tinstone, arsenic-pyrites, iron-pyrites, and copper-pyrites, quartz, and apatite: in Switzerland, in very small veins, along with felspar, rock-crystal, and other minerals that characterise what are considered as veins of the oldest formation: near Regensburg in Lower Bavaria, along with quartz, inclining to calcedony, in veins traversing granite: at Freiburg in the Breisgau, in veins traversing gneiss; in granite at Baveno in Italy; a greyish-white variety in secondary limestone in the mountains of Judica and Torisi in Sicily; and it has been lately discovered imbedded in the coarse limestone which rests over chalk in the neighbourhood of Paris; and in unaltered ejected masses at Somma, near Naples. The beautiful carmine-red octahedral variety is found in the neighbourhood of Mont Blanc; the remarkable phosphorescent varieties known under the name Chlorophane, are found in Cornwall, in the mine named Pednandrae; in Auvergne in France; and fluor also occurs in Franconia, Austria, Denmark, Hessia, Silesia; but is very rare in Russia and in Hungary.

Asia.—The chlorophane variety is found at Catharinenburg and Nertschinsky: other varieties are found in granite, in the neighbourhood of the lake of Gussino-Osero, on the Mongol frontier; also at Schlangenberg, in the silver mine Zimeof, in the Altain range. It is also mentioned as a production of the island of Ceylon.

America.—West Greenland; California; Mexico; and in New Jersey, Connecticut, New Hampshire, and Virginia, in the United States *.

Uses.

On account of the variety and beauty of its colours, its transparency, the ease with which it can be worked, and the high polish it receives, it is cut into vases, pyramids, and other ornamental articles. The largest masses, and most beautiful varieties for use, are found in Derbyshire, and it is in that county that all the ornamental articles of fluor-spar are manufactured. It is also used by the metallurgist, as a flux for ores, particularly those of iron and copper; and hence the name *fluor* given to it. The acid it contains has been employed in the way of experiment for engraving upon glass.

Observations.

1. It is distinguished from *Calcareous-spar*, by its greater hardness and weight, and its not effervescing with acids: from *Gypsum*, by its superior hardness, and specific gravity,

* Bruce and Barton, in American Mineralogical Journal, N. I. p. 32, 33.

ty, and its decrepitating in the fire, whilst gypsum exfoliates, and becomes white; and from *Heavy-spar*, by its inferior specific gravity, and greater hardness.

2. The red varieties have been named *False Ruby*, the yellow *False Topaz*, the green *False Emerald*, and the blue *False Sapphire* and *Amethyst*.

3. The name *Chlorophane*, given to the varieties that easily become phosphorescent, is from the green light they exhibit.

Third Subspecies.

Earthy Fluor.

Erdiger Fluss, *Karsten*.

Le Fluor terreuse, *Broch.* t. i. p. 593.—Erdiger Fluss, *Reuss*, b. ii. 2. s. 378. *Id. Lud.* b. i. s. 161. *Id. Suck.* 1r th. s. 662. *Id. Leonhard*, Tabel. s. 38.—Chaux fluatée terreuse, *Brong.* t. i. p. 245. *Id. Brard*, p. 48.—Erdiger Fluor, *Haus.* s. 124. *Id. Karst.* Tabel. s. 52.—Earthy Fluor, *Kid*, vol. i. p. 78.——Chaux fluatée terreuse, *Haüy*, Tabl. p. 9.—Fluserde, *Lenz*, b. ii. s. 829.—Erdiger Fluss, *Haus.* Handb. b. iii. s. 878.

External Characters.

Its colours are greyish-white, and violet-blue, and are sometimes so deep as almost to appear black.

It occurs generally in crusts, investing some other mineral.

It is dull.

It is earthy.

It is friable, passing into very soft.

Constituent

Constituent Parts.

It is said to be a compound of Lime and Fluoric Acid.

Geognostic and Geographic Situations.

It occurs in veins, along with fluor-spar, at Beeralston in Devonshire; in limestone, along with fluor-spar and arragonite, in Cumberland; at Freyberg in Saxony; and Kongsberg in Norway. At Beeralston, the white variety is regularly interposed between the layers of the octahedral fluor, without in the least disturbing its crystallization.

Observations.

The erroneous analysis of the Earthy Phosphorite of Marmarosch by Pelletier, by which it appeared to contain 28 *per cent.* of fluoric acid, has led several authors to confound it with the earthy fluor.

Genus IV.—ALUM-STONE.

Thon Haloide, *Mohs.*

Alaunstein, *Werner.*

This Genus contains one species, viz. Rhomboidal Alum-stone.

1. Rhomboidal

1. Rhomboidal Alumstone.

Rhomboedrisches Thon Haloide, *Mohs*.

Alaunstein, *Wid.* s. 399.—Pietra, d'Allume, *Nap.* p. 266.—La pierre alumineuse, *Broch.* t. i. p. 381.—Alaunstein, *Reuss*, *Mohs*, *Karsten*, *Hoffmann*.

External Characters.

Its colours are greyish and yellowish white, also reddish-white, and pale flesh-red, more rarely pearl-grey and bluish-grey. Sometimes several of these colours occur together in spotted, striped, and veined delineations.

It occurs massive, sometimes porous, or nearly vesicular, with the walls lined with small crystals.

The crystals are rhomboids, the dimensions of which have not been ascertained.

Internally it is dull, or feebly glimmering.

The cleavage of the crystals is in the direction of the rhomboid.

The fracture is coarse and small grained uneven, which passes into splintery, earthy, and flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is feebly translucent on the edges.

It is as hard as apatite.

It is brittle and easily frangible.

Specific gravity 2.4–2.6, *Mohs*.

Constituent Parts.

		Alumstone from Tolfa.	Hungarian Alumstone.
Alumina, -	43.92	19.00	17.50
Silica, - -	24.00	56.50	62.25
Sulphuric Acid,	25.00	16.50	12.50
Potash, - -	3.08	4.00	1.00
Water, - -	4.00	3.00	5.00
		99.00	98.25
	Vauquelin.	*Klaproth*, Beit. b. iv. s. 252.	*Klaproth*, Id. s. 256.

Geognostic and Geographic Situations.

It occurs at Tolfa, near Civita Vecchia, in nests, kidneys, and small veins, in a flœtz or secondary rock. The Hungarian varieties are found in beds at Beregszaz and Nagy-Begany, in the country of Bereghen, in Upper Hungary.

Uses.

Alum is obtained from this mineral, by repeatedly roasting it, then lixiviating it, and crystallizing the solution thus obtained. The art of preparing alum is an eastern discovery; and the most ancient known alum-work is that of Rocca, the present Edessa, in Syria. In the middle ages, all the alum of commerce was prepared in the Levant; but in the fifteenth century, some Genoese skilled in the Levant art of alum-making, discovered alumstone in Italy, and immediately began to extract alum from it; and this new source of wealth soon became very considerable

able, by an edict of the Pope Pius I. who prohibited the use of Levant alum.

Observations.

This mineral has been confounded with Heavy-Spar, from which it is distinguished, by inferior specific gravity, and inferior hardness: it is also nearly allied to Anhydrite in external aspect; but its cleavage readily distinguishes it from that mineral.

GENUS V.—CRYOLITE *.

Eis-Haloide, *Mohs.*

THIS Genus contains one species, viz. Pyramidal Cryolite.

1. Pyramidal Cryolite.

Pyramidales Eis-Haloide, *Mohs.*

Kryolith, *Werner.*

Alumine fluatée alkaline, *Haüy*, t. ii. p. 398.—Chryolith, *Reuss*, b. ii. 2. s. 556. *Id. Lud.* b. ii. s. 148. *Id. Suck.* 1r th. s. 532. *Id. Bert.* s. 278. *Id. Mohs*, b. ii. s. 237.—Alumine fluatée alkaline, *Lucas*, p. 27.—Kryolith, *Leonhard*, Tabel. s. 42.—Alumine fluatée, *Brong.* t. i. p. 164. *Id. Brard*, p. 87.—Kryolith,

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* This mineral was first described by Abilgaard, who named it *Cryolite*, because like ice it melts very easily before the blowpipe.

lith, *Karsten*, Tabel. s. 48. *Id. Haus.* s. 121.—Alumine fluatée alkaline, *Haüy*, Tabl. p. 22.—Kryolith, *Lenz*, b. ii. s. 943. *Id. Haus.* Handb. b. iii. s. 846. *Id. Hoff.* b. iii. s. 204. *Id. Aikin*, p. 174.

External Characters.

Its colours are pale greyish-white, snow-white, yellowish-brown and yellowish-red.

It occurs massive, disseminated, and in straight and thick lamellar distinct concretions.

It is shining, inclining to glistening, and the lustre is vitreous, inclining to pearly.

It has a fourfold cleavage, in which the folia are parallel with an equiangular four-sided pyramid; sometimes the folia are parallel with the diagonals of a rectangular four-sided prism, or with the terminal planes.

The fracture is uneven.

The fragments are cubical or tabular.

It is translucent.

It is harder than gypsum, and sometimes as hard as calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, 2.949, *Haüy*.—2.953, *Karsten*.—2.9, 3.0, *Mohs*.

Chemical Characters.

It becomes more translucent in water, but does not dissolve in it. It melts before it reaches a red heat, and when simply exposed to the flame of a candle. Before the blowpipe, it at first runs into a very liquid fusion, then hardens, and at length assumes the appearance of a slag.

Constituent

Constituent Parts.

Alumina, - -	24.0	21.0
Soda, - - -	36.0	32.0
Fluoric Acid, and Water,	40.0	47.0
	100.0	100.0
	Klaproth, Beit. b. iii. s. 214.	*Vauquelin*, Haüy, Traité, t. ii. p. 400.

Geognostic and Geographic Situations.

This curious and rare mineral has been hitherto found only in West Greenland, and but in one place of that dreary and remote region, viz. the Fiord or arm of the sea named Arksut, situated about thirty leagues from the colony of Juliana Hope. It occurs in two thin layers in gneiss: one of these contains the greyish and snow white cryolite, and is not intermixed with other minerals; the other is wholly composed of the yellowish-brown coloured variety, mixed with galena, iron-pyrites, sparry iron, quartz, and felspar. They are situated very near each other: the first is washed at high water by the tide, and a considerable portion of it is exposed, the superincumbent gneiss being removed. It varies from one foot to two feet and a half in thickness *.

Observations.

1. As this mineral, when exposed to a very low heat, melts almost like ice, it was named *Cryolith*, from κρυος, *ice*, and λιθος, *stone*.

2. It

* Allan and Giesecké, in Thomson's Annals, vol. ii. p. 389.

2. It has been confounded with Heavy-spar, from which it is distinguished, by inferior specific gravity, and its easy fusibility before the blowpipe: it might also be mistaken for some varieties of Gypsum, but is distinguished from these by superior specific gravity, and its not exfoliating when exposed to the blowpipe.

Genus VI.—GYPSUM *.

Gyps Haloide, *Mohs.*

This Genus contains two species, viz. 1. Prismatic Gypsum, 2. Axifrangible Gypsum.

1. Prismatic

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* *Gypsum* is from the Greek word Γυψος. The following explanation of the term γυψος, shows that it was applied by the ancients to an earthy substance that had been exposed to the action of fire: Γύψος οἱονεὶ γίψος τὶς οὖσα· ἡ ἑψηθεῖσα γῆ (a): in which it corresponds with the gypsum of the moderns. The ancient naturalists sometimes seem to apply the term to sulphate of lime, the gypsum of the present day, and sometimes to a calcined carbonate of lime, or quicklime, which they called *calx.* In the following passage, it is applied to a sulphate of lime; "Cognata calci res gypsum est. Qui coquitur lapis non dissimilis alabastritæ esse debet: omnia autem optimum fieri compertum est e *lapide speculari*, squamamve talem habente (b):" the term *lapis specularis* applying very closely to our selenite, which is a sulphate of lime. "Gypsoma dicto statim utendum est, quoniam *celerrime* coit (c):" the word *celerrime* being more applicable to the comparatively

(a) Vid. Etymolog. Magn.
(b) Plin. Hist. Nat. lib. xxxvi.
(c) Plin. Hist. Nat. lib. xxxvi.

1. Prismatic Gypsum or Anhydrite.

Prismatisches Gyps-Haloide, *Mohs.*

Muriacit, *Werner.*

It is divided into five subspecies, viz. Sparry Anhydrite, Scaly Anhydrite, Fibrous Anhydrite, Conchoidal Anhydrite, Compact Anhydrite. * Vulpinite. * Glauberite.

First Subspecies.

Sparry Anhydrite or Cube-Spar.

Wurfelspath, *Werner.*

Spathiger Karstenit, *Haus.* s. 124.—Spathiger Muriacit, *Karsten,* Tabel. s. 52.—Chaux sulphatée Anhydre laminaire, *Haüy,* Tabl. p. 10.—Wurfelspath, *Lenz,* b. ii. s. 946.—Wurflicher Muriacit, *Hoff.* b. iii. s. 124.

External Characters.

Its chief colour is white, which passes on the one side into blue, and on the other into red: the colours form the following

ratively rapid consolidation of calcined gypsum, than to that of common mortar. There is a passage in Theophrastus, in which a ship is said to have been set on fire, in consequence of the moistening of its cargo, which consisted of gypsum and wearing-apparel: in this case, there can be little doubt, that the substance called gypsum could not have been of the same nature with the gypsum of the present day, which in no instance, perhaps, contains such a proportion of carbonate of lime, as, when calcined, would be sufficient to produce this effect.—*Kid's Min.* vol. i. p. 69, 70, 71.

following series; a colour intermediate between brick-red and flesh-red, reddish-white, yellowish-white, greyish-white, pearl-grey, which sometimes inclines to rose-red, and also pale violet-blue. Sometimes it is slightly iridescent.

It occurs massive; also in distinct concretions, which are thin and straight lamellar, collected into others which are large granular. It is sometimes crystallized. The primitive figure is an oblique prism, in which the angles are 108° 8′ and 79° 56′. The following are some of the secondary forms:

1. Rectangular four-sided prism: it is sometimes so low as to appear as a four-sided table.
2. Broad six-sided prism.
3. Eight-sided prism.
4. Broad rectangular four-sided prism, acuminated on the extremities with four planes, which are set on the lateral edges, and the apex of the acumination deeply truncated.

Externally it is shining or splendent, and pearly: internally splendent and pearly.

It has a threefold cleavage, and the cleavages are perpendicular to each other; two of them are parallel with the lateral planes of the primitive prism, the third parallel with the terminal planes.

The fragments are cubical.

The fracture is conchoidal.

It alternates from transparent to strongly translucent, and refracts double.

It scratches calcareous-spar, but does not affect fluor-spar.

It is brittle, and very easily frangible.

Specific

Specific gravity, 2.957, *Bournon.*—2.964, *Klaproth.*—2.7, 3.0, *Mohs.*

Chemical Characters.

When exposed to the blowpipe, it does not exfoliate, and melt like gypsum, but becomes glazed over with a white friable enamel.

Constituent Parts.

	From Bern.	From Tyrol.
Lime, - -	40	41.75
Sulphuric Acid, -	60	55.00
Muriate of Soda, -		1.00
	100	97.75
	Haüy, Traité, t. iv. p. 349.	*Klaproth*, Beit. b. iv. s. 235.

Geognostic and Geographic Situations.

It is sometimes met with in the gypsum of Nottinghamshire *. In the salt-mines of Hall in the Tyrol; in those of Bex in Switzerland; in quartz, along with talc, sulphur, and iron-pyrites, in the mine of Pesay, also in Switzerland; Lauterberg in the Hartz; Tiede, near Brunswick; and in the large copper-mine of Fahlun in Sweden.

Second

* Greenough.

Second Subspecies.

Scaly Anhydrite.

Anhydrit, *Werner*.

Schupiger Muriacit, *Karsten*.

Schuppiger Karstenit, *Haus.* s. 124.—Schuppiger Muriacit, *Karsten,* Tabel. s. 52.—Chaux sulphatée Anhydre lamellaire, *Haüy,* Tabl. p. 10.—Schuppiger Anhydrit, *Lenz,* b. i. s. 849.

External Characters.

Its colours are snow, greyish, and milk white, which latter passes into smalt-blue, and rarely into grey.

It occurs massive, and in small granular concretions.

The lustre is splendent and pearly.

The cleavage is imperfect and curved.

The fragments are not particularly blunt-edged.

It is translucent on the edges.

It is easily frangible.

Specific gravity 2.957, *Haüy.*

Constituent Parts.

Lime, - - - - - -	41.75
Sulphuric Acid, - - -	55.00
Muriate of Soda, - - -	1.00
	97.75

Klaproth, Beit. b. iv. s. 235.

Geognostic and Geographic Situations.

It is found in the salt-mines of Hall in the Tyrol, 5088 feet above the level of the sea.

Third

Third Subspecies.

Fibrous Anhydrite.

Fasriger Muriacit, *Werner.*

Fasriger Muriacit, *Karsten,* Tabel. s. 52.—Fasriger Karstenit, *Haus.* Handb. b. iii. s. 883.—Fasriger Muriacit, *Hoff.* b. iii. s. 136.—Fasriger Anhydrit, *Lenz,* b. ii. s. 724.

External Characters.

Its colours are brick-red, and pale blood-red; also indigo-blue, Berlin-blue, smalt-blue, and smoke-grey.

It occurs massive, and in coarse fibrous concretions, which are straight or curved, and sometimes stellular.

Internally it is glimmering and glistening, and pearly.

The fragments are long splintery.

It is translucent on the edges, or feebly translucent.

It is rather easily frangible.

Specific gravity 3.002, *Breithaupt.*

Geographic Situation.

It is found in the salt-mines of Berchtesgaden, and at Ischel in Upper Austria, at Hall in the Tyrol, Salz on the Neckar, Carinthia, and Tiede near Brunswick.

Uses.

The blue varieties are sometimes cut and polished for ornamental purposes.

Fourth Subspecies.

Convoluted Anhydrite.

Gekröstein, *Werner.*

Chaux sulphatée Anhydre concretionnée, *Haüy.*—Gekröstein, *Hoff.* b. iii. s. 131.

External Characters.

Its colour is dark milk-white.

It occurs massive; also in distinct concretions, which are thick lamellar, and intestinally convoluted or contorted, and these are again composed of others which are thin prismatic.

Internally it is glistening or glimmering, and the lustre is pearly.

The fracture is small and fine splintery.

The fragments are indeterminate angular, and rather sharp-edged.

It is translucent on the edges, or translucent.

Same hardness as other subspecies.

Specific gravity 2.850, *Klaproth.*

Constituent Parts.

Lime, - - -	42.00
Sulphuric Acid, - -	56.50
Muriate of Soda, - -	0.25
	98.75

Klaproth, Beit. b. iv. s. 236.

Geognostic and Geographic Situations.

It occurs in the salt-mines of Bochnia, and at Wieliczka in Poland.

Observations.

It was first described as a variety of compact heavy-spar, and is by many named *Pierre de Tripes*, from its convoluted concretions.

Fifth

Fifth Subspecies.

Compact Anhydrite.

Dichter Muriacit, *Werner.*

Dichter Muriacit, *Karsten,* Tabel. s. 52.—Dichter Karstenit, *Haus.* s. 124.—Chaux sulphatée Anhydre compacte, *Haüy,* Tabl.—Dichter Anhydrit, *Lenz,* b. ii. s 847.—Dichter Muriaticit, *Hoff.* b. iii. s. 133.

External Characters.

Its colours are bluish-grey, greyish-white, and colours intermediate between ash and smoke grey, and between ash-grey and tile-red. Sometimes with spotted delineations.

It occurs massive; also in granular distinct concretions.

It is feebly glimmering, or dull.

The fracture is small splintery, passing into even and flat conchoidal.

The fragments are more or less sharp-edged.

It alternates from translucent to translucent on the edges.

Same hardness as other subspecies.

Specific gravity, 2.850, *Klaproth.*—2906, *Rose.*—2.969, *Breithaupt.*

Constituent Parts.

Lime, -	41.48
Sulphuric Acid,	56.28
Water, - -	0.75
	100.00

Rose, in Karsten's Tabellen.

Lime, -	42.00
Sulphuric Acid,	56.50
Muriate of Soda,	0.25
Loss, - -	1.28
	100.00

Klaproth, Beit. b. iv. s. 233.

Geognostic and Geographic Situations.

It occurs in beds in the salt-mines of Austria and Salzburg; and also in secondary gypsum, on the eastern foot of the Hartz mountains.

* Vulpinite.

Vulpinite, *De La Metherie*, Tableaux.—Chaux sulphatée quartzifere, *Haüy*, t. iv. p. 355.—Pierre de Vulpino, dans le Bergamasce, *Fleuriau de Belleveu*.—Chaux anhydro-sulphatée quartzifere, *Haüy*, Tabl. p. 11.—Vulpinit, *Lenz*, b. ii. s. 851.

External Characters.

Its colour is greyish-white, and veined with bluish-grey.

It occurs massive.

Internally it is splendent.

The fracture is foliated, and is said to exhibit a threefold slightly oblique cleavage.

The fragments are rhomboidal.

It occurs in granular distinct concretions.

It is translucent on the edges.

It is soft.

It is brittle.

It is easily frangible.

Specific gravity 2.878, *Haüy*.

Chemical Characters.

It melts easily before the blowpipe into a white opaque enamel; and becomes feebly phosphorescent when thrown on glowing coals.

Constituent

Constituent Parts.

Sulphate of Lime,	-	92.0
Silica,	- - -	8.0
		100.0

Vauquelin, in Bulletin des Sciences de la Société Philomatique, N. 9.; Journal de Physique, t. xlvii. p. 101.; Journal des Mines, N. xxxiv.

Geognostic and Geographic Situations.

It occurs along with granular foliated limestone, and is sometimes associated with quartz, and occasionally with sulphur. It is found at Vulpino in Italy.

Uses.

1. It takes a very fine polish, and is employed by the statuaries of Bergamo and Milan for making slabs, chimney-pieces, &c. It is known to artists by the name *Marmo bardiglio di Bergamo*.

2. It was first particularly noticed by Fleuriau.

* Glauberite.

Glauberite, *Brongniart.*

Glauberite, *Brong.* Journal des Mines, t. xxiii. p. 5. *Id. Haüy*, Tabl. p. 23. *Id. Lenz*, b. ii. s. 950. *Id. Aikin*, p. 139.

External Characters.

Its colours are greyish-white, and wine-yellow.

It

It occurs crystallized, in very low oblique four-sided prisms, the lateral edges of which are 104° 28′ and 75° 32′, and in which the terminal planes are set on obliquely.

The crystals occur singly, or in groups.

The lateral planes are transversely streaked; the terminal planes are smooth.

It is shining.

The fracture parallel with the terminal planes and edges is foliated; in other directions it is conchoidal.

It is softer than calcareous-spar.

It is transparent.

It is brittle.

Specific gravity 2.700.

Chemical Characters.

It decrepitates before the blowpipe, and melts into a white enamel. In water it becomes opaque, and is partly soluble.

Constituent Parts.

Dry Sulphate of Lime,	49.0
Dry Sulphate of Soda,	51.0
	100.0

Brongniart, J. des Mines, t. xxiii. p. 17.

Geognostic and Geographic Situations.

It is found imbedded in rock-salt at Villaruba, near Ocana in New Castile, in Spain.

Observations.

It was brought from Spain to Paris by M. Dumeril, and first analysed and described by Brongniart.

2. Axifrangible

2. Axifrangible Gypsum.

Axentheilendes Gyps-Haloide, *Mohs.*

This species contains six subspecies, viz. Sparry Gypsum or Selenite, Foliated Granular Gypsum, Compact Gypsum, Fibrous Gypsum, Scaly Foliated Gypsum, and Earthy Gypsum. * Montmartrite.

First Subspecies.

Sparry Gypsum or Selenite.

Fraueneis, *Werner.*

Lapis specularis, *Plin.* Hist. Nat. xxxvi. 22. 145.—Gypsum selenites, *Wall.* t. i. p. 165.—Selenite, *Romé de Lisle,* t. i. p. 441.—Fraueneis, *Wern.* Cronst. s. 53.—Broad foliated Gypsum, *Kirw.* vol. i. p. 123.—Fraueneis, *Emm.* b. i. s. 540.—Chaux sulphatée cristallisée, *Haüy,* t. ii. p. 266.—La Selenite, *Broch.* t. i. p. 609.—Spathiger Gyps, *Reuss,* b. ii. 2. s. 406.—Fraueneis, *Lud.* b. i. s. 164. *Id. Suck.* 1r th. s. 675.—Grossblättriger Gyps, *Bert.* s. 109.—Fraueneis, *Mohs,* b. ii. s. 183. *Id. Hab.* s. 84.—Spathiger Gyps, *Leonhard,* Tabel. s. 37.—Chaux sulphatée Selenite, *Brong.* t. i. p. 171.—Spathiger Gyps, *Karsten,* Tabel. s. 52. *Id. Haus.* s. 124.—Selenite, *Kid,* vol. i. p. 66.—Gyps-spath, *Lenz,* b. ii. s. 840.—Durchschtiger Gyps, *Oken,* b. i. s. 400.—Spathiger Gyps, *Haus.* Handb. b. iii. s. 887.—Fraueneis, *Hoff.* b. iii. s. 117.—Selenite, *Aikin,* p. 167.

External Characters.

Its colours are smoke-grey, greyish-white, snow-white, greenish-

greenish-white, and yellowish-white, and also wax-yellow, pale ochre-yellow, and yellowish-brown. Sometimes it is dark-brown, owing to intermixed stinkstone. Some varieties display iridescent colours.

It occurs massive, coarsely disseminated, also in distinct concretions, which are large and coarse granular, and sometimes inclining to thick lamellar; and crystallized.

Its primitive figure is an oblique four-sided prism, in which the angles are 113° 8′, and 66° 52′. The following are some of the secondary figures:

1. Six-sided prism *, generally broad and oblique angular, with two opposite broad, and four smaller lateral planes; or with two opposite very small, and four broader planes; or with alternate broader and narrower lateral planes: the terminal planes or faces are conical or spherical convex, or obtusely bevelled, and the bevelling planes set on obliquely, but parallelly on the broader lateral planes †; or acuminated with four planes, which are set on the smaller lateral planes ‡.
2. Lens.
3. Twin-crystals. These are either formed by two lenses, which are attached by their faces, or by two six-sided prisms pushed into each other in the direction of their breadth, in such a manner, that the united summits at one extremity form a re-entering angle, but at the other a salient angle, or four-planed acumination. When two such twin-crystals

* The primitive figure, according to Haüy, is a four-sided prism, whose bases are oblique parallelograms, with angles of 113° 7′ 48″ and 66° 52′ 12″.

† Chaux sulphatée trapezienne, Haüy.

‡ Chaux sulphatée equivalente, Haüy.

crystals are pushed into each other in the direction of their length, a

4. Quadruple crystal is formed.

The crystals occur of all degrees of magnitude, and are often long and acicular.

The lateral planes of the prism are sometimes smooth, sometimes longitudinally streaked, and shining; the convex terminal faces, and the lens, are rough and dull.

Internally the lustre is splendent and pearly.

The cleavage is three-fold; the most distinct cleavage is perpendicular to the axis of the prism; the other two are parallel with the lateral planes of the primitive prism. The cleavages are generally straight, and sometimes curved.

The fragments are rhomboidal, in which two of the sides are smooth and splendent, and four are streaked and shining.

It alternates from semi-transparent to transparent, and in the latter case is observed to refract double.

It yields readily to the nail; scratches talc, but not calcareous-spar.

It is sectile.

It is very easily frangible.

In thin pieces it is flexible, but not elastic.

Specific gravity, 2.322, *Muschenbröck*—2.3065, 2.3117, 2.3846, *Kopp.*—2.2, 2.4, *Mohs.*

Chemical Characters.

It exfoliates before the blowpipe, and, if the flame is directed towards the edge of the folia, it melts into a white enamel, which, after a time, falls into a white powder.

Constituent

Constituent Parts.

Lime,	- -	33.9
Sulphuric Acid,	-	43.9
Water,	- -	21.0
Loss,	- -	2.1
		100.0

Bucholz, in Gehlen's Journ. b. v. s. 158.

Geognostic Situation.

It occurs principally in the secondary or flœtz gypsum formation, in thin layers: less frequently in rock-salt; more rarely as a constituent part of metalliferous veins; but in considerable quantity in that deposite known in the south of England under the name Blue or London Clay. Crystals of this substance are daily forming in gypsum hills, in old mines, and in mining heaps.

Geographic Situation.

It is not unfrequent in the blue clay in the south of England, as at Shotover Hill, near Oxford; Newhaven, Sussex; Isle of Shepey in the Medway; and at Alston in Cumberland. It occurs in the secondary gypsum around Paris; in veins of copper-pyrites and grey copper-ore, at Herrengrund, near Newsohl; in a vein of galena or lead-glance at Teschen, in Bohemia; and all over the Continent of Europe, and in other quarters of the globe where foliated granular gypsum occurs.

Uses.

At a very early period, before the discovery of glass, selenite was used for windows; and we are told, that in the time

time of Seneca, it was imported into Rome from Spain, Cyprus, Cappadocia, and even from Africa. It continued to be used for this purpose until the middle ages; for Albinus informs us, that in his time, the windows of the dome of Merseburg were of this mineral. The first greenhouses, those invented by Tiberius, were covered with selenite. According to Pliny, bee-hives were incased in selenite, in order that the bees might be seen at work. It is used for the finest kind of stucco, and the most delicate pastil-colours. When burnt, and perfectly dry, it is used for cleansing and polishing precious stones, work in gold and silver, and also pearls. It was formerly much used by Roman Catholics for *frosting* the images of the Virgin Mary: hence the names *Glacies Mariæ* or *Frauen-glas* given to it. It has also been named *Lapis specularis*, and *Gypsum speculare* and *glaciale*, from its resemblance to glass or ice.

Second Subspecies.

Foliated Granular Gypsum.

Blættriger Gyps, *Werner.*

Gypsum lamellare, *Wall.* t. i. p. 165.—Blættriger Gyps, *Wid.* s. 548.—Granularly Foliated Gypsum, *Kirw.* vol. i. p. 123.—Blættriger Gyps, *Estner,* b. ii. s. 1109. *Id. Emm.* b. i. s. 532.—Gesso lamellare, *Nap.* p. 381.—Le Gyps lamelleux, *Broch.* t. i. p. 606.—Körniger Gyps, *Reuss,* b. ii. 2. s. 400.—Blættriger Gyps, *Lud.* b. i. s. 163. *Id. Suck.* 1r th. s. 673. *Id. Bert.* s. 107. *Id. Mohs,* b. ii. s. 180.—Körnigblättriger Gyps, *Hab.* s. 85.—Körniger Gyps, *Leonhard,* Tabel. s. 37. *Id. Karst.* Tabel. s. 52.—Schupiger Gyps, *Haus.* s. 125.—Körniger

ger & Klein blättriger Gyps, *Lenz*, b. ii. s. 838. *Id. Hoff.* b. iii. s. 110.—Massive Gypsum, with a granularly lamellar structure, *Aikin*, p. 168.

External Characters.

Its most common colours are white, grey, and red; seldomer yellow, brown, and black. The white colours are, snow, greyish, yellowish, and reddish white; from reddish-white, it passes into flesh-red, blood-red, and brick-red; the greyish-white passes into ash-grey, and smoke-grey, and greyish-black; and the yellowish-grey passes into wax-yellow. It seldom occurs of a hair-brown colour, and this only when it is intermixed with stinkstone. The colours sometimes occur in spotted, striped, and veined delineations.

It occurs massive, also in distinct concretions, which are large, coarse, small, and fine angulo-granular, seldom prismatic, and these are broad, narrow, short, wedge-shaped, scopiform or stellular. It is sometimes crystallized, in small conical lenzes, in which the surface is rough.

The lustre passes from shining through glistening to glimmering, and is pearly.

It has the same cleavage as selenite.

The fragments are very blunt-edged.

It is translucent.

It is very soft.

It is sectile, and very easily frangible.

Specific gravity, 2.2741, 2.3108, *Brisson*.

Constituent

Constituent Parts.

Lime, - -	32
Sulphuric Acid, -	30
Water, - -	38
	—
	98 *Kirwan.*

A reddish-white variety, found near Lüneburg, according to Hausmann, afforded, besides Sulphate of Lime, 4 parts of Muriate of Lime.—*Haus.* Nord. Deutsch. Beit. st. ii. s. 98.

Geognostic Situation.

It occurs in beds in primitive rocks, as gneiss and mica-slate: in a similar repository in transition clay-slate; but most abundantly in beds in the rocks of the secondary or flœtz class. In these rocks it is associated with selenite, compact gypsum, fibrous gypsum, rock-salt, stinkstone, and limestone.

Geographic Situation.

Europe.—It occurs in Cheshire and Derbyshire; at the Segeberg, near Kiel; and at Lüneburg, where it contains crystals of boracite, and sometimes of quartz. It is associated with flœtz rocks in Thuringia, Mansfeldt, Silesia, Suabia, Bavaria, Austria, Switzerland, the Tyrol, Poland, Spain, and France. At Airolo, in the St Gothard group, it occurs in beds in gneiss; at St Meul in the Valais, it alternates with hornblende-slate; and with mica-slate on Mount Cenis: in Salzburg, it is associated with transition limestone, and clay-slate, and there it sometimes contains sparry

sparry gypsum or selenite, and also grey copper-ore, copper-pyrites, iron-pyrites, galena, and cinnabar.

Asia.—It is found in Persia, Caramania, and in different parts of Siberia; both in flœtz and primitive mountains. Pallas mentions his having met with granular gypsum, along with mica, serpentine, and felspar, in Siberia.

America.—It is found near Athapuscau Lake, where rock-salt occurs; also in the United States of America; in Nova Scotia; and at the foot of the Andes, in South America.

Uses.

The foliated and compact subspecies of gypsum, when pure, and capable of receiving a good polish, are by artists named simply *Alabaster*, or, to distinguish them from calc-sinter, or what is called calcareous alabaster, *Gypseous Alabaster*. The finest white varieties of granular gypsum, are selected by artists for statues and busts: the variegated kinds are cut into pillars, and various ornaments for the interior of halls and houses; and the most beautiful variegated sorts are cut into vases, columns, plates, and other kinds of table furniture. Those varieties that contain imbedded portions of selenite, when cut across, exhibit a beautiful iridescent appearance, and are named *Gypseous Opal*. In Derbyshire, and also in Italy, the very fine granular varieties, are cut into large vases, columns, watch-cases, plates, and other similar articles. If a lamp is placed in a vase of snow-white translucent gypsum, a soft and pleasing light is diffused from it through the apartment. It is said the ancients being acquainted with this property, used gypsum in place of glass, in order that the light in their temples might be pale and mysterious, and in harmo-

ny

ny with the place. The *phengites* of the ancients would appear to have been foliated gypsum. According to Pliny, it was employed instead of glass in windows, on account of its translucency; and in the Temple of Fortune, and the gilded palace of Nero, the chambers were lined with the finest and most highly prized kinds of phengites. Domitian, who, towards the close of his life became suspicious and distrustful of all around him, had the portico in which he used to walk lined with phengites, in order that he might see what was passing behind him. Both subspecies are used in agriculture. Much difference of opinion has prevailed among agriculturists with respect to the uses of gypsum. It is said to have been very advantageously employed in America; and also in the county of Kent: but it has failed in most of the other counties of England, though tried in various ways, and for different crops. When peat-ashes contain a considerable portion of gypsum, they may be advantageously employed as a top-dressing for cultivated grasses, on such soils as contain little or no sulphate of lime. The pure white varieties of granular gypsum are used as ingredients in the composition of earthen-ware and porcelain; and the glaze or enamel with which porcelain is covered, has the purest gypsum, or even selenite, as one of its ingredients. Its most important use is in the preparation of *stucco:* for this purpose, the gypsum is first exposed to a heat sufficient to drive off its water of crystallization, then finely ground, mixed with a small portion of fine sand and quicklime, and, lastly, a determinate proportion of water is added, which occasions the compound first to swell, and then to contract and harden. Stucco is sometimes used for lining walls and roofs of apartments, in place of common plaster;

ter; and occasionally for covering the floors of summer-houses or churches. The finest kind of stucco is used for casts of figures, and statues of various kinds. Artificial coloured marbles are also made of stucco, which are used for covering pillars, walls, altars, pavements of churches, or halls.

Observations.

1. Its inferior weight and hardness distinguish it from *Dolomite* and *Granular Foliated Limestone.*

2. It has frequently a porphyritic structure; the imbedded minerals are generally crystals of quartz; sometimes crystals of Arragonite, as in certain Spanish varieties, and rarely crystals of Boracite.

Third Subspecies.

Compact Gypsum.

Dichter Gyps, *Werner.*

Gypsum alabastrum, et Gypsum æquabile, *Wall.* t. i. p. 161, 162.—Dichter Gyps, *Wid.* s. 544.—Compact Gypsum, *Kirw.* vol. i. p. 121.—Dichter Gyps, *Estner,* b. ii. s. 1098. *Id. Emm.* b. i. s. 529.—Gesso compatto alabastro, *Nap.* p. 384.—Alabastrite, *Lam.* t. ii. p. 76.—Chaux sulphatée compacte, *Haüy,* t. ii. p. 266.—Le Gypse compacte, *Broch.* t. i. p. 602.—Dichter Gyps, *Reuss,* b. ii. 2. s. 393. *Id. Lud.* b. i. s. 163. *Id. Suck.* 1r th. s. 670. *Id. Bert.* s. 105. *Id. Mohs,* b. ii. s. 179. *Id. Hab.* s. 86.—Chaux sulphatée compacte, *Lucas,* p. 13.—Dichter Gyps, *Leonhard,* Tabel. s. 37.—Chaux sulphatée Gypse compacte, *Brong.* t. i. p. 174.—Chaux sulphatée compacte,

pacte, *Brard*, p. 52.—Dichter Selenit, *Haus.* s. 125.—Dichter Gyps, *Karsten*, Tabel. s. 52.—Chaux sulphatée compacte, *Haüy*, Tabl. p. 10.—Dichter Gyps, *Lenz*, b. ii. s. 834. *Id. Hoff.* b. iii. s. 108.—Massive Gypsum, *Aikin*, p. 168.

External Characters.

Its colours are snow, yellowish, reddish, and greyish white; smoke, yellowish, ash, bluish and greenish grey, pale sky-blue, and violet-blue; a colour intermediate between brownish and brick red, seldom flesh-red; sometimes honey-yellow. Frequently several colours occur in the same piece, and these are either spotted, flamed, striped, or veined.

It occurs massive.

It is generally dull, seldom feebly glimmering.

The fracture is fine splintery, passing on the one side into even, on the other into fine-grained uneven.

The fragments are indeterminate angular, and blunt-edged.

It is translucent on the edges.

It is very soft; sectile; and easily frangible.

Specific gravity, 2.1679, before absorption of water; 2.2052, after absorption of water, *Brisson*.—2.288, *Kirwan*.—2.287, *Breithaupt*.

Chemical Characters.

All the different varieties of gypsum, when exposed to heat, are deprived of their water of crystallization, become opaque, fall into a powder, which, when mixed with water, speedily hardens on exposure to the air. They are difficultly fusible before the blowpipe, without addition, and melt into a white enamel: when heated with charcoal, they are converted into sulphuret of lime.

Constituent Parts.

Lime, - -	34	
Sulphuric Acid, -	48	
Water, -	18	
	100	*Gerhard.*

Geognostic Situation.

It occurs in beds, along with granular gypsum, selenite, and stinkstone, in the flœtz or secondary class of rocks.

Geographic Situation.

It occurs in the Campsie Hills; Derbyshire; Ferry-bridge in Yorkshire; and Nottinghamshire: on the Continent, in Mansfeldt, Thuringia, Bavaria, Switzerland, and France.

Observations.

Its inferior hardness, and inferior specific gravity, distinguish it from *Compact Limestone.* Its warmer feel also distinguishes it well (when both are polished) from Compact Limestone.

Fourth

Fourth Subspecies.

Fibrous Gypsum.

Fasriger Gyps, *Werner.*

Gypsum striatum, *Wall.* t. i. p. 167.—Fasriger Gyps, *Wid.* s. 546.—Fibrous Gypsum, *Kirw.* vol. i. p. 122.—Fasriger Gyps, *Estner,* b. i. s. 1105. *Id. Emm.* b. i. s. 536.—Gesso fibroso, *Nap.* p. 386.—Chaux sulphatée fibreuse, *Haüy,* t. ii. p. 266.—La Gypse fibreuse, *Broch.* t. i. p. 604.—Fasriger Gyps, *Reuss,* b. ii. 2. s. 396. *Id. Suck.* 1r th. s. 678. *Id. Bert.* s. 106. *Id. Mohs,* b. ii. s. 182.—Chaux sulphatée fibreuse, *Lucas,* p. 13.—Fasriger Gyps, *Leonhard,* Tabel. s. 37.—Chaux sulphatée Gypse fibreuse, *Brong.* t. i. p. 174.—Chaux sulphatée fibreuse, *Brard,* p. 52.—Fasriger Gyps, *Karsten,* Tabel. s. 52. *Id. Haus.* s. 125.—Fibrous Gypsum, *Kid,* vol. i. p. 65.—Chaux sulphatée fibreuse-conjointe, *Haüy,* Tabl. p. 10.—Fasriger Gyps, *Lenz,* b. ii. s. 844. *Id. Hoff.* b. iii. s. 115.—Fibrous Gypsum, *Aikin,* p. 168.

External Characters.

Its principal colours are white, grey, and red; of white, it possesses the following varieties, viz. yellowish, greyish, snow, and reddish white; from reddish-white it passes into brick-red, flesh-red, and brownish-red; the yellowish-white passes into yellowish-grey, wine-yellow, and honey-yellow.

Sometimes several colours occur together in the same specimen.

It occurs massive, and dentiform; also in fibrous distinct concretions, which are parallel, generally straight, and sometimes curved.

Its

Its lustre passes from glistening, through shining to splendent, and is pearly.

The fragments are long splintery.

It is translucent.

It is very soft, sectile; and easily frangible.

Constituent Parts.

Lime, - -	33.00
Sulphuric Acid, -	44.13
Water, - -	21.00
	98.13

Bucholz, N. Allg. Journ. d. Chem. b. v. H. ii. s. 160.

Geognostic Situation.

It occurs along with the other subspecies of this species.

Geographic Situation.

It occurs in red sandstone near Moffat; in red clay, on the banks of the Whitadder in Berwickshire; in Dunbartonshire; also in Cumberland, Yorkshire, Cheshire, Worcestershire, Derbyshire, Somersetshire, and Devonshire *. On the Continent of Europe, it is met with in Thuringia, Mansfeldt, Bavaria, Salzburg, Switzerland, France, &c.

Uses.

When cut *en cabachon*, and polished, it reflects a light not unlike that of the cat's-eye, and is sometimes sold as that

* Greenough.

that stone. It is also cut into necklaces, ear-pendants, and crosses; and in this form, it is also sold for a harder mineral, the Fibrous Limestone, or even imposed on the ignorant for that variety of felspar named Moonstone.

Observations.

It might be confounded with Fibrous Limestone, and Asbestus, but is readily distinguished from these minerals by its inferior hardness, and the alteration it undergoes at a low red heat.

Fifth Subspecies.

Scaly Foliated Gypsum.

Schaumgyps, *Werner.*

Schaumgyps, *Hoff.* b. iii. s. 106.—Chaux sulphatée niviforme, *Haüy.*

External Characters.

Its colours are yellowish-white and snow-white.

It occurs massive and disseminated; also in distinct concretions, which are small and scaly granular.

Internally it is glistening and pearly.

The fracture is small scaly foliated.

The fragments are indeterminate angular and blunt-edged.

It is opaque, or translucent on the edges.

It is very soft, passing into friable.

It is sectile, and easily frangible.

Geognostic

Geognostic and Geographic Situations.

It occurs along with selenite and compact gypsum at Montmartre, near Paris, in that formation of gypsum named by Werner the third or yellow flœtz gypsum formation.

Observations.

This subspecies is characterized by its scaly foliated aspect.

Sixth Subspecies.

Earthy Gypsum.

Gyps-erde, *Werner.*

Gypsum terrestre farinaceum; Farina fossilis, *Wall.* t. i. p. 36.—Gypserde, *Wid.* s. 543.—Farinaceous Gypsum, *Kirw.* vol. i. p. 120.—Gypserde, *Estner,* b. ii. s. 1095. *Id. Emm.* b. i. s. 527.—Gesso terroso, *Nap.* p. 379.—Le Gypse terreux, *Broch.* t. i. p. 601.—Chaux sulphatée terreuse, *Haüy,* t. ii. p. 278.—Erdiger Gyps, *Reuss,* b. ii. 2. s. 391. *Id. Lud.* b. i. s. 163. *Id. Suck.* 1r th. s. 669. *Id. Bert.* s. 105. *Id. Mohs,* b. ii. s. 178.—Chaux sulphatée terreuse, *Lucas,* p. 13.—Erdiger Gyps, *Leonhard,* Tabel. s. 37.—Chaux sulphatée, Gypse terreux, *Brong.* t. i. p. 174.—Chaux sulphatée terreuse, *Brard,* p. 52.—Erdiger Selenit, *Haus.* s. 125.—Erdiger Gyps, *Karsten,* Tabel. s. 52.—Farinaceous Gypsum, *Kid,* vol. i. p. 65.—Chaux sulphatée terreuse, *Haüy,* Tabl. p. 10.—Gypserde, *Lenz,* b. ii. s. 833. *Id. Hoff.* b. iii. s. 107.—Earthy Gypsum, *Aikin,* p. 168.

External Characters.

Its colour is yellowish-white, which passes into yellowish-grey, and sometimes inclines to snow-white.

It

It is composed of fine scaly or dusty particles, which are more or less cohering.

It is feebly glimmering.

It feels meagre, and rather fine.

It soils slightly.

It is light.

Geognostic Situation.

It is found immediately under the soil, in beds several feet thick, resting on gypsum, and also in nests or cotemporaneous masses imbedded in it. It is conjectured to have been formed in some instances by the decay of previously existing gypsum beds; in others, it appears to be an original deposite, of cotemporaneous formation with the solid kinds of gypsum.

Geographic Situation.

It is found in Saxony, Switzerland, Salzburg, and Norway.

Use.

In some districts, it is used as a manure.

Observations.

1. It is distinguished from *Agaric Mineral* by its colour, scaly particles, and its soiling feebly; and from *Earthy Heavy-spar*, by its inferior specific gravity.

2. It is the *Himmels-mehl* and *Gyps-guhr* of some authors.

* Montmartrite.

* Montmartrite.

Chaux sulphatée calcarifère, *Lucas & Haüy.*

Gypsum of Montmartre.

External Characters.

Its colour is yellowish.
It occurs massive, but never crystallized.
It is soft.
It effervesces with nitric acid.

The Montmartrite is composed of gypsum and carbonate of lime. This carbonate is converted into quicklime in the furnace, and thus a kind of mortar is made: it is on this account, that the *plaster* made of this mineral may be used in work exposed to the weather; while that of pure gypsum, on exposure, soon yields to the action of rain.

The montmartrite contains, about

Sulphate of Lime, - -	83
Carbonate of Lime, - -	17
	100

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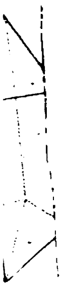

Fig 9

Fig. 1

SYSTEM

OF

MINERALOGY.

A

SYSTEM

OF

MINERALOGY,

IN WHICH

MINERALS ARE ARRANGED ACCORDING TO THE NATURAL HISTORY METHOD.

BY

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MINERAL

MINERAL SYSTEM.

CLASS II.

SALINE MINERALS.

ORDER I.—*FOSSIL SALTS.*

GENUS I.—ROCK-SALT.

Steinsalz, *Werner & Mohs.*

THIS Genus contains one Species, viz. Hexahedral Rock-Salt.

1. Hexahedral Rock-Salt.

Hexaedrisches Steinsalz, *Mohs.*

This Species is divided into two Subspecies, viz. Rock-Salt and Lake-Salt.

First Subspecies.

Rock-Salt.

Steinsalz, *Werner.*

This Subspecies is divided into two kinds, viz. Foliated Rock-Salt and Fibrous Rock-Salt.

First Kind.

Foliated Rock-Salt.

Blättriches Steinsalz, *Werner.*

Sal, *Plin.* Hist. Nat. xxxi. 7. s. 39 (in part).—Muria fossilis pura; Sal gemmæ, *Wall.* t. ii. p. 53.—Sel marin et Sel gemme, *Romé de Lisle,* t. i. p. 374.—Blättriches Steinsalz, *Wern.* Pabst. b. i. s. 361.—Lamellar Sal Gem, *Kirw.* vol. ii. p. 32.—Blättriches Steinsalz, *Estner,* b. iii. s. 63. *Id. Emm.* b. i. s. 19. —Soude muriatée cristallisée, et Soude muriatée amorphe, *Haüy,* t. ii. p. 356. 365.—Le Sel Gem lamelleux, *Broch.* t. ii. p. 21.—Blättriches Steinsalz, *Reuss,* b. iii. s. 30. *Id. Leonhard,* Tabel. s. 44. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 121.—Soude muriatée laminaire, *Haüy,* Tabl. p. 20.—Blättriches Steinsalz, *Lenz.* b. ii. s. 975. *Id. Hoff.* b. iii. s. 223. *Haus.* b. iii. s. 844.—Common Salt, *Aikin,* p. 251.

External Characters.

Its most common colours are white and grey. Of white, it occurs greyish, yellowish, and milk-white; but it seldom approaches to snow-white. Of grey, ash, smoke, and pearl grey. From pearl-grey it passes, though rarely, into flesh, blood, and brick red. Still seldomer do we observe

serve the white varieties marked with Berlin, azure, violet, or lavender blue spots or patches.

It is said also to occur ochre-yellow, wine-yellow, and emerald-green.

It occurs massive, disseminated, in minute veins, in crusts, plates, and stalactitic; also in distinct concretions, which are large, coarse, small, and fine angulo-granular, and these sometimes incline to prismatic *.

It occurs crystallized in cubes. Sometimes the cubes appear as *thick rectangular four-sided tables*, owing to two opposite lateral planes becoming very large in comparison of the others. In other crystals, the figure is that of a *rectangular four-sided prism*, which is produced by two opposite planes of the cube becoming smaller than the others.

On the fresh fracture it is shining or splendent, and the lustre is resinous.

It has a threefold rectangular cleavage, the folia parallel with the planes of the cube.

The fracture is conchoidal.

The fragments are cubic.

In general it is strongly translucent, sometimes semi-transparent and transparent.

It is as hard as gypsum, or even harder, but not so hard as calcareous-spar.

It feels rather greasy.

It is rather brittle, and easily frangible.

It has a saline taste.

Specific gravity, 2.143, 2.2, *Hassenfratz*.—2.1, 2.2, *Mohs*.

* Some authors describe rock-salt in globular and columnar concretions.

Second Kind.

Fibrous Rock-Salt.

Fasriges Steinsalz, *Werner.*

Fariges Steinsalz, *Wern.* Pabst. b. ii. s. 363.—Fibrous Sal Gem, *Kirw.* vol. ii. p. 25.—Fasriges Steinsalz, *Estner,* b. iii. s. 71. *Id. Emm.* b. ii. s. 23.—Le Sel Gem fibreuse, *Broch.* t. ii. p. 25. Soude muriatée fibreuse, *Haüy,* t. ii. p. 356. 365.—Fasriges Steinsalz, *Reuss,* b. iii. s. 27. *Id. Leonhard,* Tabel. s. 45. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 121.—Soude muriatée fibreuse-conjointe, *Haüy,* Tabl. p. 20.—Fasriges Steinsalz, *Lenz,* b. ii. s. 979. *Id. Haus.* Handb. b. iii. s. 844. *Id. Hoff.* b. iii. s. 229.—Fibrous Common Salt, *Aikin,* p. 252.

External Characters.

Its colours are greyish, yellowish and snow white; from these it passes into ash and smoke grey; more rarely it is marked with stripes of flesh red, violet, sky, and Berlin blue.

It occurs massive, and dentiform; also in distinct concretions, which are coarse and fine, and straight and curved fibrous.

Internally it is shining and glistening, and the lustre is resinous.

The fragments are splintery.

It is strongly translucent, verging on semi-transparent.

In other characters it resembles the preceding kind.

Chemical Characters.

It decrepitates briskly when exposed to the action of the blowpipe, or when laid on burning coals.

Constituent

Constituent Parts.

Cheshire Rock-Salt.		
Muriate of Soda,	-	$983\frac{1}{4}$
Sulphate of Lime,	-	$6\frac{1}{2}$
Muriate of Magnesia,	-	$0\frac{5}{16}$
Muriate of Lime,	-	$0\frac{1}{16}$
Insoluble matter,	-	10
		1000.0

Henry, in Philosophical Transactions for 1810, part i. p. 97.

Geognostic Situation.

It is sometimes found in transition gypsum in the transition-slate of the Allee Blanche, and between grey-wacke and black transition limestone near Bex, below the Dent de Chamossaire; in alpine limestone, at Hall in the Tyrol; but the greatest formation is that in muriatiferous clay, in which the salt occurs, either disseminated, or in beds, alternating with the clay, or in vast irregular masses included in it. In this formation, the salt is occasionally associated with thin layers of anhydrite, stinkstone, limestone, and sandstone. Humboldt mentions a formation of rock-salt in muriatiferous clay, lying on a very new sandstone, at Punta Araya in America *; and small quantities of it occur in the flœtz gypsum in the Segeberg, near Kiel in Holstein.

Geographic

* Humboldt's Personal Narrative, vol. ii. p. 269.

Geographic Situation.

Europe.—The principal deposite of salt in this island is that in Cheshire, where there are several beds that vary in thickness from four feet to upwards of one hundred and thirty feet, and alternate with clay and marl, which contain compact, foliated, granular, and radiated gypsum. Rock-salt also occurs at Droitwich in Worcestershire.

In the north of Germany, rocks of the salt formation and salt springs occur,—an evidence of the existence of salt beds, as all salt springs issue from salt beds, or rocks richly impregnated with salt; but no salt-beds appear at the surface until we come to the Circle of Austria, and the neighbouring countries. The range of salt beds commences at Hall in the Tyrol *, passes through Reichenthal in Bavaria, continues to Hallein in Salzburg, Hallstadt, Ischel, and Ebensee in Austria, and terminates at Aussee in Stiria. The further continuation of the salt deposition is found at a considerable distance, that is, in Hungary, at Marmoros, Rhona, Szek, and Speries: then again in the great inclosed circular valley of Transylvania; from thence it extends through Wallachia, Moldavia, Buckovina, Gallicia, to Upper Silesia.

The salt repository of Marmoros is well known. In Transylvania, which is a vast circular valley, having its bottom covered with salt, there are many extensive salt-works: in Moldavia there are also numerous salt-mines; and, what is worthy of remark, the rock-salt itself there forms

* At Sulzbach, on the Neeker, in Suabia, there is a great bed of clay richly impregnated with salt, and sometimes even containing great masses of it. This appears to be the farthest limit of the salt-beds on that side of Germany.

forms hills. The salt-mines of Wieliczka are situated about two leagues south-east of Craucau in West Gallicia, and about nine miles to the north-east of the Carpathian Mountains. They have been worked since the year 1251, and their depth and extent is very great; by some said to be 900 feet, and having an extent of more than a league from east to west. According to Abbé Estner, the salt of Hungary, Transylvania, and West Gallicia, occurs only of a grey colour. The party-coloured is found principally in Upper Austria, Salzburg, Stiria, and the Tyrol *. The beautiful blue foliated variety was formerly found at Ischel in Upper Austria; and the very rare green variety is at present found at Berchtesgaden and Hallein in Salzburg, where the fibrous blue variety which occurs in the Tyrol is also met with.

There are, besides, immense deposites of salt in Old and New Castile in Spain: thus, at Cordona, it is said to form a hill between 300 and 400 feet high; and in France there are salt-springs, but no salt-beds have hitherto been discovered.

Africa.—Besides the great beds of this mineral found in Europe, it is also very extensively distributed in other quarters of the globe. In the northern part of Africa, on both sides of the Atlas Mountains, vast quantities of rock-salt occur. In the valley of Egarement there are beds of rock-salt resting on gypsum. Mr Horneman, on his journey from Cairo to Ummosogeir, discovered a plain on the summit of the chain of limestone mountains that bound the Desart of Lybia to the north, consisting of a mass of rock-salt, spread over so large a tract of surface, that in one direction

* The salt-mines in the Tyrol are 5000 feet above the level of the sea.

rection no eye could reach its termination, and its width he computed at several miles. To the south-east of Abyssinia, there is a plain of rock-salt four days journey across, whence all that country is supplied *. At Tegazza, and in several other places in Sahara, very large beds of pure rock-salt occur under strata of different kinds of solid rock; and beds of salt appear at Darfur, and in the country of Congo.

Asia.—There is a considerable mine of rock-salt twenty versts from Jena-Tayerska, in the desart between the Volga and the Uralian Mountains; another named Iletzki, near Astracan; and there are several others in Siberia †. Salt-mines are worked in that part of China which borders on Tartary. At Teflis, Tauris, and other places in Persia, there are great masses of rock-salt; and we are informed, that in the Desart of Caramania, and also in Arabia, rock-salt is so abundant, and the atmosphere is so dry, that the inhabitants use it for building houses. The Island of Ormuz, situated in the mouth of the Persian Gulf, is principally composed of rock-salt. Rock-salt is one of the mineral productions of the valley of Cashmere; and in the province of Lahore in India, there is a hill of rock-salt equal to that of Cordona: the salt of this hill is cut into dishes, plates, and stands for lamps ‡.

America.—Rock-salt is found in vast quantity on the elevated Desarts of Peru, where it is very hard, and has usually

* Bruce mentions, that in some parts of Abyssinia, cubic pieces of rock-salt pass as current coin.

† Pallas speaks of rock-salt in the neighbourhood of the river Jaik, which is sometimes so hard as to snap the pick-axes made use of in quarrying it.

‡ Pennant's Outlines of the Globe, vol. i. p. 42.

usually a violet colour; also in the Cordilleras of New Granada, at the height of 2000 toises *. It occurs in considerable quantity in Upper Louisiana; and great masses of it have been found at the junction of the stream of Atha-pus-caou with the Atha-pus-caou Lake; and in California.

New Holland.—According to Governor Hunter, it is found in considerable quantity on the east coast of New Holland.

Uses.

Its uses are very various and important. We employ it daily as a seasoning for our food: vast quantities are employed for the preservation of animal flesh, butter, &c.; it is also used as a manure, in the manufacture of earthenware, soap-making, and in many metallurgic operations. It affords muriatic acid and soda, by certain chemical processes. It is sometimes employed in its crude state, but is more commonly purified.

Second Subspecies.

Lake-Salt.

Seesalz, *Werner.*

Seesalz, *Reuss,* b. iii. s. 36. *Id. Hoff.* b. iii. s. 231.—Körniges Steinsalz, *Haus.* Handb. b. iii. s. 844.

External Characters.

Its colour is greyish-white.

It

* Humboldt's Personal Narrative, vol. ii. p. 268.

It occurs in coarse and small roundish grains.

Internally it is shining or glistening, and the lustre is resinous.

The fracture is imperfect foliated.

In other characters it agrees with the other subspecies.

Geognostic and Geographic Situations.

It is found on the bottoms and sides of salt-lakes.

Europe.—It is collected in the islands of Cyprus and Milo, in the Mediterranean Sea. Nearly the half of the peninsula of the Crimea is filled with salt-lakes, which afford a great quantity of lake-salt.

Asia.—Lake-salt is collected in the neighbourhood of the Caspian.

Africa.—At Manzelach, near Alexandria, there are two salt-lakes, which afford a great quantity of fine white salt. The bottoms of the salt lakes in the land of the Hottentots and the Caffres, are so compactly covered with salt, that it appears like ice, and the grains or distinct concretions adhere so closely together, that the mass is as hard as stone. Many extensive districts are supplied with salt from the lake of Dombu, which is situated in the great Desart of Bilma, in the kingdom of Bornu.

America.—Lake-salt is collected in several of the salt lakes in North America, as in Mexico.

GEN. II.

Genus II. SAL AMMONIAC.

This genus contains one species, viz. Octahedral Sal Ammoniac. * Mascagnine.

1. Octahedral Sal Ammoniac.

Octaedrisches Salmiac Salz, *Mohs.*

Natürlicher Salmiack, *Werner.*

Sal ammoniacum, *Wall.* t. ii. p. 77.—Sal Ammoniac, *Romé de Lisle,* t. i. p. 382. *Id. De Born,* t. ii. p. 54.——Natürlicher Salmiack, *Wid.* s. 610.—Sal Ammoniac, *Kirw.* vol. ii. p. 33.—Natürlicher Salmiack, *Estner,* b. iii. s. 78. *Id. Emm.* b. ii. s. 24.—Muriate d'Ammoniac, *Lam.* t. i. p. 473.—Le Sel Ammoniaque, *Broch.* t. ii. p. 27.—Ammoniaque muriatée, *Haüy,* t. ii. p. 380. 386.—Salmiack, *Reuss,* b. iii. s. 38. *Id. Lud.* b. i. s. 180. *Id. Suck.* 2ter th. s. 180. *Id. Bert.* s. 328. *Id. Mohs,* b. ii. s. 267.—Ammoniaque muriatée, *Lucas,* p. 25.—Salmiack, *Leonhard,* Tabel. s. 45.—Ammoniac muriatée, *Brong.* t. i. p. 109.—Salmiack, *Karsten,* Tabel. s. 56. *Id. Haus.* s. 122.—Muriate of Ammonia, *Kid,* vol. ii. p. 12.—Salmiak, *Lenz,* b. ii. s. 984.—Natürlicher Salmiack, *Hoff.* b. iii. s. 219. *Id. Haus.* Handb. b. iii. s. 853.—Sal Ammoniac, *Aikin,* p. 251.

This species is divided into two subspecies, viz. Volcanic Sal Ammoniac, and Conchoidal Sal Ammoniac.

First

First Subspecies.

Volcanic Sal Ammoniac.

Vulcanischer Salmiak, *Karsten.*

External Characters.

The colours are yellowish and greyish-white; pearl-grey and smoke-grey; wine-yellow; sometimes apple-green, sulphur-yellow, and brownish-black.

It occurs in efflorescences, crusts, stalactitic, small botryoidal, tuberose, corroded, also in granular concretions, and crystallized, in the following figures:

1. Octahedron.
2. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes.
3. Cube, more or less deeply truncated on the edges.
4. Garnet or rhomboidal dodecahedron.
5. Leucite crystallization, or the double eight-sided pyramid, acuminated with four planes.

The crystals are small and very small; and their lateral planes are usually smooth.

Externally it is dull or glistening; internally shining and vitreous.

Its cleavage is in the direction of the planes of the octahedron.

It alternates from transparent to opaque.

It is harder than talc, and sometimes as hard as selenite.

It is slightly ductile, and elastic.

Specific gravity, 1.5442, *Hassenfratz.*—1.5, 1.6, *Mohs.*

Its taste is sharp and urinous.

Chemical Characters.

When moistened, and rubbed with quicklime, it gives out a pungent ammoniacal odour.

Constituent Parts.

Sal Ammoniac of Vesuvius.		
Muriate of Ammonia,	-	99.5
Muriate of Soda,	-	0.5
		100.0

Klaproth, Beit. b. iii. s. 91.

Geognostic Situation.

As its name implies, it is a volcanic production, occurring in the fissures, or on the surface of volcanic or pseudo-volcanic rocks.

Geographic Situation.

Europe.—It occurs in the vicinity of burning beds of coal, both in Scotland and England. It is found in the Island of Iceland. On the Continent, it is met with at Solfatara, Vesuvius, Ætna, the Lipari Islands, and Tuscany.

Asia.—Thibet, Persia, and the Isle of Bourbon.

America.—In volcanic districts both in North and South America.

Second

Second Subspecies.

Conchoidal Sal Ammoniac.

Muschlicher Salmiak, *Karsten*.

External Characters.

Its colour is greyish-white.
It occurs in angular pieces.
Its surface is uneven.
Externally it is glimmering; internally it is shining and vitreous.
The fracture is nearly perfect conchoidal.
The fragments are indeterminate angular.
It is semi-transparent or transparent.
It is malleable.
It is soft.
It is light.
Its taste is pungent and urinous.

Constituent Parts.

Muriate of Ammonia,	-	97.50
Sulphate of Ammonia,	-	2.50
		100

Klaproth, Beit. b. iii. s. 94.

Geognostic and Geographic Situations.

This mineral is said to occur, along with sulphur, in rocks of indurated clay or clay-slate, in the country of Bucharia.

Uses.

Uses.

This salt is used for a variety of purposes. Great quantities of artificial sal ammoniac are annually exported from this country to Russia, where it appears to be used by the dyers. It is employed by coppersmiths, to prevent the oxidation of the surface of the metals they are covering with tin. It has the property of rendering many metallic oxides volatile, and is frequently used to separate metals from each other. Dissolved in nitric acid, it forms the fluid named *aqua regia*, employed in the solution of gold; and pure ammonia is also obtained from this salt.

Observations.

It is an opinion entertained by many, that this salt is the same with the sal ammoniac (ἁλς ἀμμωνιακος) of the ancients; but the accounts of Pliny, Dioscorides, Collumella, Synesius, Herodotus, Strabo, and Arrian, prove that they understood by sal ammoniac rock-salt; and even the ancient Arabian physicians Avicenna and Serapion, who flourished during the eleventh century, describe rock-salt under the name sal ammoniac. The first account we have of sal ammoniac is in a treatise of Geber's, the date of which is uncertain.—Vid. Beckman, Beiträge zur Geschichte der Erfindungen, b. v. s. 254,—285.

* Mascagnine,

* Mascagnine (a), or Sulphate of Ammonia.

Mascagnin, *Karsten.*

Mascagnin, *Reuss,* b. ii. 3. s. 45. *Id. Karsten,* Tabel. s. 56.—Ammoniaque sulphatée, *Haüy,* Tabl. p. 21.—Mascagnin, *Lenz,* b. ii. s. 985.

External Characters.

Its colours are yellowish-grey and lemon-yellow.
It occurs in mealy crusts, or stalactitic.
Internally it is dull or glistening.
The fracture is uneven or earthy.
It is semi-transparent or opaque.
Its taste is sharp and bitter.

Chemical Characters.

It is easily soluble in water; partly volatilised by heat; and becomes moist on exposure to the air.

Constituent Parts.

It is a compound of Ammonia, Sulphuric Acid, and Water.

Geognostic and Geographic Situations.

It occurs among the lavas of Ætna, and Vesuvius; in the Solfatara by Puzzæolo; in the lagunes, near Siena in Tuscany; and on the bottom of a hot spring in Dauphiny.

GEN. III.

(a) It is named after the discoverer M. Mascagni.

Genus III. VITRIOL.

This Genus contains three species, viz. 1. Rhomboidal Vitriol, or Green Vitriol, 2. Prismatic Vitriol, or Blue Vitriol, 3. Pyramidal Vitriol, or White Vitriol. * Red Vitriol.

1. Rhomboidal Vitriol, or Green Vitriol.

Rhomboedrisches Vitriol Salz, *Mohs.*

Eisen Vitriol, *Werner.*

Στυπτηρια of the Greeks.—Alumen, *Plin.* xxxv. 15. p. 52.—Chalcanthum, *Plin.* ?—Vitriolum ferri, *Waller.* Syst. Min. ii. p. 22.—Fer sulphatée, *Haüy,* t. iv. p. 122.—Eisen Vitriol, *Reuss,* b. ii. 3. s. 68. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 137.—Sulphat of Iron, *Kid,* vol. ii. p. 20.—Eisenvitriol, *Lenz,* b. ii. s. 989.—Green Vitriol, *Aikin,* p. 250.

External Characters.

Its colours are emerald, apple, and verdigris green, and sometimes grass-green: on exposure to the weather, it becomes straw-yellow, cream-yellow, ochre-yellow, and yellowish-brown.

It occurs pulverulent, massive, disseminated, stalactitic, tuberose, botryoidal, reniform, in fibrous distinct concretions, and crystallized.

The primitive figure is a rhomboid with edges of 81° 23′ and 98° 37′, and plane angles of 100° 10′, and 79° 50′. The diagonally opposite apices of this rhomboid are sometimes truncated; occasionally all the angles, or the angles and edges, are truncated.

It is shining both externally and internally, and the lustre is vitreous, with exception of the fibrous varieties, which are pearly.

Its cleavage is threefold, and in the direction of the planes of the rhomboid.

The fracture is flat conchoidal.

It alternates from semi-transparent to opaque.

It refracts double.

It is as hard as gypsum.

It is friable, brittle, and easily frangible.

Specific gravity, 1.9, 2.0, *Mohs*.

It tastes sweetish, styptic, and metallic.

Chemical Character.

Before the blowpipe, on charcoal, it becomes magnetic, and colours glass of borax green.

Constituent Parts.

Oxide of Iron,	-	25.7
Sulphuric Acid,	-	28.9
Water,	-	45.4
		100.0 *Berzelius*.

Geognostic and Geographic Situations.

It is always associated with iron-pyrites, by the decomposition of which it is formed. It occurs in several coal-mines

mines in this country, and in many iron and coal mines on the Continent of Europe; and also in America, and Asia.

Uses.

It is employed to dye linen yellow, and wool and silk black: in the preparation of ink; of Berlin-blue; for the precipitation of gold from its solution; and sulphuric acid can be obtained from it by distillation. The residue of the latter process (colcothar of iron) is used as a red paint, and, when washed, for polishing steel.

Observations.

Vitriol of iron, by exposure, becomes yellow, and at last brown: in this state, it appears to answer to the *Misy*, Plin. Hist. Nat. xxxiv. 31. The Melanteria, or Inkstone of Pliny, the Lapis atramentarius flavus of Wallerius, appears to be a variety of this mineral.

2. Prismatic Vitriol, or Blue Vitriol.

Prismatisches Vitriol-Salz, *Mohs.*

Kupfervitriol, *Werner.*

Χαλκανθον of the Greeks.—Chalcanthum atramentum sutorium, *Plin.* Hist. Nat. xxxiv. 12. p. 32.—Vitriolum cupri, *Waller* Syst. Min. t. ii. p. 20.—Cuivre suphatée, *Haüy,* t. iii. p. 580. —Kupfervitriol, *Reuss,* b. ii. 3. s. 73. *Id. Karst.* Tabel. s. 56. —Sulphate of Copper, *Kid,* vol. ii. p. 23.—Kupfervitriol, *Lenz,* b. ii. s. 993. *Id. Haus.* Handb. b. iii. s. 1053.—Blue Vitriol, *Aikin,* p. 249.

External Characters.

The common colour is dark sky-blue, which sometimes approaches to verdigris-green. By exposure to the air it becomes yellow.

It occurs massive, disseminated, stalactitic, dentiform; and crystallized.

Its primitive figure is an oblique four-sided prism, in which the lateral edges are 124° 2′, and 55° 58′. The edges and angles of this prism frequently occur truncated.

Externally and internally it is shining and vitreous.

It has a double cleavage in the direction of the lateral planes of the oblique four-sided prism.

The fracture is conchoidal.

The fragments are rather sharp-edged.

It is translucent.

It is harder than gypsum, but not so hard as calcareous-spar.

Specific gravity, 2.1, 2.2, *Mohs.*

Its taste is nauseous, bitter, and metallic.

Chemical Characters.

When a portion of it is dissolved in water, and spread on the surface of iron, it immediately covers it with a film of copper.

Constituent Parts.

Oxide of Copper, -	32.13
Sulphuric Acid, -	31.57
Water, -	36.30
	100.00 *Berzelius.*

Geognostic,

Geognostic and Geographic Situations.

It occurs, along with copper-pyrites, in Pary's mine in Anglesea; and also in the copper-mines in the county of Wicklow, in Ireland. It is found in considerable quantity in several copper-mines on the Continent of Europe; and also in Siberia.

Uses.

It is used in cotton and linen printing, and the oxide separated from it is used by painters.

3. Pyramidal Vitriol, or White Vitriol.

Vitriolum zinci, *Waller*. Syst. Min. t. ii. p. 24.—Zinc sulphatée, *Haüy*, t. iv. p. 180.—Zinkvitriol, *Leonhard*, Tabel. s. 45. *Id.* *Karsten*, Tabel. s. 56.—White Vitriol or Sulphate of Zinc, *Kid*, vol. ii. p. 24.—Zinkvitriol, *Lenz*, b. ii. s. 996. *Id. Haus.* Handb. b. iii. s. 1118.—White Vitriol, *Aikin*, p. 250.

External Characters.

Its colours are greyish, yellowish, reddish, and greenish-white.

It occurs massive, stalactitic, reniform, botryoidal, in crusts; also in radiated, fibrous and granular distinct concretions; and crystallized.

Its primitive figure is a pyramid of 120° 90′. The following are some of the secondary figures:

1. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes.
2. Acicular crystals, which are promiscuously aggregated.

It

It is shining.
It is translucent.
It is soft, brittle, and easily frangible.
Specific gravity, 2.00, *Born.*
Its taste is nauseous metallic.

Chemical Characters.

It intumesces before the blowpipe, but does not phosphoresce: it dissolves in 2.285 parts of boiling water.

Constituent Parts.

	From Rammelberg.	Ditto.
Oxide of Zinc, -	27.5	21.739
Oxide of Manganese,	0.5	6.522
Sulphuric Acid, -	22.0	71.739
Water, -	50.0	
	100.0	100
	Klaproth, Beit. b. v. s. 196.	*Herz.* Archiv. b. iii. s. 537.

Geognostic and Geographic Situations.

It occurs in repositories that contain blende, and appears to be formed by the decomposition of that mineral. It occurs at Holywell in Flintshire; and it is said also in Cornwall: in the Ramelsberg in the Hartz; at Spitz in Austria; at Schemnitz in Hungary; and Sahlberg in Sweden.

Uses.

It is used as a medicine; is employed in great quantities by varnishers to make oil drying; and a fine white colour named

named *Zinc-white*, which is more durable than white-lead, is prepared from it. To prepare this colour, the salt is dissolved in water, and the white oxide, which is the zinc-white, is precipitated from it by means of potash or chalk.

* Red Vitriol, or Sulphate of Cobalt.

Kobaltvitriol, *Werner*.

Kobaltvitriol, *Kopp*, in Leonhard's Taschenbuch, b. i. s. 111. *Id. Leonhard*, Tabel. s. 45. *Id. Karsten*, Tabel. s. 56. *Id. Lenz*, b. ii. s. 1003.—Red Vitriol, *Aikin*, p. 250.

External Characters.

Its colour is flesh-red, inclining to rose-red.

It occurs coralloidal, stalactitic, in crusts; also in granular distinct concretions.

The surface is rough, and longitudinally furrowed.

It is dull, and seldom shining on the surfaces of the distinct concretions, and the lustre is pearly.

The fracture is earthy.

The fragments are blunt-edged.

It is opaque.

It affords a yellowish-white streak.

It is easily friable, and brittle.

It is light.

It tastes styptic.

Chemical Characters.

Its solution affords, with carbonate of potash, a pale-bluish precipitate, which tinges borax of a pure blue colour.

Constituent

Constituent Parts.

Oxide of Cobalt,	-	38.71
Sulphuric Acid,	-	19.74
Water,	- -	41.55
		100.00

Koppe, in Journal fur die Chemie, Physik et Mineralogie, b. vi. Heft 1. 1808, s. 157.

Geognostic and Geograghic Situations.

It occurs in mining-heaps in Biber, along with lamellar heavy-spar, earthy cobalt, and grey cobalt; and it has been also found in the Leogang at Salzburg.

Genus IV. EPSOM SALT.

This Genus contains one species, viz. Prismatic Epsom Salt.

1. Prismatic Epsom Salt.

Prismatisches Bitter Salz, *Mohs*.

Naturlicher Bitter Salz, *Werner*.

Σχιστη στυπτηρια of the Greeks.—Trichitis, *Plin.* Hist. Nat. xxxv. 15. 2. 52.?—Sal neutrum acidulare, *Wall.* t. ii. p. 71.—Sal d'Epsom; Sel de Sedlits; Sel d'Angleterre; Vitriol de Magnesia, *Romé de Lisle*, t. i. p. 306.—Natürlicher Bittersalz, *Wid.*

Wid. s. 595.—Epsom Salt, *Kirw.* vol. i. p. 12.—Natürlicher Bittersalz, *Estner,* b. iii. s. 44. *Id. Emm.* b. ii. s. 14.—Le Sel amere natif, ou Le Sel d'Epsom natif, *Broch.* t. ii. p. 11.—Magnesie sulphatée, *Haüy,* t. ii. p. 331.–336.—Bittersalz, *Reuss,* b. iii. s. 58. *Id. Lud.* b. i. s. 182. *Id. Suck.* 2ter th. s. 21. *Id. Bert.* s. 324. *Id. Mohs,* b. ii. s. 271. *Id. Leonhard,* Tabel. s. 46.—Magnesie sulphatée, *Brong.* t. i. p. 165.—Haarsalz, *Karsten,* Tabel. s. 56.—Bittersalz-fasriges, haarförmiges, & mehliges, *Haus.* s. 120. *Id. Lenz,* b. ii. s. 1015.—Natürlich Bittersalz, *Hoff.* b. iii. s. 243.—Sulphat of Magnesia, *Aikin,* p. 251.

External Characters.

Its colours are snow-white, greyish-white, and yellowish-white, and sometimes ash-grey, and smoke-grey

It occurs in farinaceous crusts, in flakes, small botryoidal, reniform, and crystallized.

Its primitive figure is a prism of 90°. The prisms are acicular and capillary *.

It has a distinct cleavage in the direction of one of the diagonals of the prism.

The farinaceous variety is dull, the others shining, or glistening, and pearly.

It varies from transparent to opaque,

It is soft.

It is brittle, and easily frangible.

Its taste is bitter and saline.

Chemical

* The crystallizations of Artificial Epsom Salt are the following:

1. Rectangular four sided prism, either bevelled on the extremities, or acuminated with four planes.
2. Six-sided prism, acuminated on the extremities with four planes, and the edges of the acumination truncated.

Chemical Characters.

Before the blowpipe, it dissolves very easily by the assistance of its water of crystallization, but it is difficultly fusible. Its solution gives a precipitate with lime-water.

Constituent Parts.

The constituent parts of purified Epsom Salt, the Sulphate of Magnesia of chemists, are, according to

	Bergmann.	*Kirwan.*
Sulphuric Acid, -	33.0	29.46
Magnesia, -	19.0	17.00
Water of Crystallization,	48.0	53.54
	100.0	100.00

Geognostic and Geographic Situations.

It occurs as an efflorescence at Hurlet, near Paisley, along with natural alum; and sometimes effloresces on old walls: at Jena it encrusts rocks of gypsum; and half burnt clay at Witschiz in Bohemia; on porphyry-slate, also in Bohemia; at Solfatera, on decomposing lava; at Gran, in Hungary, it effloresces on sandstone, clay, and compact limestone.

Uses.

When purified, it is used as a purgative medicine; and it is valued by chemists on account of the magnesia which can be obtained from it.

GEN. V.

Genus V. ALUM.

This Genus contains one species, viz. Octahedral Alum.
* Rock Butter.

1. Octahedral Alum.

Octaedrisches Alaun, *Mohs.*

Natürlicher Alaun, *Werner.*

Alumen nativum, *Wall.* t. i. p. 31.—Natürlicher Alaun, *Wid.* s. 593.—Alum, *Kirw.* vol. ii. p. 13.—Natürlicher Alaun, *Estner,* b. iii. s. 39. *Id. Emm.* b. ii. s. 9.—L'Àlumen natif, *Broch.* t. ii. p. 6.—Alumine sulphatée alkaline, *Haüy,* t. ii. p. 387. 398.—Alumine sulphatée, *Brong.* t. i. p. 155.—Sulphat of Alumine, *Kid,* vol. ii. p. 13.—Alaun, *Haus.* Handb. b. iii. s. 813.

External Characters.

Its colours are yellowish, and greyish-white.

It occurs as a farinaceous efflorescence, stalactitic, in delicate curved and parallel fibrous concretions; also crystallized, in octahedrons and cubes.

The varieties with fibrous concretions have a pearly lustre; others are glistening and vitreous.

The cleavage is fourfold, and in the direction of the planes of the octahedron.

When the fracture can be observed, it is conchoidal.

It is rather harder than gypsum.

Specific

Specific gravity, 1.7, 1.8.
Its taste is sweetish astringent.

Chemical Characters.

It is soluble in from sixteen to twenty times its weight of water. It melts easily by means of its water of crystallization; and by continuance of the heat, it is converted into a white spongy mass.

Constituent Parts.

	Natural Alum of Freinwald.
Alumina, - -	15.25
Potash, - -	0.25
Oxide of Iron, -	7.50
Sulphuric Acid, and Water,	77.00
	100.00

Klaproth, Beit. b. iii. s. 103.

Geognostic Situation.

It generally occurs as an efflorescence on aluminous minerals, as alum-slate, alum-earth, alum-stone, aluminous-coal, aluminous-slate-clay, and bituminous shale, and also encrusting lavas.

Geographic Situation.

Europe.—It occurs as an efflorescence on the surface of bituminous-shale and slate-clay at Hurlet, near Paisley; also encrusting alum-slate near Moffat, in Dumfriesshire; Ferrytown of Cree, in Galloway; and at Whitby, in Yorkshire. On the Continent of Europe, it is met with in many places, as in the alum-slate rocks near Christiania in Norway;

Norway; in coal-mines in Bohemia; also in Austria, Bavaria, Hungary, Italy, and the islands of Stromboli, Milo, &c. in the Mediterranean Sea.

Africa.—In Egypt.

America.—In Real del Monte in Mexico, on a porphyritic stone.

Uses.

It is employed as a mordant in dying; also in the manufacture of leather and paper; as a medicine; for preserving animal substances from putrefaction; and it is sometimes mixed with bread, in order to give it a whiter colour.

Observations.

1. The minerals that afford alum, either contain it ready formed, or only its constituent parts, which are disposed to unite, and form alum, when placed in favourable circumstances. This latter is the most frequent case.

2. The Romans and Grecians appear to have been unacquainted with alum: the *alumen* of the Romans, and the στυπτηρια of the Greeks, being vitriol of iron.

3. Beds and veins of native alum, in fibrous concretions, have been lately discovered at Tschermig in Bohemia. Its chemical composition is remarkable, as appears from the following analysis of Ficinus:

Alumina 10.1, Magnesia 1.4, Sulphuric Acid 43.24, Water of Crystallization 44.56, Silica 0.2 = 100. The magnesia here takes the place of the potash.

* Rock-

* Rock-Butter (a).

Bergbutter, *Werner.*

Bergbutter, *Wid.* s. 589. *Id. Emm.* b. ii. s. 13.—Le Beurré de Montagne, ou Le Bergbutter, *Broch.* t. ii. p. 10.—Bergbutter, *Reuss,* b. iii. s. 66. *Id. Lud.* b. i. s. 182. *Id. Suck.* 2ter th. s. 26. *Id. Bert.* s. 323. *Id. Leonhard,* Tabel. s. 46. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 119. *Id. Lenz,* b. ii. s. 1009.

External Characters.

The colours are yellowish-white, yellowish-grey, cream-yellow, straw-yellow, and pale sulphur-yellow.

It occurs massive, and tuberose.

Internally it is strongly glimmering, and resinous.

The fracture is straight foliated.

The fragments are blunt-edged.

It is translucent on the edges.

It feels rather greasy.

It is easily frangible.

Constituent Parts.

It is Alum, mixed with Alumina and Oxide of Iron.

Geognostic Situation.

It oozes out of rocks that contain alum, or its constituents, as alum-slate, bituminous-shale impregnated with iron-pyrites, or alum-earth.

Geographic

* It is named *Rock-Butter,* from oozing out of the fissures of alum rocks in a soft buttery state. It afterwards becomes solid.

Geographic Situation.

It occurs at the Hurlet Alum-work, near Paisley; oozing out of rocks of alum-slate in the island of Bornholm, in the Baltic; at Muskau in Upper Lusatia; Saalfeld in Thuringia; and, according to Pallas, in aluminous rocks on the banks of the river Jenisei, in Siberia.

GENUS VI.—GLAUBER SALT.

THIS Genus contains one species, viz. Prismatic Glauber Salt. * Reussite.

1. Prismatic Glauber Salt.

Prismatisches Glauber Salz, *Mohs.*

Natürliches Glauber Salz, *Werner.*

Sal mirabile, *Wall.* t. ii. p. 70.—Sel de Glauber, *Romé de Lisle,* t. i. p. 301. *Id. Born,* t. ii. p. 26.—Natürliches Wundersalz, *Wid.* s. 597.—Glauber Salt, *Kirw.* vol. ii. p. 9.—Natürliches Glaubersalz, *Estner,* b. iii. s. 50. *Id. Emm.* b. iii. s. 401.—Le Sel de Glauber natif, *Broch.* t. ii. p. 14.—Glaubersalz, *Reuss,* b. iii. s. 49. *Id. Lud.* b. i. s. 183. *Id. Suck.* 2r th. s. 18. *Id. Mohs,* b. ii. s. 273. *Id. Leonhard,* Tabel. s. 46.—Soude sulphatée, *Brong.* t. i. p. 113.—Glaubersalz, *Karsten,* Tabel. s. 56.—Glauberite, *Haus.* s. 120.—Soude sulphatée, *Haüy,* Tabl. p. 19.—Glaubersalz, *Lenz,* b. ii. s. 1027. *Id. Hoff.* b. iii. s. 245. *Id. Haus.* Handb. b. iii. s. 835.

External

External Characters.

Its colours are greyish and yellowish white; seldom snow or milk white.

It occurs in the form of mealy efflorescences; in crusts; seldom stalactitic, small botryoidal, reniform; in small and fine granular distinct concretions; and crystallized in prisms, the dimensions of which are unknown. The crystals are often acicular.

Internally it is shining, and the lustre is vitreous.

The crystallized varieties have a threefold cleavage. The fracture is conchoidal, or uneven.

The fragments are indeterminately angular, and blunt-edged.

It is soft.

It is brittle, and easily frangible.

Specific gravity 2.2, 2.3.

Its taste is first cooling, and then saline and bitter.

Chemical Characters.

Before the blowpipe, it is affected in the same manner as Epsom salt; but its solution does not, like that of Epsom salt, afford a precipitate with an alkali.

Constituent Parts.

Natural Glauber Salt of Eger, according to Reuss, (Chemische-medicinische Beschreibung des Kaiser Franzens Bades, Dresden, 1794), contains,

Sulphate of Soda, - -	67.024
Carbonate of Soda, - -	16.333
Muriate of Soda, - -	11.000
Carbonate of Lime, - -	5.643
	100

Geognostic

Geognostic Situation.

It occurs, along with rock-salt and Epsom salt, on the borders of salt-lakes, and dissolved in the waters of lakes; in efflorescences on moorish ground; also on sandstone, marl-slate, and old and newly built walls.

Geographic Situation.

Europe.—At Eger in Bohemia, it occurs efflorescent on meadow-ground; as an efflorescence on the walls of old galleries in mines, at Grenoble in France; in old salt-mines at Aussee, Ischel and Hallstadt, in Upper Austria; at Altenberg in Stiria; Felsobanya in Hungary; Hildesheim; Durrenberg, near Hallein in Salzburg; Schwartzburg in Switzerland; near Aranjuez in Spain; Solfatara in Italy.

Asia.—It occurs on the banks, and in the water of many Siberian salt-lakes; neighbourhood of the Lake Baikal; the desert plains of Iset, Ischem, and Barebyn.

Africa.—Egypt.

Uses.

It is used as a purgative medicine; and in some countries as a substitute for soda, in the manufacture of white glass.

* Reussite.

Reussin, *Karsten.*

Reussin, *Karsten,* Tabel. (1. Ausg. 46. 75.) *Id. Leonhard,* Tabel. s. 46. *Id. Reuss,* Min. ii. 3. 46.—*Karsten,* Tabel. 2. Ausg. s. 56. *Id. Lenz,* b. ii. s. 1019.

External Characters.

Its colours are snow-white and yellowish-white, which latter inclines to wine-yellow.

It occurs as a mealy efflorescence, in loose, earthy, dull particles: and crystallized in

1. Flat six-sided prisms, with two broad, and four narrow lateral planes, and bevelled on the extremities.
2. Acicular crystals.

The first are small and middle-sized, the latter loose, or scopiformly aggregated.

Internally it is shining and vitreous, and the fracture of the crystals small conchoidal.

It is soft.

Constituent Parts.

Sulphate of Soda, - -	66.04
Sulphate of Magnesia, -	31.35
Muriate of Magnesia, - -	2.19
Sulphate of Lime, - -	0.42
	100.0

Reuss, in Crell's Annalen, 1791, II. 18.

Geognostic and Geographic Situations.

It is found in the country around Sedlitz and Saidschutz, where it effloresces on the surface during the spring of the year: also at Pilln, near Brüx.

GEN. VII.

Genus VII.—NITRE.

This Genus contains but one species, viz. Prismatic Nitre.

1. Prismatic Nitre.

Prismatisches Natürlicher Saltpeter, *Mohs.*

Natürlicher Salpeter, *Werner.*

Nitrum terra mineralisatum, *Wall.* t. ii. p. 45.—Nitrate de Potasse, *De Born,* t. ii. p. 57.—Natürlicher Salpeter, *Wid.* s. 602. Nitre, *Kirw.* vol. ii. p. 25.—Natürlicher Salpeter, *Estner.* b. iii. s. 55. *Id. Emm.* b. ii. s. 16.—Nitrate de Potasse, *Lam.* t. i. p. 468.—Potasse nitratée, *Haüy,* t. ii. p. 346. 355.—Le Nitre natif, *Broch.* t. ii. p. 17.—Salpeter, *Reuss,* b. iii. s. 21. Natürlicher Salpeter, *Lud.* b. i. s. 177. *Id. Suck.* 2ter th. s. 9. *Id. Bert.* s. 325.—Potasse nitratée, *Lucas,* p. 21.—Salpeter, *Leonhard,* Tabel. s. 44.—Potasse nitratée, *Brong.* t. i. p. 112.—Salpeter, *Karsten,* Tabel. s. 56. *Id. Haus.* s. 121.—Nitrate of Potash, *Kid,* vol. ii. p. 3.—Natürlicher Salpeter, *Hoff.* b. iii. s. 216. *Id. Haus.* Handb. b. iii. s. 849. —Nitre, *Aikin,* p. 251.

External Characters.

Its colours are greyish-white, yellowish-white, and snow-white.

It occurs in flakes, crusts, and in capillary prismatic crystals. The primitive prism has not been determined.

It is dull, glimmering, or shining, and the lustre vitreous.

It has a cleavage in the direction of the smaller diagonal of the oblique four-sided prism.

It alternates from translucent to transparent.

It is as hard as gypsum.

It is brittle, and easily frangible.

Its taste is cooling and saline.

Specific gravity, 1.9369, *Hassenfratz.*—1.9, 2.0, *Mohs,*

Chemical Characters.

It deflagrates when thrown on hot coal.

Constituent Parts.

The Natural Nitre of Molfetta, according to Klaproth:

Nitrate of Potash,	-	42.55
Sulphate of Lime,	-	25.45
Carbonate of Lime,	-	30.40
Muriate of Potash ?	-	0.20
Loss,	- - - -	1.40
		100.00

Klaproth, Beit. b. i. s. 320.

Geognostic Situation.

It is usually found in thin crusts on the surface of soil, and sometimes also covering the surface of compact limestone, chalk, and calc-tuff. In many countries it germinates in certain seasons out of the earth, and when this earth is accumulated in heaps, so as to expose a large surface to the atmosphere, it is found to produce it annually.

Geographic

Geographic Situation.

Europe.—It is found in great quantities in many plains in Spain; very abundantly in the plains of Hungary, the Ukraine and Podolia; in France, on the walls and floors of chalk caves; in the county of Bamberg, on a species of limestone marl; on marly sandstone in the neighbourhood of Göttingen; at Hornberg, near Wurzburg, encrusting calc-tuff. But the most remarkable repository of natural nitre in Europe, is that discovered by Abbé Fortis, near Molfetta, in the kingdom of Naples. It there occurs encrusting a yellowish-grey coloured compact limestone. It is never found in beds with the limestone, as mentioned by some mineralogists, but always on its surface.

Asia.—Nitre is very abundant in India; also in Persia; and in the valley between Mount Sinai and Suez, in Arabia.

Africa.—This salt is abundant in Egypt; also at Ludamar, in the interior of Africa; and in the Karoo Desart, to the east of the Cape of Good Hope.

America.—The nitre used for the manufacture of gunpowder in the United States of America, is obtained from an earth collected in the limestone caves of Kentucky. The earths which exist in these caves, and which contain both nitre and nitrate of lime, are lixiviated, and the lixivium is then made to pass through wood-ashes, by the alkali of which the nitrate of lime is decomposed *. After due evaporation, the nitre is permitted to crystallize. One of the most remarkable of these caverns is in Madison county, on Crooked Creek, about 60 miles S.E. from Lexington. The cavern

* It appears, that two bushels of ashes, made by burning the dry wood in hollow trees, contain as much alkali as eighteen bushels of ashes obtained from the oak.

cavern extends entirely through a hill, and affords a convenient passage for horses and waggons. Its length is 646 yards; its breadth is generally about 40 feet; and its average height about 10 feet. One bushel of the earth in this cavern commonly yields from one to two pounds of nitre; and the same salt has been found to exist at the depth of at least 15 feet; even the clay is impregnated with nitrate of lime.

Kentucky also furnishes native nitre under a very different form, and constituting what is there called *rock-ore*, which is in fact a sandstone richly impregnated with nitrate of potash. The sandstone rests on limestone, and sometimes presents fronts of from 60 to 100 feet high. When broken into small fragments, and thrown into boiling water, the stone soon falls into sand, one bushel of which, by lixiviation and crystallization, frequently yields 10 lb. and sometimes more than 20 lb. of nitre. The nitre obtained from these rocks contains little or no nitrate of lime, and is said to be superior for the manufacture of gunpowder to that extracted from the afore-mentioned earth. Masses of native nitre, nearly pure, and weighing several pounds, are sometimes found in the fissures of these sandstones, or among detached fragments. Indeed, it is said, that these masses of native nitre sometimes weigh several hundred pounds. Similar caverns also occur in Tennessee, and in some parts of Virginia and Maryland *.

Nitre effloresces in considerable abundance on the soil near Lima; and in Tucuman in South America.

Uses.

In Hungary, Spain, Molfetta, and the East Indies, considerable qantities of natural nitre are collected; but the greatest

* Cleaveland's Mineralogy, p. 109.

greatest proportion of that used in commerce, is obtained by working artificial nitre beds. These consist of the refuse of animal and vegetable bodies, undergoing putrefaction, mixed with calcareous and other earths. Its principal use is in the fabrication of gunpowder: it is also used in medicine, and many of the arts.

Genus VIII.—NATRON.

This Genus contains one species, viz. Prismatic Natron.

1. Prismatic Natron.

Prismatisches Natron Salz, *Mohs.*

Natürliches Mineral Alkali, *Werner.*

This species is divided into two subspecies, viz. Common Natron and Radiated Natron.

First Subspecies.

Common Natron.

Gemeines Natron, *Werner.*

Nitrum, *Plin.* Hist. Nat. xxxi. 10. p. 46.—Alkali minerale natron, *Wall.* t. ii. p. 61.—Alkali fixe mineral, *Romé de Lisle,* t. i. p. 146.—Natürliches mineral alkali, *Wid.* s. 579.—Natron, *Kirw.* vol. ii. p. 6. *Id. Estner,* b. iii. s. 18.—Natürliches mineral alkali, *Emm.* b. ii. s. 31.—Carbonate de Natron, *Lam.* t. i.

t. i. p. 462.—Soude carbonatée, *Haüy*, t. ii. p. 373. 379.—L'Alkali mineral, ou Le Carbonate de Soude, *Broch.* t. ii, p. 30.—Natron, *Reuss*, b. iii. s. 4.—Natürliches Mineral Alkali, *Lud.* b. i. s. 176. *Id. Suck.* 2 th. s. 2. *Id. Bert.* s. 331. *Id. Mohs*, b. ii. s. 254.—Gemeines Natron, *Leonhard*, Tabel. s. 44.—Soude carbonatée, *Brong.* t. i. p. 149.—Gemeines Natron, *Karsten*, Tabel. s. 56.—Soda, *Haus.* s. 120.—Carbonate of Soda, *Kid*, vol. ii. p. 4.—Soude carbonatée, *Haüy*, Tabl. p. 21.—Gemeines Natron, *Lenz*, b. ii. s. 960.—Nitrum, *Haus.* Handb. b. iii. s. 831.—Natürliches Mineral Alkali, *Hoff.* b. iii. s. 212.—Natron, *Aikin*, p. 153.

External Characters.

Its colours are yellowish and greyish white; also smoke-grey and cream-yellow.

When fresh, it is compact, sometimes granular, sometimes radiated *, vitreous and glistening, and more or less translucent: when weathered, it is in loose, dull, opaque parts.

Its primitive form is an oblique four-sided prism, said to have angles of 120° and 60°.

It has an urinous and saline taste.

Specific gravity 1.4.

Chemical Characters.

It effervesces with acids. Is easily soluble in water, and its solution colours blue vegetable tinctures green. It is very fusible before the blowpipe.

Constituent

* The crystallization of Artificial Soda,—for that of Natural Soda has not been met with,—is an oblique four-sided prism, bevelled on the terminal planes.

According to Haüy, the primitive form of soda is a rhomboidal pyramid, in which the angles of the base are 120° 60′, and of the edges of the base 78° 28′.

Constituent Parts.

Egyptian Natron.		Bohemian Natron.		Natron of Hungary.	
Dry sub-carbonate of Soda, -	32.6	Cabonate of Soda,	89.18	Carbonate of Soda,	14.2
Dry Sulphate of Soda, -	20.8	Carbonate of Lime,	7.44	Muriate of Soda,	22.4
Dry Muriate of Soda,	15.0	Carbonate of Magnesia, -	1.35	Sulphate of Soda,	9.2
Water, -	31.6	Extractive matter,	2.03	Earthy residuum,	9.2
				Water, -	45.0
	100.0		100.00		100.0
Klaproth, Beit. b. iii. s. 80.		*Reuss*, Min. b. iii. s. 5.		According to *Lampadius*.	

Geognostic Situation.

It occurs as an efflorescence on the surface of soil,—on decomposing rocks of particular kinds,—on the sides and bottoms of lakes that become dry during the summer season,—also on the walls and bottoms of caves,—and dissolved in the water of lakes and springs. In Hungary, according to Ruckert and Pazmand, there are so many natron lakes, that 50,000 quintals of soda could be obtained from them annually. In some places of the same country, it effloresces on the surface of the soil, heath, &c. According to Dr Reuss, it is observed efflorescing on meadows near Priesen and Sebnitz in Bohemia, and on decomposing gneiss in the vicinity of Bilin, where it is renewed every spring. To the west of the Delta of Egypt are several lakes, some of which hold carbonate of soda, or natron, in solution, others muriate of soda, or common salt. In some of these lakes both these salts are contained, and are deposited alternately on the sides of the lake, in consequence of the evaporation of the water that held them in solution, this alternate deposition depending on the different degrees of the

the solubility of these salts: the common salt being the least soluble, is first crystallized; and when that has been separated, to such an extent as to leave a considerable excess of carbonate of soda or natron in solution, then this latter substance begins to crystallize. Berthollet is of opinion, that the natron is formed by the decomposition of the common salt by means of carbonate of lime, during which process the lime unites with the muriatic acid of the common salt, forming with it muriate of lime, while the carbonic acid thus disengaged from the lime, unites with the soda, and thus forms the natron. In some of the lakes, the eastern part contains only common salt, and the western natron, and these two solutions never mix together. It effloresces on the surface of lava in Italy; and in Switzerland and France, on the walls and roofs of caves.

Geographic Situation.

Europe.—It occurs in Bohemia, at Bilin, Carlsbad and Eger; in Hungary, in the neighbourhood of Debrezin, district of Bahar, &c.; in Switzerland, at Schwartzberg, in the canton of Berne; in the Phlegrean Fields, Monte Nuovo, near Naples; and Mount Ætna in Sicily.

Africa.—It occurs in considerable quantity in Egypt at the town of Nitria; in the valley of the Natron Lakes, Nubia; and the island of Teneriffe.

Asia.—In the vicinity of Smyrna, and the ancient city of Ephesus; in Bengal; near Bombay; near Tegapatnam, on the western coast of India; Sina, in the neighbourhood of Pekin; in Thibetian Tartary; Persia; Natolia; district of Ochotsk, in the government of Irkutsk; in the neighbourhood of Nertschinsk in Siberia; and in the Crimea.

America.—Dissolved in the lakes of Mexico.

Second

Second Subspecies.

Radiated Natron.

Strahliches Natron, *Klaproth.*

Strahliges Natron, *Reuss,* b. ii. 3. s. 3. 9. *Id. Leonhard,* Tabel s. 44. *Id. Karsten,* Tabl. s. 56.—Trona, *Haüs.* s. 120.—Soude carbonatée aciculaire, *Haüy,* Tabl. p. 21.—Strahliches Natron, *Lenz,* b. ii. s. 961.

External Characters.

Its colours are greyish and yellowish white.

It occurs in crusts, in radiated distinct concretions, and crystallized in capillary or acicular crystals, which are aggregated on one another.

The lustre is glistening and vitreous.

It is translucent.

It has a urinous and saline taste.

Chemical Characters.

Same as those of Common Natron.

Constituent Parts.

Water of Crystallization, -	22.50
Carbonic Acid, - - -	38.00
Pure Soda, - - -	37.00
Sulphate of Soda, - - -	2.50
	100.00

Klaproth, Beit. b. iii. s. 87.

Geognostic

Geognostic and Geographic Situations.

Mr Bagge, Swedish Consul at Tripoli, gives the following information respecting this interesting subspecies of natron. "The native country of this natron, which is there called *Trona*, is the province Sukena, two days journey from Fezzan. It is found at the bottom of a rocky mountain, forming crusts, usually the thickness of a knife, and sometimes, although rarely, of an inch, on the surface of the earth. It is always crystalline: in the fracture it consists of cohering, longish, parallel, frequently radiated crystals, having the aspect of unburnt gypsum. Besides the great quantity of trona which is carried to the country of the Negroes and to Egypt, fifty tons are annually carried to Tripoli. It is not adulterated with salt. The salt-mines are situated on the sea-shore; but the trona occurs twenty-eight days journey up the country *." According to the accounts of Mr Barrow, it would appear also to occur in the district of Tarka, in Boshieman's Land, in Southern Africa.

Uses of Natron.

It is principally employed in the manufacture of glass, and soap, in dyeing, and for the washing of linen. It is sometimes purified before it is used, but more frequently (particularly that from Egypt) it is used in its natural state. In Hungary, particularly at Debrezin, it is used in great quantity in the manufacture of soap: it has also been employed in considerable quantity in Scotland and England for the same purpose. In Siberia, a fine white glass is manufactured with it. In the Levant, the natron

* Bagge, in the Abhandl. d. Schwed. Acad. v. j. 1773, b. xxxv. s. 131.

natron of Suckena is mixed with tobacco, in order to give it a sharper taste. The ancient Egyptians are said to have macerated dead bodies in it for several months previous to preparing them as mummies. It is sometimes also purified for the alkali it contains, and is then used as a flux.

Observations.

1. Klaproth restored to this species the old name *Natron*, a word said to be derived from Nitria in Upper Egypt, where, as already mentioned, it occurs in considerable quantity.

2. The terms *Natrum* and *Nitrum*, which are used indiscriminately by ancient writers, are generally applied to this mineral, sometimes to saltpetre or nitre, and sometimes to sal-ammoniac.

Genus IX.—BORAX.

This Genus contains one species, viz. Prismatic Borax.
* Sassoline.

1. Prismatic Borax.

Borax Tincal, *Wall.* t. ii. p. 82.—Tinkal, *Leonhard,* Tabel. s. 44. *Id. Karsten,* Tabel. s. 56.—Soude boratée, *Haüy,* Tabl. p. 20.—Borax, *Lenz.* b. ii. s. 1024.—Tinkal, *Haus.* Handb. b. iii. s. 840.

External Characters.

Its colours are greyish, yellowish, and greenish-white: also greenish-grey, and mountain-green.

It

Its primitive form is an oblique four-sided prism. The following are some of the secondary crystallizations:

1. Irregular six-sided prism, with alternate broad and narrow lateral planes, and oblique terminal planes.
2. Irregular six-sided prism, with two opposite broader lateral planes: sometimes bevelled on the extremities, the bevelling planes set on the smaller lateral planes. The lateral edges are 91° 50′ and 134° 5′.
3. Irregular eight-sided prism, with lateral edges of 134° 5′ and 135° 55′.
4. Flat four-sided prism, with rhomboidal base.

The surface of the crystals is sometimes smooth, sometimes rough, and covered with a white, grey, or brown crust.

The crystals occur loose, and of various sizes.

Internally it is shining and resinous.

The fracture is partly foliated, partly flat conchoidal.

The fragments are blunt-edged.

It is semitransparent.

It refracts double in a high degree.

It is soft and very soft; brittle and easily frangible.

Specific gravity, 1.569, *Karsten*.—1.705, *Klaproth*.

Its taste is alkaline and sweet.

Chemical Characters.

It intumesces before the blowpipe, and melts into a transparent glass.

Constituent Parts.

Boracic Acid, - -	37.00
Soda, - - - -	14.50
Water, - - -	47.00
	98.50

Klaproth, Beit. b. iv. s. 356.

Geognostic

Geognostic and Geographic Situations.

It occurs dissolved in the water of many springs in Persia; also in the soil of different parts of Persia; and in Thibet, it is found in the soil, or in the water of lakes.

It is said also to occur in China, and in the neighbourhood of Escapa in Potosi.

Uses.

It is used as a flux for metals, and as an ingredient in artificial gems; but its great use is to facilitate the soldering of the more precious metals. It is employed as a flux by mineralogists in examining the properties of minerals before the blowpipe; and is sometimes used in medicine as a refrigerant.

Observations.

1. The name *Borax* occurs in Geber, who wrote in the ninth century; and is derived from the word Baurach, in use among the Arabians. It has been confounded with the Chrysocolla of Pliny, in consequence of the use that jewellers make of it in soldering gold. It is brought from India in an impure state, under the name *tinkal*, enveloped in a kind of fatty matter, which is soap with soda for its base. When purified in Europe, it takes the name of *borax*. This purification is performed by the Dutch; but the process which they follow is unknown.

2. Karsten describes, under the name *Sassolin*, a mineral principally composed of boracic acid. The following account contains the principal information we possess in regard to it:

* Sassoline, or Native Boracic Acid.

Natürliches Sedativsalz, *Estner*, b. iii. s. 84.—Sassolin, *Reuss*, b. ii. 3. s. 12. *Id. Leonhard*, Tabel. s. 44. *Id. Karsten*, Tabel. s. 56.—Acide boracique, *Hauy*, Tabl. p. 56.

Its colours are greyish and yellowish white, and cream-yellow.

It occurs in grains, crusts, very small corroded pieces, which appear to be composed of crystalline grains, and acicular crystals.

Externally it is uneven.

It is dull or glimmering, and the lustre is resinous.

The fracture passes from uneven into small foliated.

The fragments are blunt-edged.

It is feebly translucent.

It becomes resinous in the streak.

It is soft, and friable.

Chemical Characters.

It melts easily before the blowpipe into a transparent globule.

Constituent Parts.

Boracic Acid, - -	86.0
Ferruginous Sulphate of Manganese, - - -	11.0
Sulphate of Lime, - -	3.0
	100.00

Klaproth, Beit. b. iii. s. 99.

Geognostic and Geographic Situations.

It is found on the edges of hot-springs near Sasso, in the territory of Florence.

CLASS III.

CLASS III.

METALLIC MINERALS.

ORDER I. *NATIVE METALS.*

GENUS I. PLATINA.

THIS Genus contains three species, viz. 1. Native Platina, 2. Palladium, 3. Iridium.

1. Native Platina.

Gediegen Platin, *Werner.*

Platina aurum album, *Wall.* t. ii. p. 365.—Platine, *Romé de Lisle,* t. iii. p. 487. *Id. De Born,* t. ii. p. 479.—Platin, *Werner,* Pabst. b. i. s. 31. *Id. Wid.* s. 661. *Id. Kirw.* vol. ii. p. 109. *Id. Emm.* b. ii. s. 106. *Id. Lam.* t. i. p. 96.—Le Platine natif, *Broch.* t. ii. p. 86.—Platin natif ferrifere, *Haüy,* t. iii. p. 368.—Platin, *Reuss,* b. iii. s. 234. *Id. Lud.* b. i. s. 210. *Id. Suck.* 2ter th. s. 97. *Id. Mohs,* b. iii. s. 3. *Id. Hab.* s. 98.—Platin natif, *Brong.* t. ii. p. 275.—Platin natif ferrifere, *Brard,* p. 234. *Id. Lucas,* p. 101.—Gediegen Platin, *Leonhard,* Tabel. s. 51. *Id. Karsten,* Tabel. s. 60.—Platina, *Kid,* vol. ii. p. 73.—Platin natif ferrifere, *Haüy,* Tabl. p. 72.—Platin, *Haus.* Handb. b. i. s. 97. *Id. Hoff.* b. iii. s. 7.—Native Platina, *Aikin,* p. 74.

External Characters.

Its colour is very light steel-grey, which approaches to silver-white.

It occurs in flat, small, and very small grains, having pretty smooth surfaces; seldom in small angular or roundish grains, with impressions of other minerals.

Externally it is shining, glistening, or glimmering, and the lustre is metallic.

The fracture, on account of the smallness of the particles, cannot be determined. It is probably hackly.

The streak is more shining than the true lustre.

It is intermediate between semi-hard and soft: it is nearly as hard as iron.

It is malleable *.

Specific gravity, 15.601.—18.947, *Tralles.*—17.7, *Wollaston.*—Purified, 23.0, *Thomson.*

Chemical Characters.

It is soluble in the nitro-muriatic acid. It is infusible, without addition, excepting in the focus of a burning-glass, or when exposed to the action of flame urged by oxygen-gas. It is the least fusible of the metals. It does not amalgamate with mercury.

Constituent Parts.

The variety in grains, with a granulated surface, consists of Platina, with a very minute portion of Gold, and of Palladium: the variety in flat and angular grains, consists of Platina,

* It is so ductile, that Dr Wollaston has succeeded in drawing it into a wire $\frac{1}{18750}$ part of an inch in diameter.

Platina, alloyed with small proportions of Iron, Copper, Lead, Palladium, Iridium, Rhodium, and Osmium.

Geognostic and Geographic Situations.

Europe.—Platina has not hitherto been discovered, either pure, or forming a principal constituent part of any ore in Europe. The only ore in which it occurs, is the grey silver-ore of Guadalcanal in Spain.

America.—It has never yet been discovered to the north of the Isthmus of Panama, on the continent of North America. Platina in grains is only found in two places in the Spanish South American dominions; in Choco, one of the provinces of the kingdom of New Granada; and near the shores of the South Sea, in the province of Barbacoas, between the 2° and 6° of north latitude. It is peculiar to an alluvial tract of 600 square leagues, where it is associated with grains of native gold, zircon, spinel, quartz, and magnetic ironstone. It is not true that this metal occurs near Carthagena, or Santa Fé, or in the islands of Porto Rico and Barbadoes, or in Peru, although these different localities are mentioned by authors *. The platina in granulated grains is found in alluvial soil, along with grains of gold, in gold-workings in Brazil †.

Uses.

Its property of remaining unaltered in the air, or when exposed to high heats, of resisting the action of many salts, and of receiving a fine polish, have rendered this metal useful for various chemical and physical instruments, as pyrometers,

* Humboldt's New Spain, vol. iii. p. 150. Black's Translation.

† Wollaston, Phil. Trans. for 1809.

rometers, crucibles, pendulums, reflecting telescopic mirrors, and for wheels in the construction of watches. Reflecting mirrors made of glass, although they preserve their lustre and polish well, are inconvenient, because they form a double image: mirrors made with metallic alloys, which were substituted in their place, give but a single image, but tarnish on exposure to the air: mirrors of platina possess the advantage of not tarnishing, and they give but one image, and, owing to their great density, augment the reflecting power. Of all metals it expands the least by heat, and follows the most regular course in its expansion: hence it is admirably fitted for measures. The geometers Delambre and Mechain, in measuring the arc of the meridian contained between Dunkirk and Barcelona, used, in their operations, rods made of this metal. Klaproth has shewn, that it may be used with great advantage in painting and ornamenting porcelain; and although when burnt in and burnished, it has nearly the same colour as silver, yet it is not, like it, liable to be tarnished by sulphureous effluvia, or to be affected by alterations of the atmosphere. The platina used for these purposes is repeatedly melted with arsenic; without its aid, we could only have obtained it in very small masses, owing to the intense heat required for its fusion, and the small quantity fused.

Observations.

1. This mineral is named *Platina*, on account of its silvery aspect, the word being derived from the Spanish *plata*, silver.

2. It is distinguished from *Silver*, by its colour, external shape, greater hardness, and specific gravity.

3. It

3. It is chemically distinguished from *Silver*, by its infusibility without addition, and its insolubility in nitric acid.

4. In the cabinet of the Academy of Bergaria in Biscay, there is said to be a mass of platina, the size of a pigeon's egg *. Humboldt lately presented the King of Prussia with a mass still larger, and which weighs 1088.8 grains, and has a specific gravity of 18.947, according to Professor Tralles.

2. Palladium.

Palladium, *Wollaston*.

Philosophical Transactions for 1809, p. 192.; and *Haus.* Handb. b. i. s. 99.

External Characters.

Its colour is pale steel-grey, passing into silver-white.
It occurs in small grains.
The lustre is metallic.
The fracture is diverging fibrous.
It is opaque.
Specific gravity, 11.8, 12.148 †, *Wollaston*.

Chemical Characters.

It is infusible; but on the addition of sulphur, it melts with ease; by continuance of the heat, the sulphur is dissipated,

* Mr Alaman, a Mexican gentleman, informs me, that there is no specimen of platina of the size mentioned in the text, in the Academy of Bergaria.

† The second specific gravity was communicated to me by Mr Lowry.

pated, and a globule of malleable palladium remains. It forms a deep red solution with nitric acid.

Constituent Parts.

It consists of Palladium, alloyed with a minute portion of Platina, and of Iridium.

Geognostic and Geographic Situations.

It is found in grains, along with grains of native platina, in the alluvial gold districts in Brazil.

Observations.

This mineral was first discovered, described, and analysed by Dr Wollaston.

3. Iridium.

Iridium, *Wollaston.*

Philosophical Transactions for 1805; and *Haus.* Handb. b. i. s. 96.

External Characters.

Its colour is very pale steel-grey.
It occurs in very small irregular flat grains.
The lustre is shining and metallic.
The fracture is foliated.
It is brittle.
It is harder than platina.
Specific gravity, 19.5.

Chemical

Chemical Characters.

By fusion with nitre, it acquires a dull black colour, but recovers its original colour and lustre by heating with charcoal.

Constituent Parts.

Iridium is always alloyed with a portion of Osmium.

Geognostic and Geographic Situations.

It occurs in alluvial soil in South America, along with platina.

Observations.

It was first examined, and introduced to the notice of naturalists, by Dr Wollaston.

Genus II. GOLD.

This Genus contains only one species, viz. Hexahedral Gold.

1. Hexahedral Gold.

Hexaedrisches Gediegen Gold, *Mohs.*

Gediegen Gold, *Werner.*

This species is divided into four subspecies, viz. Gold-yellow Native Gold, Brass-yellow Native Gold, Greyish-yellow Native Gold, and Argentiferous Native Gold.

First

First Subspecies.

Gold-yellow Native Gold.

Geld-gelbes Gediegen Gold, *Werner.*

Id. Wern. Pabst. b. i. s. 3. *Id. Emm.* b. ii. s. 111. *Id. Estner,* b. iii. s. 215.—L'Or natif, jaune d'Or, *Broch.* t. ii. p. 89.—Gold-gelbes gediegen Gold, *Reuss,* b. iii. s. 246. *Id. Mohs,* b. iii. s. 11. *Id. Leonhard,* Tabel. s. 51. *Id. Karsten,* Tabel. s. 60. *Id. Haus.* Handb. b. i. s. 101. *Id. Hoff.* b. iii. s. 11.

External Characters.

Its colour is perfect gold-yellow, which varies in intensity; in some varieties it inclines to brass-yellow.

It seldom occurs massive, often disseminated, in membranes, in roundish and flattish pieces, in grains which are large, coarse, small and fine, in leaves, and crystallized, in the following figures:

1. Octahedron.
   - *a.* Perfect.
   - *b.* Truncated on the angles.

   By the increase of these truncating planes, there arises a
2. Cubo-octahedral form, and then the
3. Cube.
   - *a.* Truncated on all the angles.
   - *b.* Truncated on the unconformable and alternate angles.
   - *c.* Perfect.
   - *d.* All the angles very flatly acuminated, with four planes, which are set on the lateral planes.

When

When these acuminating planes become so large that they meet, there is formed a

4. A very acute double eight-sided pyramid, acuminated on each extremity with four planes. It is the Leucite crystal.

By the increase of the truncations on the figure 3. *b.*, there is formed a

5. Tetrahedron.
6. Rhomboidal dodecahedron.

The crystals are generally small and very small, very rarely middle sized, superimposed, and seldom in small druses.

Externally it is shining and splendent, and the lustre metallic.

Internally it is shining and glistening.

The fracture is fine hackly.

The fragments are indeterminate angular, and very blunt-edged.

The streak is shining.

It is soft.

It is uncommonly difficultly frangible.

It is completely malleable, and flexible.

Specific gravity, from 17.000 to 19.000, 13.000 to 18.000, *Haager.*—12.000, *Mohs.*

Chemical Characters.

It is fusible into a globule, which is not altered by continuance of the heat.

Constituent Parts.

It contains only a very minute portion of Silver and Copper.

Geognostic

Geognostic Situation.

It occurs disseminated, in veins, and mineral beds, in granite, gneiss, mica-slate, clay-slate, clay-porphyry, and sandstone; also in grains and masses in alluvial deposites, in the beds of rivers, or in the alluvial soil in the flat country through which rivers occasionally flow. It is generally associated with quartz and iron-pyrites, and frequently also with yellow blende, brown iron-ochre, calcareous-spar, and heavy-spar. Its other accompanying minerals are felspar, hornstone, red silver, brittle silver-glance, copper-pyrites, copper-green, variegated copper-ore, malachite, brown iron-ore, galena or lead-glance, red lead-spar, blende, grey antimony, white cobalt, copper-nickel, arsenical-pyrites, and orpiment.

Geographic Situation.

Europe.—It is found in alluvial soil in the mining field of Leadhills. In the time of Queen Elizabeth, extensive washings were carried on in that district, for the purpose of collecting this precious metal; and it is reported that three hundred men were employed in searching for it, and that in the course of a few summers a quantity was collected equal in value to £100,000 Sterling. It also occurs in Glen Turret in Perthshire *; in stream-works in Cornwall; and in a ferruginous sand near Arklow, in the county of Wicklow, where a mass weighing twenty-two ounces, the largest piece hitherto met with in Europe, was found †. It occurs

* I am informed that gold has been found at Cumberhead in Lanarkshire.

† The sand of any river is worth washing for the gold it contains, provided it will yield twenty-four grains in a hundred weight; but the sand of the

occurs in granite at Gasten in Salzburg; at Gardette in France; in gneiss in Upper Hungary; in mica-slate in Salzburg and the Tyrol; in clay-porphyry in Transylvania; in hornblende rock along with auriferous iron-pyrites, in veins of quartz, at Edelfors in Sweden. Rich mines of gold were formerly worked in Spain, and the most important of these were situated in Gallicia, where the gold occurred in regular veins. These mines, according to Diodorus Siculus, were worked by the Phœnicians, and afterwards by the Romans, who derived great wealth from them. The island of Thasos in the Mediterranean was celebrated for its mines of gold; and Thrace and Macedonia afforded much gold to the ancients. The sands of the Danube, Rhine, Rhone, Tagus, and many other European rivers, afford gold, and have been at different periods washed for this metal.

Asia.—There are few considerable mines of gold at present worked in this quarter of the globe. In Siberia, native gold occurs at Schlangenberg, in veins that traverse hornblende rock: auriferous pyrites is met with in quartz at Beresof, in the same country. In the southern parts of Asia, the sands of many rivers afford gold. The Pactolus, a small river in Lydia, formerly afforded so much gold, that it is alleged to have been one of the chief sources of the riches of Crœsus. The numerous islands in the Indian ocean, as Java, Japan, Formosa, Borneo, and the Philippines, afford considerable quantities of gold.

In the island of Sumatra, 15,400 ounces of gold are collected annually. It is obtained, either from veins, where it

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the African rivers often yield sixty-three grains in not more than five pounds weight; which is in the proportion of fifty times as much.—*Kid*, vol. ii. p. 76.

it is associated with quartz, or from alluvial soil, where it occurs in the form of dust, or in masses that sometimes weigh upwards of nine ounces *.

There are considerable mines of gold in Cochinchina, of which the most important are those in the provinces of Cham and Naulang, where the gold occurs in dust or grains, and in pieces that sometimes weigh fully two ounces. Gold-mines are also worked in the kingdom of Siam.

Africa.—This continent affords a considerable quantity of gold, which is always obtained in the form of dust or rolled masses, which is found in the sand of rivers, or the alluvial soil of valleys or plains. The northern parts of Africa afford but little gold, but in the middle and southern regions, there are several tracts remarkable for the quantity of gold they afford. The first is Kardofan, situated between Darfur and Abyssinia. The gold collected there, is brought to market by the Negroes in quills of the ostrich and vulture. This territory, it would appear, was known to the ancients, who regarded Æthiopia as a country rich in gold.

The second principal tract lies to the south of the great Desart of Zara, and in the western part of Africa. The gold is collected in that extensive flat which stretches from the foot of those mountains in which are situated the sources of the rivers Gambia, Senegal, and Niger. Gold is also found in the sands of all these rivers. Bambouck, which is situated to the north-west of these mountains, furnishes the greatest part of the gold which is sold on the western coast of Africa, as well as that which is brought to Morocco,

* Marsden's Sumatra, p. 165,—172. 3d edition.

rocco, Fez, Algiers, and to Cairo and Alexandria in Egypt.

The third principal tract where gold is abundant, lies on the south-east coast, between 15° and 22° of south latitude, and nearly opposite Madagascar. The gold of that country, it is said, is found not only in the state of dust, but also in veins; and it is supposed, that Ophir, from which Solomon obtained gold, was a country on the same coast. Nearer to the equator, the Gold Coast supplied the Portugueze, and afterwards the Dutch, with great quantities of gold dust *.

America.—In modern times, this continent is considered the richest country of the world in gold. There the gold is chiefly collected in alluvial soil, and in the beds of rivers, and sometimes also from veins. In Mexico, the gold is for the most part extracted from alluvial soil by means of washing; and the particles vary in size, from that of dust to the weight of from five to six pounds. Another part of the Mexican gold is extracted from veins which traverse primitive mountains. The veins of native gold are most frequent in the province of Oaxaca, either in gneiss or mica-slate. This last rock is particularly rich in gold, in the celebrated mines of Rio San Antonio. These veins are about a foot and half wide, and contain besides the gold common quartz. The same metal occurs, either pure, or mixed with silver-ore, in the greatest number of veins that have been wrought in Mexico; and there is scarcely a single silver-mine which does not also contain gold.

On the coast of California, there is a plain of fourteen leagues in extent, covered with an alluvial deposite, in which lumps of gold are dispersed.

In

* Brongniart's Mineralogie, t. ii. p. 271, 272, 273.

In the kingdom of New Granada in South America, gold is found in considerable quantity. It is obtained by the washing of the alluvial deposites in which it is contained. Gold veins have been found in the mountains of Guamoco and Antioquia, but their working is almost entirely neglected. The greatest riches in gold obtained by washing, are deposited to the west of the central Cordillera, in the provinces of Antioquia and Choco, in the valley of the Rio Cauca, and on the coast of the South Sea, in the *Partido de Barbacoas.* The alluvial grounds which contain the greatest quantity of gold in dust and grains, disseminated among fragments of greenstone and porphyry-slate, extend from the western Cordilleras almost to the shores of the South Sea.

The province of Antioquia, into which we can only enter on foot, or on the shoulders of men, contains veins of gold in mica-slate, also wash-gold, or gold-dust, as it is sometimes called, in alluvial deposites.

The largest piece of gold ever found in Choco, weighed 25 lb. It is said that a piece of gold was found in Peru, near La Paz, in the year 1730, of the weight of 45 lb.

Humboldt, to whom we are indebted for the preceding particulars in regard to the gold of Spanish America, informs us, that the total annual produce of the gold-mines of the Spanish American colonies, amounts to 25,026 lb. Troy.

A very considerable proportion of the gold of commerce comes from the Portugueze possessions in the Brazils. In that country, it is collected by washing from the sand of rivers, and the other alluvial deposites. Gold is found almost every where throughout that vast country, along the foot of the immense chain of mountains which lies nearly parallel

parallel with the coast, and extends from 5° to 30° of south latitude. From this country nearly 30,000 mares of gold are annually exported to Europe; so that the total produce of gold from the Spanish and Portugueze colonies in the Americas, may be stated at 45,580 lb. Troy *.

A considerable quantity of gold has been of late years collected in North Carolina. It is there found in alluvial land.

It would appear from the preceding statement, that most of the gold of commerce comes from America and Africa, and that by far the greatest proportion of this is collected from an alluvial land, which is frequently ferruginous. The only considerable gold-mines in Europe, are those of Hungary, but the gold is principally the brass-yellow subspecies.

Second Subspecies.

Brass-yellow Native Gold.

Messing-gelbes gediegen Gold, *Werner.*

Id. Werner's Pabst. b. i. s. 5. *Id. Emm.* b. ii. s. 113.—L'Or natif d'un jaune de Laiton, *Broch.* t. ii. p. 91.—Messing-gelbes

* If we understand correctly the accounts given by early writers, the quantity of gold amassed by the ancients must have been prodigious. Thus, in the 1st Book of Kings, chap. x. ver. 14. we are told, that King Solomon received 666 talents of gold (more than 27 tons weight, according to the usual mode of estimating the talent,) in one year; and in the 21st verse of the same chapter, it is said, "And all King Solomon's drinking vessels were of gold, and all the vessels of the forest of Lebanon were of pure gold: none were of silver; it was nothing accounted of in the days of Solomon." Diodorus says, that the tomb of King Simandius was environed

gelb s gediegen Gold, *Reuss*, b. iii. s. 258. *Id. Mohs*, b. iii. s. 16. *Id. Leonhard*, Tabel. s. 51. *Id. Karsten*, Tabel. s. 60. *Id. Haus.* Handb. b. i. s. 101. *Id. Hoff.* b. iii. s. 15.

External Characters.

Its colour is brass-yellow, of every degree of intensity.

It occurs disseminated, rarely massive, capillary, moss-like, reticulated, and in leaves; also crystallized in the following figures:

1. Octahedron.
2. Six-sided table, in which the terminal planes are set on alternately straight and oblique.

Specific gravity 12.713, *Karsten*.

Constituent Parts.

	Eula in Bohemia.
Gold, - - -	96.9
Silver *, - - -	2.0
Iron, - - - -	1.1
	100

Lampadius, Handbuch zur Chem. Annal. d. Min. 251.—253.

Geognostic

environed with a circle of gold three hundred and fifty cubits about, and a foot and a half thick. Semiramis erected in Babylon three statues of gold, one of which was forty feet high, and weighed a thousand Babylonian talents. For these statues there was a table or altar of gold forty feet long, and twelve feet broad, weighing fifty talents.

* It is probable that this subspecies contains more silver than appears from the analysis of Lampadius.

Geognostic and Geographic Situations.

This mineral is found in the gold-mines of Hungary, Transylvania, Bohemia, and Siberia, and in many other situations where the gold-yellow subspecies occurs. It is said to be the most frequent native gold of Europe. It generally occurs in small veins in porphyry and grey-wacke. The minerals with which it is most frequently associated in these veins, are native silver, silver-glance, brittle silver and red silver, iron-pyrites, and quartz. Besides these, the following also occur, viz. copper-pyrites, grey copper, copper-glance, variegated copper, and copper-green; almost the only iron-ores are brown iron-ore; the species of zinc are yellow and brown blende; of lead, lead-glance or galena, and green lead-spar; traces of copper-nickel, and white cobalt; native arsenic, arsenical-pyrites, and red orpiment. Besides quartz, the following earthy minerals are met with in these veins, viz. brown-spar, calcareous-spar, heavy-spar, selenite, common garnet, and lithomarge.

Third Subspecies.

Greyish-yellow Native Gold,

Graugelbes gediegen Gold, *Werner*.

Id. Emm. b. ii. s. 114.—L'Or natif d'un jaune grisatre, *Broch.* t. ii. p. 92.—Fahlgelbes gediegen Gold, *Reuss,* b. iii. s. 260. —Graugelbes gediegen Gold, *Leonhard,* Tabel. s. 51. *Id. Karsten,* Tabel. s. 60. *Id. Hoff.* b. iii, s. 17.

External Characters.

Its colour is brass-yellow, which verges on steel-grey.

It occurs in very small flattish grains, like those of platina.

Its surface is glistening.

It is never crystallized.

It is heavier than brass-yellow native gold, but lighter than gold-yellow native gold.

In other characters it does not differ from the preceding.

Constituent Parts.

It is said to contain Platina.

Geognostic and Geographic Situations.

It occurs, along with platina and magnetic iron-ore, in South-America.

Uses.

The numerous and important uses of this metal, will be considered in another work. We may here only remark, that for whatever purpose gold is used, it is mixed with a quantity of copper, which is usually about $\frac{1}{24}$, and never exceeds $\frac{1}{4}$, which gives the gold a consistence and a hardness it does not possess when pure.

Observations.

Iron-pyrites is sometimes auriferous, but the richest varieties at Facebay in Transylvania, do not afford more than 0.02 to 0.03 of gold. Auriferous pyrites is also met with at Adelfors in Smoland in Sweden, in the Valais and Grisons in in Switzerland, in Dauphiny, Siberia, and Mexico. This variety is distinguished from copper and iron-pyrites, by colour, specific gravity, and malleability.

Fourth Subspecies.

Argentiferous Gold, or Electrum.

Electrum, *Klaproth.*

Electrum, *Plin.* Hist. Nat. xxxiii. cap. iv. § 23.—Natürliches Electrum, v. *Veltheim's* Grundriss einer Mineralogie Braunscher, 1781, fol. 11.—Elektrum, *Klap.* b. iv. s. 1.—Argentiferous Native Gold, *Aikin*, p. 76.

External Characters.

Its colour is pale brass-yellow, passing into silver-white.

It occurs in small plates, dentiform, and in imperfect cubes.

The other characters are not stated by Klaproth, to whom we are indebted for what is known of this mineral.

Chemical Characters.

It is not soluble either in nitrous or nitromuriatic acids.

Constituent Parts.

Gold,	- - - -	64
Silver,	- - - -	36
		100

Klaproth, Beit. b. iv. s. 3.

 Geognostic

Geognostic and Geographic Situations.

It occurs, along with massive heavy-spar, or ash-grey splintery hornstone, at Schlangenberg in Siberia.

Observations.

1. The ancients applied the name *Electrum*, not only to amber, but also to a particular mixture of gold and silver, as appears from the following passage of Pliny: "*Omni auro inest argentum vario pondere. Ubicunque quinta argenti portio est*, electrum *vocatur* *." Hence Klaproth applies the name Electrum to this mineral.

2. As this mineral is not acted on, either by nitrous or nitro-muriatic acid, it follows, that the gold and silver are more than mechanically mixed.

Genus III. SILVER.

This genus contains one species, viz. Hexahedral Silver.

1. Hexahedral Silver.

Hexaedrisches Silber, *Mohs.*

This species is divided into two subspecies, viz. Common Native Silver, and Auriferous Native Silver.

First

* Plin. Hist. Nat. Lib. xxxiiii cap. iv. § 23.

First Subspecies.

Common Native Silver.

Id. Wern. Pabst. b. i. s. 12. *Id. Estner*, b. iii. s. 319. *Id. Emm.* b. ii. s. 156.—L'Argent natif ordinaire, *Broch.* t. ii. p. 116.—Argent natif, *Haüy*, t. iii. p. 384.—Gediegen Silber, *Reuss*, b. iii. s. 310.—Gemeiner gediegen Silber, *Lud.* b. i. s. 210. *Id. Suck.* ter th. s. 129. *Id. Bert.* s. 360. *Id. Mohs*, b. iii. s. 102. *Id. Hab.* s. 102.—Argent natif, *Lucas*, p. 103.—Gemeiner gediegen Silber, *Leonhard*, Tabel. s. 53.—Argent natif, *Brong.* t. ii. p. 248. *Id. Brard*, p. 240.—Gediegen Silber, *Karsten*, Tabel. s. 60. *Id. Haus.* s. 69.—Native Silver, *Kid*, vol. ii. p. 83.—Argent natif, *Haüy*, Tabl. p. 73.—Gediegen Silber, *Haus.* Handb. b. i. s. 105. *Id. Hoff.* b. iii. s. 39.—Native Silver, *Aikin*, p. 76.

External Characters.

Its colour is pure silver-white; but the surface, by exposure to the air, becomes yellowish-brown, or brownish-black.

It seldom occurs massive, more frequently disseminated, in blunt-cornered pieces, in plates, and in membranes: it is said also to occur in Spanish America in rolled pieces *. Besides these, it presents the following particular and regular external shapes: dentiform, filiform, reticulated, in leaves, capillary, which latter, when it is very much entangled, passes into compact. The crystallizations are the following:

1. Cube †.

2. Cube.

* In the Imperial Cabinet of minerals at Vienna, there is a rolled piece of native silver from Spanish America, which weighs upwards of 36 pounds.

† Argent natif cubique, Haüy.

2. Cube, truncated on the angles *.
3. Octahedron, either common or cuneiform †, and sometimes truncated on all the edges.
4. Tetrahedron.
5. Rhomboidal dodecahedron.
6. Leucite form.
7. Six-sided table, in which the terminal planes are set on alternately straight and oblique, and are bevelled.

The crystals are small and very small, and microscopic.

The surface of the crystals is smooth; that of the particular shapes longitudinally streaked; that of the external shapes in leaves is sometimes drusy, sometimes streaked.

The surface varies from splendent to glimmering, according to the kind of surface; that of the crystals being splendent and shining; of the particular and common external shapes glistening and glimmering, with a metallic lustre.

The fracture is fine hackly.

The fragments are indeterminate angular, and blunt-edged.

The streak is splendent, with metallic lustre.

It is harder than gold, tin, or lead; but softer than iron, platina, and copper.

It is perfectly malleable.

It is flexible, and difficultly frangible.

Specific gravity, 10.4743, *Haüy*.—10.000, *Gellert*.—10.338, *Selb*.—10, 10.4, *Mohs*.

Chemical

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* Argent natif cubo-octaedre, Haüy.

† Argent natif octaedre, Haüy.

Chemical Characters.

It is soluble in nitric acid at the common temperature of the atmosphere; but the sulphuric acid does not act on it until heated. It is precipitated from its solution in nitric acid by muriatic acid; and the precipitate, which is *luna cornea*, is insoluble in water; if a plate of copper be immersed in a solution of nitrate of silver, the silver is deposited, in its metallic state, on the surface of the copper. It is fusible into a globule, which is not altered by continuance of the heat.

Constituent Parts.

Native Silver from Johanngeorgenstadt.

Metallic Silver, -	99
Metallic Antimony, -	1
With a trace of Copper and Arsenic.	
	100

John, Chem. Untersuchungen, b. i. s. 283.

Geognostic Situation.

It occurs principally in veins in primitive mountains. In Suabia, and in some places in the Saxon Erzgebirge, it occurs in granite; in gneiss, and mica-slate, in Saxony, Bohemia, and Norway; in clay-slate in Ireland, Saxony, and Bohemia; in syenite and porphyry in Saxony and Hungary; and in primitive trap in Norway. In veins in transition rocks, as in grey-wacke in the Hartz. In flœtz rocks, as in clay-porphyry at Alva, in the Ochil Hills; and in other districts in limestone, sandstone, clay-stone, and slate-

clay.

clay. The native silver in these rocks is accompanied with various metalliferous and earthy minerals. The following are the principal metalliferous minerals, viz. corneous silver, silver-glance or sulphuretted silver, brittle silver-glance or brittle sulphuretted silver, red silver; also antimonial and arsenical silver, native arsenic, white cobalt, red cobalt, copper-nickel, and native bismuth; further, galena or lead-glance, black and brown blende, copper-pyrites, iron-pyrites, brown iron-ore, native mercury, &c. The following are some of the earthy minerals, viz. heavy-spar, brown-spar, calcareous-spar, fluor-spar, quartz, horn-stone, flint; and less frequently asbestus, steatite, apatite, &c.

Geographic Situation.

Europe.—Many years ago, a vein of silver was, for a short time, wrought with considerable advantage in the parish of Alva, in the county of Stirling. The metalliferous minerals were, native silver, and silver-glance, with ores of copper and cobalt; and the vein-stones were calcareous-spar and heavy-spar. It is said, that from £40,000 to £50,000 worth of silver was extracted from the ores, before the repositories were exhausted. We are told, that a mass of capillary native silver was found in the veins traversing the blue-coloured limestone of the island of Isla. Native silver has also been met with at St Mewan, St Stephen's, Huel-Mexico, and Herland, in Cornwall *. The most northern silver-mines in Europe, are those of Kongsberg

* In the second volume of the Transactions of the Geological Society, it is mentioned, that the native silver in Cornwall is associated with galena or lead-glance, iron-pyrites, bismuth, cobalt, and wolfram, in veins traversing clay-slate.

berg in Norway. The predominating rocks of the district, which are mica-slate and hornblende-slate, are traversed by numerous veins containing native silver, silver-glance or sulphuretted silver, also native gold, auriferous silver, red silver, corneous silver, galena, native arsenic, brown blende, copper-pyrites, and iron-pyrites. The most abundant and frequent vein-stones are calcareous-spar and heavy-spar. In former times, these mines afforded uncommonly beautiful and large specimens of native silver. In the year 1628, a mass of pure silver, weighing 68 lb. was met with in the mine Segen Gottes, and in the year 1630, in the same mine, one of 204½ lb. In the year 1666 a mass of silver weighing 560 lb., and which is still preserved in the Royal Collection at Copenhagen, was dug out of the mine named Nye-Forhaabing. In the year 1695, the mine Neue Juels afforded a mass weighing upwards of 118 lb.; and in the year 1769, in the mine Gottes Hülfe in der Noth, a mass estimated at 500 lb. was extracted from one of the veins *. Native silver is also found at Sala, in Westmaunland in Sweden; and in the mines in the Hartz, in small quantity, along with galena and calcareous-spar. In the kingdom of Saxony, as in the district of Freyberg, it occurs in veins, associated with various ores of silver, arsenic, iron, lead, and nickel, along with calcareous-spar, heavy-spar, fluor-spar, and quartz, in veins that traverse gneiss. The masses are sometimes of great magnitude; thus, we are told, that in 1750, a mass of native silver, weighing upwards of 1¼ cwt. was dug out of the great mine named Himmelsfurst, situated within a few miles of Freyberg. It is also mentioned by

* Hausmann's Reise durch Scandinavien in den Jahren 1806 & 1807, b. ii. s. 18.

by Albini, in his "Meissnische Berg-Chronicke," p. 30. that at Schneeberg, in the year 1478, a rich silver vein was discovered, and so large a block of native silver and ore cut out, that Duke Albert of Saxony descended into the mine, and used this huge block, which smelted 400 centners of silver, (a centner is 110 lb.), as a table to dine on. Native silver also occurs in Bohemia, in veins in clay-slate, along with galena or lead-glance, blende, silver-glance, cobalt, nickel, sparry iron, iron-pyrites, quartz, and calcareous-spar. At Rudelstadt in Silesia, along with red silver, quartz, calcareous-spar, and lamellar heavy-spar. At Furstenberg in Suabia, in calcareous-spar, with quartz, and lamellar heavy-spar. At Wittichen, also in Suabia, in granite, along with black cobalt-ochre, white cobalt, seldom with native bismuth, red silver, and iron-glance. At Reinerzau in Wirtemberg, along with silver-glance, and red silver, and ores of cobalt, bismuth, copper, iron, and manganese; and the vein-stones are lamellar heavy-spar, and fluor-spar: in the mine named Herzgol Frederick, in the same country, it is associated with uran-mica, and lamellar heavy-spar, and fluor-spar. At Allemont in France, it occurs in veins, along with silver-glance, red silver, corneous silver, ores of cobalt, native antimony, and nickel; and the vein-stones are calcareous-spar, mixed with asbestus and epidote. At Guadalcanal in Spain, along with red silver, and calcareous-spar. At Felsobanya in Hungary, along with native gold and iron-shot quartz. At Schemnitz, with white and brown lead spars, native gold, brittle silver-glance, and quartz; and in other mines, also in Hungary, associated with silver-glance, brittle silver-glance, red manganese, brown-spar, and calcedony. At Kapnick in Transylvania, with silver-glance, red silver, blende, brown-spar, and quartz.

Asia.

Asia.—Native silver is collected in several parts of Siberia: thus, at Kolywan, in the mine of St Andreas, it occurs disseminated in hornstone, along with brittle silver-glance; at Schlangenberg, in various forms, along with blue copper; at Nertschinsk, with copper-green, and heavy-spar. It is said to be mined in China; and it is known to occur at Pondang in Java.

North America.—The silver-mines of Mexico and Peru have long been celebrated. Most of the Mexican silver is obtained from silver-glance or sulphuretted silver, grey copper, corneous silver, red silver, argentiferous galena or lead-glance, and argentiferous iron-pyrites. In some parts of Mexico, however, as we are informed by M. Humboldt, the operations of the miner are directed to a mixture of ochry brown iron-ore, and minutely disseminated native silver. This ochreous mixture, which is named *pacos* in Peru, is the object of considerable operations at the mines of Angangueo, in the intendancy of Valladolid, as well as of Yxtepexi, in the province of Oaxaca *. Massive native silver, which is much less abundant in America than is generally supposed, has been found in considerable masses, sometimes more than 444 lb. avoirdupois, in the veins of Batopilas in New Biscay. These mines, which are not very actively worked at present, are amongst the

* The Pacos, according to Klaproth, contains the following ingredients:

Silver,	14.00
Brown Oxide of Iron,	71.00
Silica	3.50
Sand, &c.	1.00
Water,	8.50
	98.00

Klaproth, Beit. b. iv. s. 9.

the most northern of Mexico. Nature exhibits the same minerals there, that are found in the silver-mines of Kongsberg in Norway. Native silver is constantly accompanied by silver-glance or sulphuretted silver, in the veins of Mexico as well as in those of the mines of Europe. These very minerals are frequently found united, in the rich mines of Sombrerete, Madrona, Ramos, Zacatecas, Hapujaha, and Sierra de Penos. From time to time, small branches or filaments of native silver are also discovered in the celebrated vein of Guanaxuato; but these masses have never been so considerable as those which were formerly drawn from the mine Del Encino, near Pachuca and Tasco, where native silver is sometimes contained in selenite. At Sierra de Pinos, near Zacatecas, native silver is accompanied with radiated blue copper

Dr Schumacher informs us, that a Mr Ginge, a missionary, brought from West Greenland a specimen of capillary native silver, associated with calcareous-spar, and which, he says, was picked up on the shores of that country *.

South America.—The mines of Huantajaya, surrounded with beds of rock-salt, are particularly celebrated, on account of the great masses of native silver which they contain in a decomposed vein; and they furnish annually between from 45,942 to 52,505 lb. Troy of silver. The native silver is accompanied with conchoidal corneous silver, silver-glance or sulphuretted silver, galena or lead-glance, with small grains of quartz, and calcareous-spar. In 1758 and 1789, two masses of native silver were discovered in the mines of Coronel and Loysa, the one weighing eight, the other

* Verzeichniss der Danish-Nordischen Mineralien, p. 147.

other two quintals. The mines of Gualgayoc and Micuipampa, commonly called Chota, also in South America, afford native silver. Immense wealth, M. Humboldt remarks, has been found even at the surface, both in the mountain of Gualgayoc, which rises like a fortified castle in the midst of the plain, and at Fuentestiana, at Caromolache, and at La Pampa de Navar. In this last plain, for an extent of more than half a square league, wherever the turf has been removed, silver-glance has been extracted, and filaments of native silver adhere to the roots of the gramina. Frequently the silver is found in masses, as if melted portions of this metal had been poured upon a very soft clay. The mines of Gualgayoc have furnished to the treasury of Truxillo, between the month of April 1774 and the month of October 1802, the sum of 1,189,456 lb. Troy of silver; or at an average 44,095 lb. annually.

The mines of Pasco afford native silver, along with ores of this metal, and afford annually from 131,263 lb. Troy to 196,894 lb. Troy of silver.

Mr Helms is of opinion, that the Cordilleras of America, when properly investigated, will afford so great a quantity of silver, as to overturn our present commercial system,—by making silver as common as copper and iron.

Uses.

Its various uses, in coinage, and for other useful and ornamental purposes, will be considered in a separate work.

Observations.

Native silver is distinguished from *Antimonial Silver*, and *Native Antimony*, by fracture and tenacity: it has a hackly

hackly fracture, and is completely malleable; but they are brittle, and have a foliated fracture.

Second Subspecies.

Auriferous Native Silver.

Guldisches gediegen Silber, *Werner*.

Id. Werner, Pabst. b. i. s. 12. *Id. Estner*, b. iii. s. 315. *Id. Emm.* b. ii. s. 154.—L'Argent natif aurifere, *Broch.* t. ii. p. 114.—Guldisch Silber, *Reuss*, b. iii. s. 332. *Id. Lud.* b. i. s. 210. *Id. Suck.* 2ter th. s. 128. *Id. Bert.* s. 362. *Id. Mohs*, b. iii. s. 123. *Id. Leonhard*, Tabel. s. 53. *Id. Karsten*, Tabel. s. 60. *Id. Haus.* Handb. b. i. s. 104. *Id. Hoff.* b. iii. s. 44.

External Characters.

Its colour is intermediate between brass-yellow and silver-white.

It occurs disseminated, in membranes, which are pretty thick, in leaves, and sometimes crystallized in cubes.

Its specific gravity, on account of the quantity of gold which it contains, is greater than that of common native silver.

In other characters, it agrees with the preceding species.

Constituent Parts.

Silver,	-	-	72.00
Gold,	-	-	28.00
			100.00

Fordyce, Phil. Trans. 1779, p. 528.

Geognostic

Geognostic and Geographic Situations.

It occurs in veins in primitive rocks at Kongsberg in Norway; at Rauris is Salzburg; and at Schlangenberg in Siberia.

GENERAL OBSERVATIONS ON SILVER *.

1. The most valuable silver mines in the Old World are situated in the Austrian dominions, consequently including those of Bohemia, Hungary, Transylvania, Salzburg, Moravia, and Austria: the next in importance are those of Russia and Saxony; and less considerable are the Hanoverian, Prussian, Bavarian, and Swedish mines. In the New World, the silver-mines of Mexico and Peru far exceed in value the whole of the European and Asiatic mines; for we are told by Humboldt, that these mines, in the space of three centuries, afforded 316,023,883 lb. Troy of pure silver †. Humboldt also states the quantity of gold and silver imported into Europe from America, between the years 1492 and 1803, at £1,166,775,322 Sterling, and gives the following table of the annual produce of the gold and silver mines of Europe, Northern Asia, and America.

ANNUAL

* The silver of commerce is principally obtained from silver-glance, red silver, and lead-glance.

† Humboldt remarks, that this silver would form a solid sphere of rather more than 91 English feet.

ANNUAL PRODUCE of the Gold and Silver Mines of EUROPE, NORTHERN ASIA, and AMERICA.

Great Political Divisions.	GOLD.				SILVER.				Value of Gold and Silver in Piastres.	Value of Gold and Silver in Sterling money.
	Marcs of France.	Killogr.	Value in Francs.	Value, Sterling money.	Marcs of France.	Killogr.	Value in Francs.	Value, Sterling money.		
Europe, -	5,300	1,297	4,467,444	£ 178,697	215,200	52,670	11,704,444	L. 468,177	16,171,888	L. 646,874
Northern Asia,	2,200	538	1,853,111	74,124	88,700	21,709	4,824,222	192,966	6,677,333	267,090
America,	70,647	17,291	59,557,889	2,382,315	3,250,547	795,581	176,795,778	7,071,830	236,353,667	9,454,145
TOTAL,	78,147	19,126	65,878,444	£ 2,635,136	3,554,447	869,960	193,324,444	£ 7,732,973	259,202,888	£ 10,368,109

2. The relative value of gold and silver, as will appear from the following statement, has varied considerably at different times. According to the present regulations in the British mint, a pound of standard gold is coined into $44\frac{1}{2}$ guineas: a pound weight of standard silver is coined into 62 shillings; and a guinea is current for 21 shillings. These particulars enable us to calculate the relative value of gold to silver, if we neglect the alloy in the coins; for $44\frac{1}{2}$ guineas are equivalent in value to 1869 sixpences, and 62 shillings being equal to 124 sixpences, the value of gold is to that of silver as 1869 to 124, or as $15\frac{9}{124}$ to 1 *. This would accurately express the relative values of the two metals, if the quantity of alloy in a pound weight of standard in each bore the same proportion to the whole, which however is not the case. In a pound weight of standard gold at the British mint, one-twelfth is alloy; in a pound weight of standard silver, it is $\frac{3}{40}$; and the relative value of pure gold to pure silver, according to these regulations, and the established currency between coins of the two metals, is as $15\frac{2859}{13400}$ to 1. One of the earliest accounts of the relative value of gold and silver we possess, is that of Herodotus, who informs us, that in Persia and Greece, it was as 13 to 1. Plato, who flourished about fifty years after Herodotus, asserts, in his Hipparchus, that the value of gold in Greece was to that of silver as 12 to 1 †. Menander, who was born about the year 341 before the Christian era, estimates the value of gold to that of silver so low as 10 to 1. According to Pliny, the relative value of the two metals in Rome, was at one period as high as $14\frac{13}{28}$ to 1; but this did not continue long;

* This is applicable to the state of matters before the late coinage of 1817.

† Platonis Opera, t. iii. p. 231. edit. H. Steph. 1578.

long; for we find, in the conditions on which the Romans made peace with the Ætolians, about 189 years before the Christian era, that they coincided with the Greeks in estimating the value of gold to be to that of silver as 10 to 1. On the return of Cæsar to Rome from Gaul, he brought with him so much gold, that the value of that metal to that of silver was soon as low as 7½ to 1. We cannot say how long this last-mentioned proportion between the two precious metals continued; but we find, that in the time of Claudius, about a century after Cæsar's return from Gaul, the value of gold was considerably advanced; for under this Emperor's reign, it was thought proper, according to Tacitus * and the younger Pliny †, to limit the fee of an advocate to 10,000 sesterces, and this legal fee is stated in the Digest at 100 aurei. Now, as 10,000 sesterces were equal to 2,500 denarii, it follows, that the value of gold was to that of silver as 2,500 to 200; or as 12½ to 1. It is highly probable that this proportion continued some time after the reign of Alexander Severus, as the state of the Empire justifies such a supposition. At what period it ceased cannot be determined; but under the reign of Constantine the Great, we find, that the value of gold was much diminished, the proportion being now as 10½ to 1. Owing to the political alterations which succeeded the reign of Constantine, the value of gold was much increased: even so soon as the time of Arcadius and Honorius, about sixty years after Constantine, the proportional value of the metals was as 14⅖ to 1.

From this statement, it appears, that the lowest proportional value of the two metals in ancient times, was as 7½ to 1, and the highest as 14⅖ to 1; which latter does not differ

* Tacitus, Annalium, lib. xi. cap. 7.

† C. Plinii Epist. lib. v. ep. 21.

differ much from that which exists at present. The various causes which gave rise to these fluctuations, are luminously detailed in Lord Liverpool's valuable "Letter to the King on the Coins of the Realm."

GENUS IV. MERCURY.

THIS Genus contains two species, viz. 1. Fluid Mercury, 2. Dodecahedral Mercury.

1. Fluid Native Mercury.

Tropfbares Gediegen Quecksilber, *Mohs.*

Gediegen Quecksilber, *Werner.*

Argentum vivum, *Plin.* Hist. Nat. xxxiii.—Mercurius virgineus; Hydrargyrum nativum, *Wall.* t. ii. p. 148.—Mercure natif, *Romé de Lisle,* t. iii. p. 152.—Gediegen Quecksilber, *Wid.* s. 719. *Id. Wern.* Pabst. b. i. s. 6.—Native Mercury, *Kirw.* vol. ii. p. 223.—Gediegen Quecksilber, *Emm.* b. ii. s. 129.—Mercure natif, *Lam.* t. i. p. 166. *Id. Broch.* t. ii. p. 96. *Id. Haüy,* t. iii. p. 423.—Gediegen Quecksilber, *Reuss,* b. iii. s. 269. *Id. Lud.* b. i. s. 205. *Id. Suck.* 2ter th. s. 109. *Id. Bert.* s. 432. *Id. Mohs,* b. iii. s. 93.–96.—Mercure natif, *Lucas,* p. 109.—Gediegen Quecksilber, *Leonhard,* Tabel. s. 51.—Mercure natif, *Brong.* t. ii. p. 241. *Id. Brard,* p. 253. Gediegen Quecksilber, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 69.—Native Quicksilver, *Kid,* vol. ii. p. 93.—Mercure natif, *Haüy,* Tabl. p. 77.—Gediegen Quecksilber, *Haus.* Handb. b. i. s. 108. *Id. Hoff.* b. iii. s. 18.—Native Quicksilver, *Aikin,* p. 81.

External Characters.

Its colour is pure tin-white.

It occurs perfectly fluid; and in larger or smaller particles or globules in the cavities of ores of mercury.

It is splendent, and the lustre is metallic.

It does not wet the finger.

It is opaque.

It feels very cold.

Specific gravity, in its fluid state, 13.581, *Haüy*.—When solid, 15.61, *Biddle*.—12.0, 14.0, *Mohs*.

Chemical Characters.

It volatilises entirely before the blowpipe, at less than a red heat.

Constituent Parts.

According to Klaproth, it contains no intermixture of any other metal.

Geognostic Situation.

This mineral occurs principally in rocks of the coal formation, and either disseminated, or in veins traversing them. It is associated with cinnabar, corneous mercury, and dodecahedral native mercury, and often also with iron-pyrites, heavy-spar, calcareous-spar, and quartz. Small veins of it are rarely met with in primitive rocks, as mica-slate and clay-slate, where it is accompanied with native silver, grey manganese-ore, and flexible asbestus.

Geographic Situation.

Europe.—It is found at Idria in the Friaul; Niderslana in Upper Hungary; Morsfeldt and Wolfstein in the Palatinate;

tinate; Moschellandsberg and Stahlberg in Deux-Ponts; Leogang in Salzburg; Horzowitz in Bohemia; Almaden in Andalusia, and Albaracia in Arragon; in slate-clay at Paterno in Sicily; and at Oristani in Sardinia.

America.—Guancavelica in Peru.

Uses.

This metal is used in the construction of barometers and thermometers; also for collecting gases absorbable in water; and its property of amalgamating, enables the metallurgist to extract, at a small expence, minute portions of gold and silver from poor ores *. When amalgamated with tin, it is used for silvering mirrors: amalgams of gold and silver are employed for plating other metals †; and the amalgam of mercury and bismuth is used for the rubbers of electrical machines. In the oxidated and saline states, it acts as a powerful medicine.

Observations.

1. The greater part of the mercury of commerce is obtained by distilling native cinnabar, not from native mercury, which occurs but in small quantity.

2. When rendered solid by artificial freezing mixtures, it is found to be malleable, and to crystallize in octahedrons.

3. The fracture of congealed mercury is hackly.

2. Dodecahedral

* The amalgamation of gold and silver appears to have been known to the ancients.—Vid. Plin. Hist. Nat. xxxiii.; Vitruvius, viii. 8.

† The process of gilding is mentioned by Pliny.—Vid. Plin. l. c. ed. Bip. p. 101.

2. Dodecahedral Mercury, or Native Amalgam.

Natürliches Amalgam, *Werner.*

Amalgam natif d'Argent, *Romé de Lisle,* t. iii. p. 162.—Natürliches Amalgam, *Wern.* Pabst. b. i. s. 7. *Id. Wid.* s. 722.—Natural Amalgama, *Kirw.* vol. ii. p. 223.—Natürliches Amalgam, *Emm.* b. ii. s. 134.—Amalgame natif d'Argent, *Lam.* t. i. p. 432. *Id. Broch.* t. ii. p. 99.—Mercure argenteal, *Haüy,* t. iii. p. 432.—Amalgam, *Reuss,* b. iii. s. 273. *Id. Lud.* b. i. s. 205. *Id. Suck.* 2ter th. s. 111. *Id. Bert.* s. 433. *Id. Mohs,* b. iii. s. 99. *Id. Leonhard,* Tabel. s. 51.—Mercure argental, *Brong.* t. ii. p. 242. *Id. Brard,* p. 254.—Amalgam, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 69.—Quicksilver alloyed with Silver, *Kid,* vol. ii. p. 94.—Mercure argental, *Haüy,* Tabl. p. 77.—Natürlich Amalgam, *Haus.* Handb. b. i. s. 107. *Id. Hoff.* b. iii. s. 21.—Silver Amalgam, *Aikin,* p. 81.

This species is divided into two subspecies, viz. Fluid or Semi-fluid Amalgam, and Solid Amalgam.

First Subspecies.

Fluid or Semi-fluid Amalgam.

Flüssiges oder halbflüssiges Amalgam, *Werner.*

External Characters.

Its colour is intermediate between tin-white and silver-white, according as it contains more or less silver, but usually inclines more to the first.

It occurs very rarely massive and disseminated, usually in small roundish portions; and crystallized in the following figures:

1. Rhomboidal

1. Rhomboidal dodecahedron.
   a. Rarely perfect, generally
   b. Truncated, more or less deeply, on all the edges.

The crystals are small and very small, and generally singly superimposed.

Externally it is shining and splendent, with a metallic lustre. Internally shining.

The fracture is small grained uneven.

When pressed between the fingers, or cut with a knife, it emits a creaking sound like artificial amalgam.

It is as hard as talc.

Specific gravity 10.5.

Constituent Parts.

Mercury, - - -	74
Silver, - - -	25
	99

Heyer, in Crell's Annalen, 1790, b. ii. s. 36. 44.

Geognostic and Geographic Situations.

It is generally associated with native mercury and cinnabar. It is found at Moschellandsberg in Deux-Ponts; and it is said also at Rosenau in Hungary.

Second Subspecies.

Solid Amalgam.

Festes Amalgam, *Werner*.

Festes natürlich Amalgam, *Hoff.* b. iii. s. 24.

External

External Characters.

Its colour is silver-white, which in some varieties falls into tin-white.

It occurs massive and disseminated.

Its lustre is shining, approaching to glistening.

The fracture is flat conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is as hard as gypsum, and sometimes even as hard as calcareous-spar.

It is rather brittle, and rather easily frangible.

It creaks strongly when cut.

Specific gravity 10.5.

Chemical Characters.

Before the blowpipe, the mercury is volatilised, and a bead of pure silver remains. It whitens the surface of copper when rubbed warm on it.

Constituent Parts.

Mercury, - - -	74	64
Silver, - - -	25	36
	99	100
	Heyer.	*Klaproth*, Beit. b. i. s. 183.

Geognostic Situation.

It is usually accompanied with native mercury and cinnabar; it also occurs along with native silver, and iron-pyrites; and the earthy minerals with which it is associated, are calcareous-spar, quartz, heavy-spar, hornstone, &c.

Geographic

Geographic Situation.

It is found at Rosenau and Niderslana in Hungary; Morsfeld in the Palatinate; Moschellandsberg and Stahlberg in Deux-Ponts; in the Leogang in Salzburg; and Sahlberg in Sweden.

Observations.

1. It is distinguished from *Native Silver*, by fracture, tenacity, and frangibility.

2. Native silver, when rubbed on copper, does not whiten it as amalgam does.

3. The name *Quicksilver* was given to this mineral, on account of its fluid form, and silvery aspect.

GENUS V. COPPER.

This genus contains one species, viz. Octahedral Copper.

1. Octahedral Copper.

Octaedrisches Kupfer, *Mohs.*

Gediegen Kupfer, *Werner.*

Cuprum nativum, *Wall.* t. ii. p. 274.—Cuivre natif, *Romé de Lisle,* t. iii. p. 305.—Gediegen Kupfer, *Werner,* Pabst. b. i. s. 62. *Id. Wid.* s. 737.—Cuivre natif, *De Born,* t. ii. p. 303. —Native Copper, *Kirw.* vol. ii. p. 128.—Gediegen Kupfer, *Estner,*

Estner, b. iii. s. 459. *Id. Emm.* b. ii. s. 206.—Le Cuivre natif, *Broch.* t. ii. p. 158. *Id. Haüy,* t. iii. p. 518.–529.—Gediegen Kupfer, *Reuss,* b. iii. s. 392. *Id. Lud.* b. i. s. 219. *Id. Suck.* 2ter th. s. 168. *Id. Bert.* s. 377. *Id. Mohs,* b. iii. s. 200. *Id. Hab.* s. 106.—Cuivre natif, *Lucas,* p. 124.—Gediegen Kupfer, *Leonhard,* Tabel. s. 56.—Cuivre natif, *Brong.* t. ii. p. 211. *Id. Brard,* p. 279.—Gediegen Kupfer, *Karsten,* Tabel. s. 62. *Id. Haus.* s. 69.—Native Copper, *Kid,* vol. ii. p. 98.—Cuivre natif, *Haüy,* Tabl. p. 85.—Gediegen Kupfer, *Haus.* Handb. b. i. s. 111. *Id. Hoff.* b. iii. s. 84.—Native Copper, *Aikin,* p. 84.

External Characters.

Its colour is copper-red, but is frequently tarnished yellowish, and often incrusted with green.

It occurs massive, disseminated, in angular pieces, in grains, membranes, plates, capillary, filiform, botryoidal, irregular dendritic, ramose, with impressions; and crystallized in the following figures:

1. Perfect cube *, fig. 163. Pl. 8.
2. Cube truncated on the angles, which is the middle crystal between the cube and the octahedron †, fig. 164. Pl. 8.
3. Cube truncated on the edges, which is the middle crystal between the cube and the rhomboidal or garnet dodecahedron ‡.
4. Cube truncated on all the edges and angles, fig. 165. Pl. 8.

5. Rhomboidal

* Cuivre natif cubique, Haüy.

† Cuivre natif cubo-octaedre, Haüy.

‡ Cuivre natif cubo-dodecaedre, Haüy.

5. Rhomboidal or garnet dodecahedron, fig. 166. Pl. 8.
6. Perfect octahedron, sometimes truncated on the edges *, fig. 167. Pl. 8.
7. Rectangular four-sided prism, flatly acuminated with four planes, which are set on the lateral planes †.

The crystals are seldom middle-sized and small, usually very small and microscopic. They seldom occur singly imbedded and superimposed, more commonly aggregated in a variety of external shapes.

The lateral planes of the crystals are sometimes smooth, sometimes drusy; the lustre of the surface of the crystals is splendent; that of the other shapes is glistening.

Internally it is intermediate between glistening and glimmering, and the lustre is metallic.

The fracture is hackly.

The fragments are indeterminate angular, and blunt-edged.

The streak is splendent, with metallic lustre.

It is intermediate between semihard and soft; it is harder than silver.

It is completely malleable.

It is flexible, but not elastic.

It is difficultly frangible.

Specific gravity, 8.4, 8.7, *Mohs.*—8.6, *Hausmann.*

Chemical Characters.

When copper is allowed to stand for some time in ammonia, it communicates to it a blue colour: it is fusible before

* Cuivre natif octaedre, Haüy.

† The figures enumerated above, also refer to the principal crystallisations of Native Gold, Native Silver, and Silver-glance.

before the blowpipe into a bead of apparently pure copper.

Constituent Parts.

Native Copper from Ekatharineburg.

Copper, - -	99.80
Trace of Gold and Iron,	
	100.0

John, Chem. Untersuch. b. i. s. 256.

Geognostic Situation.

No metal occurs so frequently in a native state as copper, and it is often met with in large masses on the surface of the earth, particularly in uncultivated and remote regions. In the interior of the earth, it generally occurs in veins, where it is usually associated with red copper and brown iron-ore, seldomer with red iron-ore, copper-glance or vitreous copper-ore, copper-pyrites, malachite, and copper-green, and most rarely with olivinite, and its congenerous species. The rocks in which these veins are contained, are granite, gneiss, mica-slate, chlorite-slate, talc-slate, foliated granular limestone, and grey-wacke. It also occurs imbedded in masses, or in drusy cavities, in serpentine, amygdaloid, flœtz limestone, and flœtz ironstone. The earthy minerals with which it is generally associated in the different formations, are, quartz, calcareous-spar, chlorite, and a kind of soft clay.

Geographic Situation.

Europe.—It occurs in small veins and imbedded portions in serpentine, in the Island of Yell, one of the Shetland Islands;

Islands; in red sandstone, along with copper-pyrites, grey copper, malachite, brown hematite, sparry iron, and iron-pyrites, in Mainland, the largest of the Shetland Islands. It has been long known as a mineral production of Cornwall, where it occurs in veins that traverse granite, and clay-slate, along with tinstone, red copper, malachite, iron-ore, common quartz, rock-crystal, sometimes with chlorite, &c. It generally occurs near the surface, or only a few fathoms under it, although there are instances of its being found very deep in some of the veins. It is met with in the mines named Huel-Unity, Cook's Kitchen, Mullion, Camborne, St Just, Poldory, and also in the rocks of the Lizard. It occurs in Nalsoe, one of the Faroe Islands, imbedded in amygdaloid, along with fibrous and radiated zeolite, and copper-green; in the Bear Islands in the White Sea; at Gullardsrud-schurf in Norway, in serpentine; at Friedrichs-minde, also in Norway, along with earthy blue copper, and copper-green, in grey hornstone and limestone; at Guldholmen, near Moss in Norway, along with calcareous-spar, in a trap rock; at Fahlun in Sweden; in the Hartz, as at Blankenburg, where it is associated with brown-spar, and brown hematite, in veins that traverse grey-wacke-slate; in different venigenous formations that traverse gneiss, in the Saxon Erzgebirge; in beds of bituminous marl-slate at Bottendorf in Thuringia; in the Brennthal, near Mühlbach in Salzburg, in clay-slate; at Kamsdorf in the Westerwald, in beds of ironstone; at Altenkirchen, in veins that traverse grey-wacke, where it is associated with brown iron-ore, malachite, red copper, copper-green, copper-glance or vitreous copper-ore, and quartz; at Reichenbach, near Oberstein, in flœtz amygdaloid, along with prehnite; at St Bel, near Lyons in France;

France; in veins that traverse gneiss, in the Kenziger-thall in Suabia; in the mine of Maria-Taferl, at Moldowa in the Bannat, in syenite-porphyry; and in different mines in Hungary.

Asia.—In the Island of Japan, along with red copper, and brown iron-ore; in large masses in the Kurile Islands; in the Altain and Uralian Mountains; Kamschatka; and China.

North America.—In masses in the soil in Canada; on the banks of Copper-mine River, on the confines of the Arctic Ocean; in the mines of Ingaran, near the base of the volcano of Jorullo, in Mexico, along with copper-glance or vitreous copper-ore, and red copper; in the intendancy of Valladolid; and in the province of New Mexico.

South America.—Large masses of native copper are met with on the surface of the uncultivated and thinly inhabited regions of Brazil; and Professor Vandilli informs us, that a mass weighing 2600 lb. was found in a valley near to Cachoeira, in that country. It measures 3 feet 2 inches in length, 2 feet 1 inch in breadth, and 10 inches in thickness. Its surface is rough, and covered in some places with malachite and red copper. Very lately, an American gentleman, Dr Baron, discovered a large mass of native copper in the river Onatanagan, to the south of the Lake Superior. He describes it as measuring 12 feet in circumference at one end, and 14 feet at the other. It is also met with in the upper mines of Chili.

Uses.

The copper used for economical and other purposes is obtained from the ores of copper afterwards to be described ed, native copper seldom occurring in any considerable quantity. Combined with zinc, it forms the useful compound called *Brass*, and with tin, *Bell-metal* or *bronze*. It is also used in coinage, either pure, or when combined with gold or silver, to which it gives a greater degree of tenacity. Its oxide is employed in colouring glass and porcelain green; and when combined with acetic acid, it affords the well-known pigment called *Verdigris*. Great quantities of it are used for sheathing the bottom of ships intended for long voyages into warm climates, to preserve them from the attack of the *Teredo navalis*, and other destructive vermes. When covered with tin, it is employed for culinary vessels.

This metal, as already mentioned, is occasionally found in great masses, dispersed over the surface of the earth in uncultivated countries: hence Werner conjectures, that it was the first metal worked by man. From its known metallic characters, this opinion may be considered as very probable, especially when supported by the account which is given of some of the native tribes of the north-western parts of America, who, though little civilized, have applied to domestic purposes the native copper with which their country abounds. It is also known, that, at a very early period, domestic utensils, and instruments of war, were made of a compound of this metal and tin: even during the Trojan war, as we learn from Homer, the combatants had no other armour but what was made of bronze, which is a mixture of copper and tin. Macrobius, who wrote in the fourth century, informs us, that when the Etruscans intended building a new city, they marked out its limits with a coulter of brass, and that priests of the Sabines were in the habit of cutting their hair with a knife of the same

same metal *. The Greek and Roman sculptors executed fine works of art in porphyry, granite, and other hard minerals, by means their copper instruments. The great hardness of the ancient copper instruments, has induced historians to believe, that the ancients possessed a particular secret for tempering copper, and converting it into steel. There is no doubt the axes and other ancient tools were almost as sharp as steel instruments; but it was by a mixture with tin, and not by any tempering, that they acquired their extreme hardness. Axes, and other instruments of copper, have been discovered in the tombs of the ancient Peruvians, and also in those of the early inhabitants of Mexico. These were so hard, that the sculptors of these countries executed large works in the hardest greenstone and basaltic porphyry: their jewellers cut and pierced the emerald, and other precious stones, by using at the same time a metal tool and a siliceous powder. Humboldt brought with him from Lima an ancient Peruvian chisel, in which M. Vauquelin found 0.94 of copper, and 0.06 of tin. This mixture was so well forged, that, by the closeness of the particles, its specific gravity was 8.815; while, according to the experiments of M. Briche, chemists never obtain this maximum of density, but by a mixture of 16 parts of tin, with 100 parts of copper. It appears that the Greeks and Romans made use of both tin and iron at the same time in the hardening of copper. Even a Gaulish axe, found in France by M. Dupont de Nemours, which cuts wood like a steel axe, without breaking or yielding, contains, according to the analysis of Vauquelin, 87 of copper, 3 of iron, and 9 of tin †.

Observations.

* Macrobius, Saturnalia, lib. v. cap. 19. p. 29. 512.

† Humboldt's New Spain.

Observations.

1. Native Copper is distinguished from *Copper-nickel*, by its malleability, and inferior degree of hardness; copper-nickel being semi-hard, bordering on hard, and brittle.

2. When iron-plates are put into a solution of copper vitriol, their surfaces soon become covered with a coating or crust of malleable copper, which is called Copper of Cementation. As copper thus formed is an artificial product, it cannot be included in a system of oryctognosy.

GENUS VI. IRON.

THIS Genus contains one Species, viz. Octahedral Iron.

1. Octahedral Iron.

Octaedrisches Eisen, *Mohs*.

Gediegen Eisen, *Werner*.

This Species is divided into two Subspecies, viz. Terrestrial Native Iron, and Meteoric Native Iron.

First Subspecies.

Terrestrial Native Iron.

Tellureisen, *Werner*.

Gediegen Eisen, *Charpentier*, Mineralogische Geographie von Sachsen, s. 343.—Fossiles gediegen Eisen, *Klaproth*, Beit. b. iv.

b. iv. s. 102.—Fer natif amorphe, *Haüy*, Tabl. p. 93.—Massive Native Iron, *Aikin*, p. 96.

External Characters.

Its colour is steel-grey.

It occurs massive, in plates, and in leaves.

Internally it is glistening, and the lustre is metallic.

The fracture is hackly.

It is opaque.

It is malleable; but not in so high a degree as meteoric iron.

It is hard.

It is magnetic.

Constituent Parts.

From the mine named Johannes, near Great Kamsdorf in Saxony.

Iron,	-	-	92.50
Lead,	-	-	6.00
Copper,	-	-	1.50
			100.00

Klaproth, Beit. b. iv. s. 106.

Geognostic and Geographic Situations.

It is said to have been found associated with brown ironstone, sparry ironstone, and heavy-spar, at Kamsdorf *; along with clay and hematite at Eibenstock †; with brown ironstone and quartz, in a vein in the mountain of Oulle, in

* Charpentier, Mineralog. Geographie v. Sachsen, s. 342.

† Werner's Pabst. b. i. s. 130.

in the vicinity of Grenoble *; at Miedziana-Gora in Poland †; in the scoriæ of the volcanic mountain of Graveneire, in the department of Puy de Dome ‡; imbedded in American iron-pyrites ||; and it is said in the island of Bourbon §.

Observations.

1. Lucas mentions a pseudo-volcanic *steel*, found near the village of Bouiche, in the department of the Allier in France. It was discovered by M. Mossier, in the form of small globules imbedded in minerals, which had been scorified by the fire of a coal-mine, formerly in a state of inflammation.

2. The Kamsdorf and Eibenstock irons appear to be accidental artificial masses.

Second Subspecies.

Meteoric Native Iron.

Meteoreisen, *Karsten.*

Plin. Hist. Nat. xxxiv. 14. (41. ed. Bip. v. 260.) & ii. 56. (ed. Bip. s. 166.) ¶.—Meteorstein, *Klaproth,* Beit. b. iv. s. 99-101.

* Schreiber, in Journal de Physique, Juillet 1792.

† Journal de Physique, t. 65. p. 128.

‡ Mossier, in Lucas's Tableau, t. 2. p. 367.

|| Proust, Journal de Physique, t. 61. p. 272.

§ Brong. t. 2. p. 148.

¶ Differentia ferri numerosa: Prima, in genere *terræ cœlive*: Item, ferro (pluisse) in Lucanis, anno antequam M. Crassus a Parthis interemtus est,

101. *Id. Leonhard,* Tabel. s. 62. *Id. Karsten,* Tabel. s. 64. —Fer natif meteorique, *Haüy,* Tabl. p. 93.—Meteoreisen, *Haus.* Handbuch. b. i. s. 114.—Fer natif meteorique, *Lucas,* t. ii. p. 358.—Meteoric Native Iron, *Aikin,* p. 95.

External Characters.

Its colour is pale steel-grey, which inclines to silver-white, like platina. It is generally covered with a thin brownish crust of oxide of iron.

It occurs ramose, imperfect globular, and disseminated in meteoric stones.

Its surface is smooth and glistening.

Internally it is intermediate between glimmering and glistening, and the lustre is metallic.

The fracture is hackly.

The fragments are blunt-edged.

It yields a splendent streak.

It is intermediate between soft and semi-hard.

It is malleable.

It is flexible, but not elastic.

It is very difficultly frangible.

Specific gravity 7.575, *Karsten.*

Constituent Parts.

	Agram.	Mexico.
Iron, -	96.5	96.75
Nickel, -	3.5	3.25
	100.0	100.00

Klaproth, Beit. b. iv. s. 101, 102.

According

[illegible] cum eo Lucani milites, quorum magnus numerus in exercitu [illegible] plsit, *spongiarum fere similis fuit.*

According to Mr Howard, the native iron found in Siberia, South America, and Senegal, contains a portion of Nickel. The American contains 0.10; the Siberian 0.17; and the Senegambian 0.5 and 0.6.

Geographic Situation.

This subspecies of iron appears to be formed in the atmosphere by some process hitherto unknown to us. It is precipitated towards the surface of the earth in masses of greater or lesser magnitude, and which generally appear to proceed from fire-balls. The fall of masses of iron from the heavens, has been known from a very early period, and instances of it have even occurred in our own times, as will appear from the following enumeration:

1. About 56 years before the Christian era, a mass of spongy iron fell from the atmosphere in Lucania *.

2. In the year 648, a glowing mass, like a fiery anvil, fell from the air, at Constantinople. This appears to have been a mass of iron.

3. Avicenna speaks of a mass of iron weighing 50 pounds, which fell from the air near Lurgea; and Averrhoes of a mass of iron, estimated to weigh 100 pounds, which fell at Cordova in Spain, and of which swords were made.

4. In the year 1164, during the feast of Pentecost, a shower of iron fell in Misnia †.

5. A great mass of iron fell from the air, in a forest near to

* Plin. Hist. Nat. ii. p. 56.

† Georg. Fabric. Rer. Misnic. lib. i. p. 32.

to Neuhof, between Leipsic and Grimma, between the years 1540 and 1550 *.

6. In the year 1559, five stones or masses of iron fell near Miskoz in Transylvania †.

7. In the years 1560 and 1570, many masses of iron fell in different places in Piedmont.

8. In the year 1603, a mass of metal, probably iron, fell in Bohemia.

9. In the year 1652, a mass of iron, weighing 5 pounds, fell in India, about 100 leagues south-east of Lahore.

10. There is preserved in the town of Ellbogen in Bohemia, a mass of iron weighing 200 pounds, which appears to have fallen from the air in the year 1647; and it is said, about the same time, a ball or mass of iron fell from the air on board a ship in the open sea, and killed two men.

11. On the 12th of January 1683, a stone or mass of iron fell near Castrovillari in Calabria ‡.

12. In the bishopric of Agram in Croatia, on the afternoon of the 26th of May 1751, a fire-ball burst with a loud explosion, and two masses of iron fell from it; the one fragment, which weighed 71 pounds, sunk a considerable depth into the earth; and the other, which was 16 pounds weight, fell on the surface of a meadow, at the distance of 2000 paces from the former. The largest fragment is still preserved in the Imperial Cabinet in Vienna.

13. A mass of iron weighing 66 pounds fell at Chantoney in Vendée on the 5th August 1812 ||.

Besides these undoubted instances of meteoric iron, others

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* Albini, Meissnische Berg-Chronik, p. 139.

† Nic. Isthuansii, Hist. Hungar. l. xx. fol. 394.

‡ Mercati, Metallotheca Vaticani, cap. xix. p. 248.

|| This fact was communicated by Mr Heuland.

others less certain are mentioned; and of these the most remarkable are the following:

1. Professor Pallas, many years ago, discovered a mass of native iron, about 1600 pounds weight, lying on the surface of a hill between Krasnojark and Abakunsk. It is considered as a holy relic by the natives, who believe that it fell from heaven. It is enveloped in a slight brownish coloured crust, and the vesicular cavities are filled with a mineral of the nature of olivine. It has all the characters, both external and chemical, of meteoric iron: hence it is generally supposed to have had a similar origin.

2. Goldberry, in his journey through Western Africa, in the years 1805–7, found a mass of native iron in the Great Desart of Sahra. Fragments of it were brought to Europe by Colonel O'Hara, and were analysed by Mr Howard, who found it composed of 96 parts of Iron and 4 of Nickel.

3. Barrow mentions a mass of iron he met with on the banks of the Great Fish River, in Caffraria, in Southern Africa. Chladni is of opinion that it is meteoric; but Barrow considers it as an artificial mass.

4. Several masses of native iron have been met with in Mexico. A mass found at Zacatecas, about fifteen years ago, according to Humboldt, still weighed nearly 2000 pounds.

5. Bougainville, the French circumnavigator, discovered an enormous mass of native iron on the banks of the river La Plata in South America. It is calculated to weigh about 100,000 pounds. It has not been analysed.

6. Many years ago, a mass of native iron, calculated to weigh about 30 tons, was discovered in the district of St Jago del Estro, in South America. It lies in the middle of a great plain, and no rock or mountain within an hun-

dred

dred miles of it. Proust ascertained that it contained nickel: and Howard found it composed of 90 parts of iron and 10 of nickel in 100 parts. This fact, with its general aspect, strongly favours the idea of its meteoric origin.

7. Dr Bruce, in the American Mineralogical Journal, mentions a mass of iron, weighing 3000 pounds, which is said to have been found near the Red River. It is 3 feet 4 inches in length, and 2 feet 2 inches in breadth. Its specificgravity is 7.400. According to Professor Silliman and Colonel Gibbs, it contains nickel as a constituent part.

8. A large mass of iron, supposed to be meteoric, has been ascertained to exist on the shores of Baffin's Bay, by the expedition under Captain Ross *.

GENUS VII. ARSENIC.

This Genus contains one Species, viz. Native Arsenic.

1. Native Arsenic.

Gediegen Arsenik, *Werner & Mohs.*

Cadmia bituminosa of *Agricola.*—Arsenicum nativum, *Wall.* t. ii. p. 161.—Gediegen Arsenik, *Wern.* Pabst. b. i. s. 207. *Id. Wid.* s. 965.—Native Arsenic, *Kirw.* vol. ii. p. 255.—Arsenic testacé, *De Born,* t. ii. p. 194.—Gediegen Arsenic, *Emm.* b. ii. s. 548.—Arsenic natif, *Lam.* t. i. p. 353. *Id. Haüy,* t. iv. p. 220. *Id. Broch.* t. ii. p. 435.—Gediegen Arsenik, *Reuss,* b. iv.

* My young friend and pupil Dr Fyffe informs me, he has detected about 3 *per cent.* of Nickel in the Iron of Baffin's Bay,—a circumstance which increases the probability of its being of meteoric origin.

b. iv. s. 494. *Id. Lud.* b. i. s. 297. *Id. Suck.* 2ter th. s. 442. *Id. Bert.* s. 500.—Arsenic natif, *Lucas*, p. 162. *Id. Brard*, p. 359.—Gediegen Arsenik, *Leonhard*, Tabel. s. 78.—Arsenic natif, *Brong.* t. ii. p. 80.—Gediegen Arsenic, *Karsten*, Tabel. s. 74. *Id. Haus.* s. 70.—Arsenic natif, *Haüy*, Tabl. p. 108. —Gediegen Arsenic, *Haus.* b. i. s. 120. *Id. Hoff.* b. iii. s. 207.—Native Arsenic, *Kid*, vol. ii. p. 203. *Id. Aikin*, p. 125.

External Characters.

On the fresh fracture it is whitish lead-grey, inclining to tin-white: it, however, tarnishes very quickly, first grey, and then greyish-black.

It occurs massive, disseminated, in plates, reniform, botryoidal, reticulated, with rhomboidal, cubical, and conical impressions; also in distinct concretions, which are straight and scopiform radiated, small and fine granular, and thin and curved lamellar.

Externally it is either rough or granulated, and very feebly glimmering.

Internally, on the fresh fracture, it is usually glistening, inclining to glimmering, sometimes to shining, and the lustre is metallic.

The fracture is small, and fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is harder than calcareous-spar, but not so hard as fluor.

It is difficultly frangible.

It is rather sectile.

The streak is shining and metallic.

When struck, it has a ringing sound, and emits an arsenical odour.

Specific

Specific gravity, 5.7249, 5.7633, *Brisson.*—5.670, *Kirwan.*—5.7, 5.8, *Mohs.*

Chemical Characters.

Before the blowpipe it yields a white smoke, diffuses an arsenical odour, burns with a blue flame, is gradually and almost entirely volatilised, and deposites a white coating on the coal.

Constituent Parts.

It usually contains a small portion of iron, and when it occurs with gold or silver, a little gold or silver.

Geognostic Situation.

It occurs in veins in primitive rocks, as in gneiss, mica-slate and clay-slate, and less frequently in transition and secondary rocks. In these repositories it is generally found where several veins cross, and then it is a frequent precursor of rich bursts of silver or cobalt, or it points out the termination of valuable accumulations of ores. It is frequently associated with red silver, silver-glance or sulphuretted silver-ore, arsenical pyrites, orpiment, and galena or lead-glance; sometimes also along with native silver, silver-white cobalt, grey copper-ore, grey antimony-ore, copper-nickel, sparry iron, iron-pyrites, copper-pyrites, heavy-spar, calcareous-spar, brown-spar, fluor-spar, and quartz.

Geographic Situation.

Europe.—It occurs at Kongsberg in Norway, along with ores of silver, cobalt, and antimony, at Andreasberg in the Hartz, and Allemont in France: in veins along with red silver,

silver, in mica-slate, at Joachimsthal in Bohemia, and with the same mineral in gneiss, at Freyberg in Saxony, and at Ste Marie aux Mines in France; and it is also found in Silesia, Suabia, Spain and Hungary.

Asia.—In large masses at the bottom of a silver-mine at Zimeof in Siberia.

America.—St Felix in Chili *.

GENUS VIII.—BISMUTH.

THIS Genus contains one Species, viz. Octahedral Bismuth.

1. Octahedral Bismuth.

Octaedrisches Wismuth, *Mohs.*

Gediegen Wismuth, *Werner.*

Wismuthum nativum, *Wall.* t. ii. p. 205.—Gediegen Wismuth, *Werner,* Pabst. b. i. s. 183. *Id. Wid.* s. 887.—Native Bismuth, *Kirw.* vol. ii. p. 264.—Bismuth natif, *De Born,* t. ii. p. 214.—Gediegen Wismuth, *Emm.* b. ii. s. 434.—Bismuth natif, *Lam.* t. ii. p. 331. *Id. Haüy,* t. iv. p. 184. *Id. Broch.* t. ii. p. 343.—Gediegen Bismuth, *Reuss,* b. iv. s. 310. *Id. Mohs,* b. iii. s. 633.—Bismuth natif, *Brong.* t. ii. p. 131. *Id. Haüy,* Tabl. p. 105.—Gediegen Wismuth, *Haus.* Handb. b. i. s. 123. *Id. Hoff.* b. iv. s. 65.—Native Bismuth, *Aikin,* p. 121.

External

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* Heuland.

External Characters.

Its colour on the fresh fracture surface is silver-white, which inclines to red; but by exposure it soon becomes tarnished, with columbine or temper steel colours.

It is seldom massive, generally disseminated, and in leaves having plumosely streaked surfaces; also dentiform, in coarse, small and fine granular distinct concretions, and crystallized in the following figures:

1. Octahedron.
2. Tetrahedron, in which the angles are truncated.
3. Cube.

The crystals are small and very small.

Internally it is splendent, and the lustre is metallic.

It has a fourfold cleavage, the folia in the direction of the planes of the octahedron.

The fragments are indeterminate angular and blunt-edged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is malleable.

It is rather difficultly frangible.

Specific gravity, 8.9, 9.0, *Mohs.*—9.570, *Kirwan.*—9.0202, *Brisson.*

Chemical Characters.

It melts even by the flame of a candle; before the blow-pipe, it melts very quickly to a silver-white globule, which, by continuance of the heat, is volatilized, and deposites a white covering on the charcoal. It dissolves with effervescence in nitric acid; but if we add water to the solution, it is precipitated into the form of a white powder.

Geognostic

Geognostic Situation.

It occurs in veins in gneiss, mica-slate, and clay-slate. It is usually accompanied with ores of cobalt, particularly tin white cobalt and grey cobalt; also with copper nickel, bismuth ochre, iron pyrites, sparry iron, and brown blende; sometimes with native silver, and very seldom with galena or lead-glance; the vein-stones are quartz, hornstone, calcareous-spar, brown spar, and heavy spar.

Geographic Situation.

Europe.—It is found at St Columb and Botallack, in Cornwall, but more frequently at Johanngeorgenstadt and Schneeberg, in the Kingdom of Saxony, than in any district in Europe: it occurs also in considerable quantity at Joachimsthal in Bohemia; and in less abundance in the Black Forest (Schwarzwald) in Swabia. It has been also met with at Zalathna in Transylvania; Temeswar in the Bannat; at Biber in Hanau; St Saveur, and in the mines of Brittany in France; Dalecarlia and Nerike in Sweden; and Modum in Norway.

America.—It occurs at Huntington, parish of New-Stratford, in the State of Connecticut, in a vein of quartz, along with native silver, common and magnetic pyrites, and galena or lead-glance *.

Uses.

It enters as an ingredient into the composition of printing types, and of pewter; is used as solder, in the construction of mirrors, and for the refining of gold and silver; its oxide is

* Bruce's American Mineralogical Journal, p. 267.

is used as a white pigment, as an essential ingredient in a kind of salve, which is used for giving a black colour to the hair, and as an ingredient in sympathetic ink. All the bismuth of commerce is obtained from Saxony.

Observations.

1. Its principal characters are, colour, cleavage, malleability, softness and weight.

2. It is distinguished from *Bismuth-glance* by its colour and regular external figures; the recticulated varieties, from *Reticulated Native Silver*, by their colour and inferior malleability; and its colour and hardness distinguish it from *Native Antimony.*

Genus IX. ANTIMONY.

This Genus contains two Species, viz. Dodecahedral Antimony, and Octahedral Antimony.

1. Dodecahedral Antimony.

Spiesglas, *Mohs.*

Gediegen Spiesglas, *Werner.*

Swab, in d. Schriften der K. Schwed. Acad. 10. b. v. I. 1748. s. 100.—Regulus Antimonii nativus, *Wall.* t. ii. p. 196.—Gediegen Spiesglas, *Werner,* Pabst. b. i. s. 197. *Id. Wid.* s. 909. —Native Antimony, *Kirw.* vol. ii. p. 245.—Antimonie natif, *De*

De Born, t. ii. p. 137.—Gediegen Spiesglas, *Emm.* b. ii. s. 464. —Antimonie natif, *Haüy*, t. iv. p. 252.—L'Antimonie natif, *Broch.* t. ii. p. 369.—Gediegen Spiesglanz, *Reuss*, b. iv. s. 362. *Id. Lud.* b. i. s. 277. *Id. Suck.* 2ter th. s. 383. *Id. Bert.* s. 475. *Id. Mohs*, b. iii. s. 688.—Antimonie natif, *Lucas*, p. 171.—Gediegen Spiesglanz, *Leonhard*, Tabel. s. 78.—Antimoine natif, *Brong.* t. ii. p. 126. *Id. Brard*, p. 370.—Gediegen Spiesglanz, *Karsten*, Tabel. s. 72. *Id. Haus.* s. 70.—Native Antimony, *Kid*, vol. ii. p. 199.—Antimoine natif, *Haüy*, Tabl. p. 112.—Gediegen Spiesglanz, *Hoff.* b. iv. s. 99. *Id. Haus.* Handb. b. i. s. 125.—Native Antimony, *Aikin*, p. 123.

External Characters.

Its colour is perfect tin-white. On the fresh fracture it sometimes becomes covered with a yellowish or greyish tarnish.

It occurs massive, disseminated, reniform; also in distinct concretions, which are coarse, small, and fine angulo-granular, and the latter are collected into thin and curved lamellar; and crystallized, in the following figures:

1. Octahedron.
2. Rhomboidal dodecahedron.

On the fresh fracture it is splendent, and the lustre is metallic.

Its cleavage is octahedral and dodecahedral.

The fragments are sometimes octahedral or dodecahedral, more usually indeterminate angular, and blunt-edged.

It is harder than calcareous-spar, but not so hard as fluor-spar.

It is rather sectile, and easily frangible.

Specific gravity, 6.720, *Klaproth*, 6.5, 6.8, *Mohs*.

Chemical

Chemical Characters.

Before the blowpipe it melts easily, and volatilizes in the form of a grey inodorous vapour; if the melted globule be allowed to cool slowly, it becomes covered with white brilliant acicular crystals. A very minute globule of silver generally remains after the antimony has been dissipated.

Constituent Parts.

	Andreasberg.
Antimony, - -	98.00
Silver, - -	1.00
Iron, - -	0.25
	99.25*

Klaproth, Beit. b. iii. s. 172.

Geognostic and Geographic Situations.

Europe.—It is found in argentiferous veins in the gneiss mountain of Chalanches in Dauphiny, where it is accompanied with grey antimony or antimony-glance, white antimony, red antimony, silver-white cobalt, and quartz; at Andreasberg in the Hartz, associated with red silver, calcareous-spar and quartz; at Sahlberg, in Westermannland in Sweden, disseminated in calcareous spar.

America.—At Cuencamé in Mexico.

Observations.

* It is sometimes alloyed with a small and variable proportion of arsenic; in consequence of which, its vapour, when exposed to the blowpipe, has an arsenical odour.

Observations.

1. It is characterized by colour, cleavage, distinct concretions, hardness and weight.

2. It is distinguished from *Native Bismuth* by colour, want of tarnish, and inferior specific gravity; from *Antimonial Silver* by inferior specific gravity, and in some degree by colour.

2. Octahedral Antimony.

Octaedrisches Spiesglas, *Mohs.*

This Species contains two Subspecies, viz. 1. Antimonial Silver, 2. Arsenical Silver.

First Subspecies.

Antimonial Silver.

Spiesglas Silber, *Werner.*

Mine d'Argent blanche antimoniale, *Romé de Lisle,* t. i. p. 460. —Antimonialisch gediegen Silber, *Wid.* s. 684.—Antimoniated Native Silver, *Kirw.* vol. ii. p. 110.—Spies-glanz Silber, *Estner,* b. iii. s. 337. *Id. Emm.* b. ii. s. 162.—Argent antimonial, *Broch.* t. ii. p. 119. *Id. Haüy,* t. iii. p. 391.—Spiesglanz Silber, *Reuss,* b. iii. s. 325. *Id. Lud.* b. i. s. 211. *Id. Suck.* 2ter th. s. 135. *Id. Bert.* s. 369. *Id. Mohs,* b. iii. s. 127. —Argent antimonial, *Lucas,* p. 104.—Spiesglanz Silber, *Leonhard,* Tabel. s. 53.—Argent antimonial, *Brong.* t. ii. p. 249. *Id. Brard,* p. 243.—Spiesglanz Silber, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 70.—Silver alloyed with Antimony, *Kid,* vol. ii. p. 85.—Argent antimonial, *Haüy,* Tabl. p. 74.—Silberspiesglans, glanz, *Haus.* Handb. b. i. s. 126.—Spiesglas Silber, *Hoff.* b. iii. s. 46.—Antimonial Silver, *Aikin*, p. 76.

External Characters.

Its colour is intermediate between silver-white and tin-white; sometimes inclining more to the one, sometimes more to the other, yet in general more to the first.

It occurs massive, and disseminated; also in distinct concretions, which are coarse, small and fine granular. It is sometimes crystallized, and in the following figures:

1. Rectangular four-sided prism, sometimes truncated, or bevelled on the lateral or terminal edges and angles.
2. Unequiangular six-sided prism.
3. Double six-sided pyramid, truncated on the apices. The crystals are sometimes acicular and superimposed.

The surface of the prisms is usually longitudinally streaked; and the massive varieties uneven.

Externally it is glistening, sometimes only glimmering.

Internally it is shining and splendent, with a metallic lustre.

The cleavage is octahedral.

Its hardness is intermediate between that of calcareous-spar and fluor-spar.

It is sectile, and rather easily frangible.

Specific gravity, 9.4, *Haüy.*—10.000, *Selb.*—9.820, *Klaproth.*

Chemical Characters.

Heated on charcoal before the blowpipe, the antimony is volatilized, with the odour which is peculiar to it, and there

there remains a mass of silver, surrounded with a brown slag, which colours borax green.

Constituent Parts.

				Fine Granular from Wolfach.	Coarse Granular from Wolfach.	From Andreasberg.
Silver,	89	78	75.25	84	76	75¼
Antimony,	11	22	24.75	16	24	24¾
	100	100	100.00	100	100	100
	Selb.	*Vauquelin.*	*Abich.*	*Klap.* Beit. b. ii. s. 301.	Ibid.	Ibid. b. iii. s. 176.

Geognostic Situation.

It occurs in veins, in granite and grey-wacke, and in both situations it is associated with arsenical silver, native arsenic, galena or lead-glance, brown blende, and calcareous-spar; but in the granite, it is also accompanied with native silver, red silver, iron pyrites, straight lamellar heavy-spar, and fluor-spar; and in the grey-wacke, with native antimony, red silver, silver-glance, and brown-spar.

Geographic Situation.

It occurs in veins that traverse granite, at Altwolfach in Suabia; in veins that traverse clay-slate, at Andreasberg in the Hartz; at Kasalla, near Guadalcanal in Spain; and, it is said, also at the Rathausberg in Gastein, and the Goldberg at Rauris in Salzburg; and at Allemont in France.

Observations.

It is distinguished from *Native Silver*, by its sectility and cleavage: from *White Cobalt*, by its sectility, and inferior

inferior hardness: from *Arsenical Pyrites*, by its cleavage, and inferior hardness.

Second Subspecies.

Arsenical Silver.

Arseniksilber, *Werner*.

Id. Wern. Pabst. b. i. s. 28.—Argent arsenical, *De Born*, t. ii. p. 417.—Arsenikalisch gediegen Silber, *Wid.* s. 687.—Arsenicated native Silver, *Kirw.* vol. ii. p. 111.—Arsenicsilber, *Estner*, b. iii. s. 342. *Id. Emm.* b. ii. s. 165.—L'Argent arsecal, *Broch.* t. ii. p. 122.—Argent antimonial, arsenifere, et ferrifere, *Haüy*, t. iii. p. 398.—Arsenik-silber, *Reuss*, b. iii. s. 499. *Id. Lud.* b. ii. s. 211. *Id. Suck.* 2ter th. s. 144. *Id. Bert.* s. 503. *Id. Mohs*, b. iii. s. 131. *Id. Leonhard*, Tabel. s. 53.—Argent arsenical, *Brong.* t. ii. p. 250.—Silber-arsenik, *Karsten*, Tabel. s. 74.—Silver alloyed with Arsenic and Iron, *Kid*, vol. ii. p. 86.—Argent antimonial ferro-arsenifere, *Haüy*, Tabl. p. 74.—Arsenik-silber, *Hoff.* b. iii. s. 48.—Arsenical Antimonial Silver, *Aikin*, p. 19.

External Characters.

Its colour on the fresh surface is tin-white, which tarnishes greyish black.

It occurs massive, and small reniform; also in distinct concretions, which are reniform curved lamellar.

Internally it is glistening and metallic.

The fracture is small-grained uneven, with a tendency to a cleavage.

The fragments are indeterminate angular and blunt-edged.

It is harder than antimonial silver.

It

It is shining in the streak.

It is sectile, slightly inclining to brittle, and easily frangible.

Specific gravity 9.440, *Haüy*.

Chemical Characters.

Before the blowpipe, the arsenic and antimony are volatilized, and emit a garlic smell; a globule of silver remains, which is more or less pure.

Constituent Parts.

	Andreasberg.
Arsenic,	35.00
Iron,	44.25
Silver,	12.75
Antimony,	4.00
	96.00

Klaproth, Beit. b. i. s. 187.

Geognostic and Geographic Situations.

It generally occurs along with native arsenic, dark-red silver, brittle silver-glance, galena or lead-glance, and brown blende, in massive white calcareous-spar. It is found in the Hartz; also at Altwolfach in Suabia; and at Guadalcanal and Kasalla in Spain.

Observations.

It does not tarnish so quickly, and its colour is lighter than that of native arsenic, with which it has been confounded.

GEN. X.

GENUS X. TELLURIUM.

This Genus contains one Species, viz. Hexahedral Tellurium.

1. Hexahedral Tellurium.

Hexaedrisches Tellur, *Mohs.*

Gediegen Sylvan, *Werner.*

Tellure natif aurifere et ferrifere, *Haüy,* t. ii. p. 325.—Le Silvane natif, *Broch.* t. ii. p. 480.—Gediegen Tellur, *Reuss,* b. iv. s. 604. *Id. Lud.* b. i. s. 310. *Id. Suck.* 2ter th. s. 492.—Gediegen Sylvan, *Bert.* s. 520. *Id. Mohs,* b. iii. s. 57.—Tellure natif, *Lucas,* p. 185.—Gediegen Tellur, *Leonhard,* Tabel. s. 80.—Tellure natif, *Brong.* t. ii. p. 125. *Id. Brard,* p. 391.—Gediegen Tellur, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 70.—Tellure natif auro-ferrifere, *Haüy,* Tabl. p. 119.—Gediegen Tellur, *Haus.* Handb. b. i. s. 129.—Gediegen Sylvan, *Hoff.* b. iv. s. 126.—Native Tellurium, *Aikin,* p. 139.

External Characters.

Its colour is tin-white.

It occurs massive, disseminated, in small and fine granular distinct concretions, and crystallized in rectangular four-sided prisms acuminated with four planes, which are set on the lateral planes *.

Internally

* Haüy is of opinion, that the primitive form is the regular octahedron.

Internally it is shining, and the lustre is metallic.

Its cleavage is hexahedral.

It is as hard as gypsum, and sometimes harder, but never so hard as calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity, 6.1, 6.2, *Mohs.*—6.115, *Klaproth.*

Chemical Characters.

Before the blowpipe it melts as easily as lead, emits a thick white smoke, and burns with a light green colour, and a pungent acrid odour, like that of horse raddish. When exposed to a low heat, it is converted into a yellowish or blackish coloured oxide: by an increase of temperature it melts into a dark-brown or blackish coloured glass, in which gold grains are interspersed: at a still higher heat, the oxide is entirely volatilized. In concentrated nitric acid, it is converted into a yellow oxide, and a small portion is dissolved, which is precipitated in yellow flakes on the addition of water.

Constituent Parts.

Tellurium, - -	92.55
Iron, - -	7.20
Gold, - -	0.25
	100.00

Klaproth, Beit. b. iii. s. 8.

Geognostic Situation.

It occurs in veins in grey-wacke, along with iron pyrites. sometimes with lead-glance, and always with quartz.

Geographic

Geographic Situation.

It occurs at Facebay in Transylvania; also in Norway, where it has been lately detected by Professor Esmark *.

Observations.

1. It resembles Native Antimony, but is distinguished from it by its inferior hardness, and its lower specific gravity.

2. It is known in older works in mineralogy under the names Aurum paradoxicum, Aurum problematicum, and White Gold-ore.

ORDER II.

* There is a fine specimen of the very rare Norwegian Tellurium in the interesting and instructive cabinet of the Geological Society of London, and another in the splendid collection of Mr Heuland.

ORDER II.—ORE.

GENUS I.—TITANIUM ORE.

THIS Genus contains three Species, viz. 1. Prismatic Titanium Ore, 2. Prismato-Pyramidal Titanium Ore, 3. Pyramidal Titanium Ore.

1 Prismatic Titanium Ore, or Sphene *.

Prismatisches Titan-erz, *Mohs.*

THIS Species is divided into two Subspecies, viz. Common Sphene and Foliated Sphenc.

First Subspecies.

Common Sphene.

Gemeiner Sphen, *Karsten.*

Braun Mänakerz, *Werner.*

Titane-Siliceo-Calcaire, *Haüy.*

Brauner Titanit, *Schumacher's* Verz. s. 114.—Titane siliceo-calcaire, *Haüy*, t. iv. p. 307.; also Sphene, *Haüy*, t. iii. p. 114. —Gemeiner Titanit, *Reuss*, b. iv. s. 584. *Id. Suck.* 2ter th. s. 481.

* The name *Sphene*, is derived from the Greek word σφηνος, (*a wedge*), because some of the crystals have a wedge-like shape.

s. 481.—Brunon, *Mohs*, b. iii. s. 465.—Titanit, *Leonhard*, Tabel. s. 82.—Gemeiner Sphen, *Karsten*, Tabel. s. 74.—Titane-siliceo-calcaire, *Haüy*, Tabl. p. 116.—Gemeiner Sphen, *Haus*. Handb. b. ii. s. 613. *Id. Hoff*. b. iv. s. 260.—Sphene, *Aikin*, p. 137.

External Characters.

Its colours are reddish, yellowish, and blackish-brown, also grass-green, pistachio-green, asparagus-green, olive-green, yellowish-grey, and greenish-white.

It occurs in granular distinct concretions, and crystallized in the following figures:

1. Low very oblique four-sided prism, acutely bevelled on the extremities, the bevelling planes set on the obtuse lateral edges*. The obtuse lateral edge of the prism is 136° 50′, and the angle of the bevelment is 60°. This is the primitive form †. Fig. 168. Pl. 8.
2. Sometimes the acute angles of the prism are truncated, and the truncating planes set on the acute lateral edges.
3. Broad six-sided prism, with two opposite broader, and four opposite smaller lateral planes, and acuminated with four planes.
4. Rectangular four-sided prism, which is either bevelled on the extremities, or acuminated with four planes, which are set on the lateral planes. This prism is formed when all the edges of the oblique prism are truncated, and the truncating planes

* Titan siliceo-calcaire ditetraedre, Haüy.

† Titan siliceo-calcaire uniternaire, Haüy.

planes meet together, entirely obliterating the oblique planes.

5. Oblique double four-sided pyramid, in which the apices are bevelled.
6. The preceding figure so very flat or obtuse, that it has a lenticular form.

Sometimes two crystals unite, forming either a furrowed or canaliculated twin-crystal *, or a compressed rectangular cruciform one.

The crystals are large, middle-sized, small, and very small.

The surface of the crystals is generally smooth; rarely longitudinally streaked, as in the octahedron.

Internally it is shining or glistening, and the lustre is adamantine, sometimes inclining to resinous, sometimes to vitreous.

The cleavage is imperfect.

The fracture is imperfect conchoidal, which inclines to uneven.

It alternates from opaque, to translucent.

Its streak is greyish or yellowish white.

It is harder than apatite, but not so hard as felspar.

It is brittle, and easily frangible.

Specific gravity, 3.480, *Schumacher*.—3.510, *Klaproth*.—3.4, 3.6, *Mohs*.

Chemical Characters.

Before the blowpipe it is fusible with difficulty into a blackish-brown enamel; with borax it yields a grey-slag; with phosphat of soda a green globule.

Constituent

* The above figure is the Rayonnanté en forme de gouttiere of Saussure; Sphene canaliculé of Haüy.

Constituent Parts.

	Passau.	Salzburg.	St Gothard.
Oxide of Titanium,	33	46	33.3
Silica, -	35	36	28.0
Lime, - -	33	16	32.2
Water, -	0	1	0
	101	99	93.5
	Klaproth, Beit. b. i. s. 251.	*Ibid.* b. v. s. 344.	*Cordier* in Jour. de Mines, N. 73. 70.

Geognostic and Geographic Situations.

Europe.—It occurs in small and very small crystals, imbedded in the syenite of the Criffle and other hills in Galloway; in the syenite of Inverary; in syenite on the south side of Loch-Ness; in the same rock, in the mountains around the King's House, and in the syenite mountains that extend from that dreary and desolate track towards Inverouran; in the syenite of Ben-Nevis *; the granite of Aberdeen †; in the syenite of Culloden in Inverness-shire ‡; in that between Freeburn and Aviemore; in the syenite of Shetland; and in the flœtz-trap rocks in Mid-Lothian. It is is also found in the iron-mines of Arendal in Norway; Bovkhult in West Gothland, in primitive limestone; in the granite rocks of Trolhätta in Sweden; in the syenite of Passau on the Inn; and in that of Moravia; in the granite or syenite of Nantes in France; in clinkstone in the Sanadoire in the Department of Puy de Dôme; and in the volcanic rocks on the borders of the Rhine: and on St Gothard

* Greenough.

† Mr Mackenzie junior of Applecross.

‡ MacCulloch.

Gothard and at Salzburg it is associated with chlorite; which mineral is either disseminated through the crystals, or incrusts them.

America.—It is found imbedded in a compound of hornblende, felspar, and graphite, in the vicinity of Lake St George, and in granular foliated limestone at Kingsbridge, island of New-York *.

Africa.—In the antique syenite of Egypt.

Observations.

1. The distinctive characters of this mineral are colour, crystallization, hardness, and weight.

2. The brown varieties are distinguished from *Grenatite*, by inferior hardness, and different form; from *Zircon*, by form, inferior hardness, and inferior specific gravity; the green and yellow varieties from *Epidote*, by cleavage; from *Actynolite*, by greater hardness, weight and crystallizations; and from *Axinite*, by its crystallizations, colours, inferior hardness, and greater weight.

3. Both the brown and yellow subspecies have been described under the name *Titanium Spar*.

Second

* Bruce's American Mineralogical Journal, p. 239,—241.

Second Subspecies.

Foliated Sphene.

Schaaliger Sphen, *Karsten.*

Gelb Mänakerz, *Werner.*

Titane siliceo-calcaire, *Haüy.*

Gelber Titanite, *Schumacher,* Verz. s. 46.—Titane siliceo-calcaire, *Haüy,* t. iv. p. 307.; also Sphene, *Id.* t. iii. p. 114.—Spathiger Titanit, *Reuss,* b. iv. s. 590. *Id. Suck.* 2ter th. s. 485. *Id. Bert.* s. 280.—Titanit, *Leonhard,* Tabel. s. 82.—Schaaliger Sphen, *Karsten,* Tabel. s. 74.—Titan siliceo-calcaire, *Haüy,* Tabl. p. 116.—Spathiger Sphen, *Haus.* Handb. b. ii. s. 614.—Gelb Manakerz, *Hoff.* b. iv. s. 263.—Sphene, *Aikin,* p. 137.

External Characters.

Its colours are pea-yellow, straw-yellow, cream-yellow, honey-yellow, and sulphur-yellow; the pea-yellow passes into clove-brown, and into yellowish-grey.

It occurs massive, in straight lamellar concretions, and crystallized in the same figures as the preceding subspecies.

The crystals vary from large to very small.

The lustre on the cleavage is splendent or shining, on the imperfect conchoidal and uneven fractures, only shining or glistening, and is resinous.

It has a double cleavage, in which the folia are parallel with the lateral planes of the oblique four-sided prism.

The fracture is imperfect conchoidal, inclining to uneven.

It is translucent, or only translucent on the edges.

In

In other characters it agrees with the preceding subspecies.

Its chemical characters and composition are the same as those of common sphene.

Geognostic and Geographic Situations.

Europe.—It occurs at La Portia in Piedmont; St Gothard; at Arendal in Norway, in beds of magnetic ironstone, subordinate to gneiss. In these beds, it is associated with common sphene, epidote or pistacite, hornblende, augite, scapolite, felspar, quartz, calcareous-spar, and garnet. Very small honey-yellow crystals occur in the clinkstone of the Mariaberg, near Aussig in Bohemia.

America.—In primitive limestone at Newton in New Jersey; in an aggregate of felspar, hornblende, and graphite, near Ticonderago, where it was discovered by Colonel Gibbs; in Staten Island, in greenstone and hornblende rocks; in the vicinity of Peeks-hill, New-York, in syenite; and in veins of greenstone or syenite that traverse granite at Wantage, Sussex county, New Jersey *.

Observations.

1. Its distinct cleavage distinguishes it from *Common Sphene;* its crystallizations, and greater hardness, distinguish it from *Sparry Iron;* and its inferior weight and greater hardness, distinguish it from *Tungsten.*

2. The *Semeline* of Andernach, and the *Spinthere* of Marone in Dauphiny, are probably varieties of this mineral.

2. Prismato-

* Bruce's American Mineralogical Journal, p. 239,—242.

2. Prismato-Pyramidal Titanium-Ore.

Prismato-Pyramidales Titan-erz, *Mohs.*

This Species is divided into three Subspecies, viz. Rutile, Iserine, and Menachanite.

First Subspecies.

Rutile *.

Rutil, *Werner.*

Titane Oxidé, *Haüy.*

Rother Schorl, *Klap.* b. i. s. 233.—Schorl crystallizé opaque rouge, *De Born,* t. i. p. 168.—Titanite, *Kirw.* vol. ii. p. 329.—Sagenite, ou Schorl rouge, *Saussure,* t. iv. § 1894.—Oxide rouge de Titanium, *Lam.* t. i. p. 414.—Crispite, *Id.* t. ii. p. 233.—Titane oxidé, *Haüy,* t. iv. p. 296.—Le Ruthile, *Broch.* t. ii. p. 470.—Titanschorl, *Reuss,* b. iv. s. 569. *Id. Lud.* b. i. s. 305. *Id. Suck.* 2ter th. s. 476. *Id. Bert.* s. 514. *Id. Mohs,* b. i. s. 455.—Titane oxydé, *Lucas,* p. 180.—Rutile, *Leonhard,* Tabel. s. 82.—Titane ruthile, *Brong.* t. ii. p. 97.—Titane oxidé, *Brard,* p. 383.—Rutill, *Karsten,* Tabel. s. 74. *Id. Haus.* s. 111.—Native Oxide of Titanium, *Kid,* vol. ii. p. 222.—Titane oxidé, *Haüy,* Tabl. p. 115.—Rutil, *Haus.* Handb. b. i. s. 319. *Id. Hoff.* b. iv. s. 252.—Titanite, *Aikin,* p. 135.

External Characters.

Its most frequent colour is reddish-brown, of various degrees

* *Rutile,* from the Latin *rutilus,* reddish.

grees of intensity, which passes into light hyacinth-red and blood-red. Sometimes dark isabella-yellow.

It occurs massive, disseminated, in membranes; also in lamellar and granular distinct concretions, and crystallized.

Its primitive figure is a pyramid of 117° 2′, and 84° 48′. The following are some of the secondary forms.

1. Long rectangular four-sided prism.
2. The preceding figure truncated on the lateral edges, and thus forming an eight-sided prism.
3. Four-sided prism, in which the lateral edges are bevelled.
4. Four-sided prism acuminated with four planes, which are set on the lateral planes. The edges and apex of the acuminations are sometimes truncated.
5. Six-sided prism, sometimes acuminated with six planes, which are set on the lateral planes, and these are rarely convex *. Fig. 169. Pl. 8.
6. Sometimes two prisms are joined by their terminal planes, under a very obtuse angle, thus forming a kind of twin-crystal †. Fig. 170. Pl. 8.
7. It occurs sometimes in capillary and acicular crystals.

The crystals are occasionally curved; have frequent transverse rents, and are sometimes apparently broken entirely across, the ends removed to some distance from one another, and the interstice filled up with the substance of which the matrix consists.

* Vid. Bruce's American Mineralogical Journal, p. 238. where the above figure is described.

† Titane oxidé geniculé, Haüy.

The crystals are usually small and very small, seldom middle-sized; the capillary crystals are frequently scopiformly aggregated; often reticulated, and the interstices have the shape of equilateral triangles *.

The lateral planes of the crystals are longitudinally streaked, the other planes are smooth.

Externally it is shining and glistening.

Internally the lustre is intermediate beetween adamantine and semi-metallic, and is splendent on the surface of the cleavage, but only shining or glistening in the conchoidal or uneven fractures.

It has a cleavage in which two of the folia are parallel with the lateral planes of the rectangular four-sided prism, and two others parallel with the diagonals of the same prism. Of these cleavages those parallel with the lateral planes are the most distinct.

The fracture is intermediate between coarse-grained uneven, and small and imperfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

Its streak is brown.

It is transparent or only translucent on the edges.

It is harder than apatite.

It is brittle, and easily frangible.

Specific gravity, 4.180, *Klaproth*.—4.247, *La Metherie*.—4.1025, *Haüy*.—4.255, *Lowry*.

Chemical Characters.

Without addition, or even with phosphoric salts, it is infusible before the blowpipe; with borax or alkali, it affords a hyacinth-red transparent glass.

Constituent

* The reticulated variety was named by Saussure Sagenite, and Schorl tricoté.

Constituent Parts.

According to the analysis of Klaproth, it is pure oxide of titanium, slightly intermixed with oxide of iron. Ekeberge and Vauquelin found in a variety from Westmannland a small portion of oxide of chrome *.

Geognostic Situation.

It is found imbedded, in veins and in drusy cavities, in granite, syenite, gneiss, mica-slate, limestone, chlorite-slate and hornblende-slate.

Geographic Situation.

Europe.—It occurs in the granite of Cairngorm, the limestone of Rannoch, and in the rocks of Ben Gloe, where it was discovered by MacCulloch; also at Craig Cailleach, near Killin in Perthshire, imbedded in quartz, and near to Beddgelert in Caernarvonshire. In Norway it occurs at Arendal, in a vein of granite which traverses gneiss, and in a rock of the same kind at Aschaffenburg. On St Gothard it is met with in those drusy cavities that so often occur in granite, resting on the rock-crystal, adularia, and foliated chlorite, with which they are lined. In the country of Salzburg, it is imbedded in tremolite, and in Hungary in common quartz, and in rock-crystal, which lies in nests in mica-slate. It is found near St Grieux, and at Allemont in France; at Buitrago in Spain, in veins in gneiss along with schorl; at Boinik in Hungary, and in Transylvania.

* Annales du Mus. t. vi. p. 93. It is the Titane oxidé chromifere of Haüy.

Asia.—It is found at the town of Sarapulka, twelve wersts from Mursinska in Siberia.

America.—It occurs in veins of an aggregated rock of felspar, quartz, mica, and granular foliated limestone, which traverse primitive limestone in the island of New-York: also in primitive limestone on the Hudson River; in large quantity imbedded in quartz, in the vicinity of Richmond in Virginia; in quartz in hornblende-slate, at Worthington in Massachusets; in quartz from the neighbourhood of Baltimore; and in quartz near the Schuyler copper-mines in Bergen county, New Jersey. It is also met with in South Carolina; in quartz in the county of Delaware in Pennsylvania, and in the back part of North Carolina, where it is said to occur in great abundance *.

Observations.

1. It is nearly allied to *Tinstone*, but is distinguished from it by colour and inferior specific gravity; and its colours, form, considerable specific gravity distinguish it from *Octahedrite* and *Schorl.*

2. It has been described under the following names:—*Red Schorl, Shorlaceous Garnet, Titanitic Schorl.* The acicular varieties have been named *Sagenite*, and others *Gallitzinite*.

Second

* Bruce's American Mineralogical Journal, p. 235,—238.

Second Subspecies.

Iserine.

Iserin, *Werner*.

L'Iserine, *Broch.* t. ii. p. 478.—Iserin, *Reuss*, b. iv. s. 598. *Id. Lud.* b. i. s. 306.—Iser-Titan, *Suck.* 2ter th. s. 489.—Iserin, *Mohs*, b. iii. s. 450. *Id. Leonhard*, Tabel. s. 81. *Id. Karsten*, Tabel. s. 74.—Titane oxydé ferrifere, *Haüy*, Tabl. p. 116. —Titaneisenstein, *Haus.* b. i. s. 251.—Iserin, *Hoff.* b. iv. s. 258.—Iserine, *Aikin*, p. 136.

External Characters.

Its colour is iron-black, inclining to brownish-black.

It occurs in small, seldom middle-sized, obtuse angular, grains, and in rolled pieces, with a somewhat rough, strongly glimmering surface.

Internally it alternates from splendent to glistening, and the lustre is metallic.

The fracture is more or less perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is completely opaque.

It is harder than felspar.

It is brittle.

It retains its colour in the streak.

Specific gravity 4.5, 4.650, *Klaproth*.

Chemical Characters.

Before the blowpipe, it melts into a blackish-brown coloured glass, which is slightly attracted by the magnet. The

The mineral acids have no sensible effect on it; but the acid of sugar extracts a portion of the titanium.

Constituent Parts.

Oxide of Titanium,	48	28
Oxide of Iron, -	48	72
Oxide of Uranium, -	4	
	100	100
	Thomson, in Edin. Phil. Trans. for 1807.	*Klaproth*, Beit. b. v. s. 206.

Geognostic and Geographic Situations.

It occurs imbedded in gneiss, and disseminated in granitic sand, along with iron-sand, in the bed of the river Don in Aberdeenshire *. On the Continent of Europe, it has been hitherto found only in the lofty Riesengebirge, near the origin of the stream called the Iser, disseminated in granite-sand †, and in alluvial soil, along with pyrope, in Bohemia.

Observations.

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* Vid. Dr Thomson's Paper on the Black Sand of the river Don in Aberdeenshire.—Edin. Phil. Trans.

† The Buchberg is the highest basalt hill in Germany, being 2921 feet above the level of the sea, and the highest basalt except that small portion lodged in the cavity of the Schneegrube, which is situated near 4000 feet above the level of the sea. The hill itself is elevated 500 feet above the level of the stream named Iser, that waters its granite base, and at some distance below which the Iserine is found. Whilst travelling through Silesia with that excellent and truly philosophical mineralogist, my amiable, and ever to be regretted friend, the late Dr Mitchell, we ascended the Buchberg, with the view of ascertaining more particularly the geognostic situation of the Iserine; but after a very careful examination, we could discover it neither in the granite nor basalt, but only loose in the granitic sand.

Observations.

1. This mineral is by many mineralogists, and probably with justice, referred to the magnetic iron-sand.
2. Its fracture distinguishes it from *Menachanite.*

Third Subspecies.

Menachanite.

Menacan, *Werner.*

Menachanite, *Kirw.* vol. i. p. 326.—Le Menakanite, *Broch.* t. ii. p. 468.—Titane oxidé ferrifere granuliforme, *Haüy,* t. iv. p. 306.—Manacan, *Reuss,* b. iv. s. 54. *Id. Lud.* b. i. s. 305. *Id. Mohs,* b. iii. s. 452. *Id. Leonhard,* Tabel. s. 81.—Titane Menakanite, *Brong.* t. ii. p. 99.—Manakan, *Karsten,* Tabel. s. 74.—Menachanite, *Kid,* vol. ii. p. 224.—Titane oxidé ferrifere, *Haüy,* Tabl. p. 116.—Titaneisenstein, *Haus.* Handb. b. i. s. 251.—Menakan, *Hoff.* b. iv. s. 247.—Menachanite, *Aikin,* p. 136.

External Characters.

Its colour is greyish-black, inclining to iron-black.

It occurs only in very small flattish angular grains, which have a rough glimmering surface.

Internally it is glistening or glimmering, or the lustre is adamantine, passing into semi-metallic.

It has an imperfect cleavage.

The fragments are indeterminate angular and sharp-edged.

It is perfectly opaque.

It

It is not so hard as magnetic iron-sand.
It is brittle, and easily frangible.
It retains its colour in the streak.
Specific gravity, 4.427, *Gregor*.—4.270, *Lampadius*.

Physical Character.

It is attractible by the magnet, but in a much weaker degree than magnetic ironstone.

Chemical Characters.

It is infusible, without addition, before the blowpipe: it tinges borax of a greenish colour, which inclines to brown.

Constituent Parts.

	Cornwall.	Botany Bay
Oxide of Iron, -	51.00	49
Oxide of Titanium,	45.25	40
Oxide of Manganese,	0.25	
Silica, -	3.50	11
	100.00	100
	Klaproth, Beit. b. ii. s. 231.	*Chenevix*, in Nicholson's Journ. vol. v. p. 132.

Geognostic and Geographic Situations.

It is found, accompanied with fine quartz-sand, in the bed of a rivulet which enters the valley of Manaccan in Cornwall; on the shores of the Island of Providence in America; the vicinity of Richmond in Virginia; and at Botany Bay in New South Wales.

Observations.

Observations.

It has been confounded with Magnetic Iron-Sand, from which it may be readily distinguished by its cleavage, lustre and inferior hardness; and its inferior hardness and weight distinguish it from *Tinstone*.

3. Pyramidal Titanium-Ore, or Octahedrite.

Octaedrit, *Werner*.

Schorl bleu, *Romé de Lisle*, t. ii. p. 406.—Schorl octaedre rectangulaire, *Bournon*, Journ. de Phys. 1787, Mai.—Oisanite, *Lam.* t. ii. p. 269.—Octaedrite, *Saussure*, Voyages dans les Alpes, t. vii. p. 139. § 1901.—Anatase, *Haüy*, t. iii. p. 129. 136. *Id. Broch.* t. ii. p. 548. *Id. Reuss*, b. iv. s. 580.—Pyramiden Manak, *Lud.* b. ii. s. 191.—Anatase-titan, *Suck.* 2ter th. s. 480.—Anatase, *Mohs*, b. iii. s. 462. *Id. Leonhard*, Tabel. s. 82.—Titane-Anatase, *Brong.* t. ii. p. 101.—Anatas, *Karsten*, Tabel. s. 74. *Id. Haus.* s. 111.—Octahedral Titanite, *Kid*, vol. ii. p. 223.—Titan anatase, *Haüy*, Tabl. p. 116.—Anatas, *Haus.* Handb. b. i. s. 322.—Octaedrit, *Hoff.* b. iv. s. 249.—Octohedrite, *Aikin*, p. 137.

External Characters.

Its colour passes from indigo-blue, through many shades, to dark reddish-brown, clove-brown, and yellowish-brown.

It has been hitherto found only crystallized.

Its primitive form is a pyramid of 97° 38′, and 137° 10′ *. The following are the secondary figures:

The

* Anatase primitif, Haüy.

1. The pyramid truncated on the extremities *.
2. Double four-sided pyramid acuminated on the extremities with four planes, and the acuminating planes set on the lateral planes †.
3. Double four-sided pyramid acuminated with eight planes, of which two and two are set on each lateral plane ‡.

The crystals are small and very small, and are usually superimposed.

The surface is transversely streaked, and is splendent, and the lustre is semi-metallic.

Internally it is also splendent, and the lustre is adamantine, inclining to semi-metallic.

It has a fourfold cleavage parallel with the sides of the primitive figure, and one cleavage parallel to the common base of the pyramids.

The fragments are indeterminate angular and sharp-edged.

It is strongly translucent or semi-transparent, or passing to transparent.

It is harder than apatite, and sometimes nearly as hard as felspar.

It is brittle.

Specific gravity, 3.8571, *Haüy*.—3.8, 3.9, *Mohs*.

Chemical Characters.

It is infusible before the blowpipe. When melted with borax, a reddish-brown coloured glass is formed. When this

* Anatase basé, Haüy.

† Anatase dioctaedre, Haüy.

‡ Anatase prominulé, Haüy.

this glass is brought to the extremity of the flame, the reddish-brown colour changes into blue, and becomes opaque. If the action of the blowpipe be still continued, it at length becomes white. In a higher temperature, the reddish-brown colour again appears; and according as the temperature is altered, the appearance and disappearance of the colours can be produced.

Constituent Parts.

According to the experiments of Vauquelin, it is an oxide of titanium.

Geognostic and Geographic Situations.

It is a rare mineral. It is found at Bourg d'Oisans in Dauphiny, in veins in primitive rocks along with felspar, axinite, rock-crystal, and chlorite: it has also been met with in drusy cavities in transition clay-slate in Hadeland in Norway; and associated with rose-red fluor in St Gothard in Switzerland.

Observations.

1. It is distinguished from *Tungsten* by its lustre, greater hardness, and inferior specific gravity; and from *Axinite*, by its crystallizations, cleavage, and hardness.

2. It is named *Oisanite* by La Methrie, and *Anatase* by Haüy.

4. Octahedron, in which each of the angles is acuminated with four planes, which are set on the lateral edges, fig. 179. Pl. 9.; sometimes the edges are truncated, and also the summits of the acuminations, fig. 180. Pl. 9.
5. Octahedron, bevelled on the edges, fig. 181. Pl. 9.: sometimes the bevelling planes become so large that each face of the octahedron appears divided into three compartments, or each plane supports a flat three-planed acumination, fig. 182. Pl. 9. Sometimes the angles and edges of the octahedron in this figure are also truncated, and according as these bevelling and truncating planes are larger or smaller, the figure varies in appearance.
6. Octahedron, in which each angle is acuminated with four planes, which are set on the lateral planes, fig. 183. Pl. 9. This variety is generally combined with the planes of several of the preceding ones.
7. Octahedron, in which each angle is acuminated with eight planes, two of which are set on each plane, fig. 184. Pl. 9. This variety is always associated with some of the preceding, and crystals have been met with, exhibiting this variety combined with all the preceding ones. Fig. 185. Pl. 9. represents such a crystal, which is marked as follows:— P, planes of the octahedron: (1.) Truncations on the angles: (2.) Truncations on the edges: (3.) Four acuminating planes on the angles, which are set on the edges of the octahedron: (4. Bevelling planes on the edges: (5.) Four acuminating planes

on

on the angles, which are set on the planes of the octahedron: (6.) Eight-planed acumination *.

The crystals are usually small and very small, seldom middle-sized: they occur sometimes aggregated on one another, side by side, and scalarwise.

The planes are smooth and splendent.

Internally it alternates from shining to glistening, and its lustre is adamantine, inclining to semi-metallic.

It has a fourfold cleavage, in which the folia are parallel with the sides of the octahedron.

The fracture is coarse and small-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

The massive varieties are usually opaque, or very faintly translucent on the edges. The crystals are transparent and semi-transparent, and sometimes strongly translucent.

It yields a muddy tile-red streak.

Its hardness is intermediate between that of calcareous-spar and fluor.

It is brittle, and easily frangible.

Specific gravity, 5.600, *Phillips*.—5.691, *Lowry*.—5.6, 6.0, *Mohs*.

Observations.

This subspecies is distinguished from the others by crystallization, lustre, cleavage, and translucency.

Second

* The various forms, and numerous intermediate ones, are delineated in a set of plates attached to Mr Phillips valuable Memoir on Red Copper-ore, in the first volume of the Transactions of the Geological Society of London.

Second Subspecies.

Compact Red Copper-Ore.

Dichtes Rothkupfererz, *Werner.*

Id. Werner, Pabst. b. i. s. 66.—Compact florid, or Cochineal-red Copper-Ore, *Kirw.* vol. ii. p. 135.—Dichtes Rothkupfererz, *Estner,* b. iii. s. 530. *Id. Emm.* b. ii. s. 213.—Le Cuivre Oxide rouge compacte, *Broch.* t. ii. p. 181.—Dichtes Rothkupfererz, *Reuss,* b. iii. s. 433. *Id. Lud.* b. i. s. 226. *Id. Suck.* 2ter th. s. 189. *Id. Bert.* s. 380. *Id. Mohs,* b. iii. s. 213. *Id. Leonhard,* Tabel. s. 56.—Cuivre oxidulé compact, *Brong.* t. ii. p. 219.—Dichtes Rothkupfererz, *Karsten,* Tabel. s. 62.—Red Oxide of Copper, *Kid,* vol. ii. p. 101.—Cuivre oxidulé massif, *Haüy,* Tabl. p. 38.—Dichtes Rothkupfererz, *Haus.* Handb. b. i. s. 239. *Id. Hoff.* b. iii. s. 95.—Amorphous Red Copper, *Aikin,* p. 88.

External Characters.

Its colour is intermediate between lead-grey and cochineal-red, often passing into dark cochineal-red.

It occurs massive, disseminated, and in a kind of reniform shape.

Internally it is glimmering, inclining to glistening, and the lustre is semi-metallic.

The fracture is even, inclining to flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It gives a tile-red streak, and loses thereby a little of its lustre.

It

It is as hard as the foliated subspecies.

It is brittle, and easily frangible.

Third Subspecies.

Capillary Red Copper-Ore.

Haarförmiges Roth Kupfererz, *Werner.*

Kupferblüthe, *Werner,* Pabst. b. i. s. 68.—Fibrous red Copper-ore, *Kirw.* vol. ii. p. 137.—Kupferblüthe, *Estner,* b. iii. s. 538. *Id. Emm.* b. ii. s. 216.—Le Cuivre Oxide rouge capillaire, *Broch.* t. ii. p. 184.—Haarförmiger Rothkupfererz, *Reuss,* b. iii. s. 439. *Id. Lud.* b. i. s. 227. *Id. Suck.* 2ter th. s. 194. *Id. Bert.* s. 382. *Id. Mohs,* b. iii. s. 226. *Id. Leonhard,* Tabel. s. 56.—Cuivre oxidulé capillaire, *Brong.* t. ii. p. 219.—Haarförmiges Rothkupfererz, *Karsten,* Tabel. s. 62. *Id. Haus.* Handb. b. i. s. 239. *Id. Hoff.* b. iii. s. 97.—Cuivre oxydulé capillaire, *Haüy,* Tabl. p. 88.—Capillary Red Copper, *Aikin,* p. 88.

External Characters.

Its colour is most commonly carmine-red, which becomes paler by keeping.

It occurs in small capillary crystals, also in thin tables, which are sometimes aggregated into amorphous and scopiform flakes.

It is shining, and the lustre is adamantine.

It is translucent; but its internal aspect, and the other external characters, cannot be determined, on account of the smallness of the parts of the mineral.

Chemical Characters of the Species.

It is easily reduced to the metallic state before the blowpipe: if pulverised, and thrown into nitric acid, a violent effervescence ensues, and the copper is dissolved, the solution at the same time acquiring a green colour; but if thrown into muriatic acid, no effervescence takes place. We can by this character distinguish red copper-ore from red silver-ore and cinnabar: red silver-ore does not effervesce in nitric acid; and cinnabar does not dissolve in it. It is soluble in ammonia, to which it communicates a blue colour.

Constituent Parts.

	Cornwall.	Siberia.
Copper,	88.5	91.0
Oxygen,	11.5	9.0
	100.0	100.0

Chenevix, Phil. Trans. for 1801. *Klaproth*, Beit. b. iv. s. 29.

	Foliated, Siberia.	Compact Siberia.
Red Oxide of Copper,	97.55	99.50
Intermixed Copper,	1.45	......
Water, - -	0.75	0.25
Oxide of Iron, -	0.25	0.25
	100.00	100.00

John, Chem. Unter. b. i. s. 264. & 261.

Geognostic Situation of the Compact and Foliated Subspecies.

It occurs principally in veins that traverse primitive, and sometimes transition rocks, rarely in secondary rocks, and but seldom in beds, along with copper-glance or vitreous copper. In the veins, it is associated with native copper, blue copper, malachite, copper-green, tile-ore, copper-glance or vitreous copper-ore, copper-pyrites, copper-black or black oxide of copper, olivenite, cube-ore or hexahedral olivenite, arsenical-pyrites, and brown iron-ore. The veinstones are,

quartz,

quartz, fluor-spar, calcareous-spar, heavy-spar, and occasionally chlorite and mica.

Geographic Situation of the Foliated and Compact Subspecies.

Europe.—It occurs in different veins in the mine of Huel-Gorland in Cornwall. All the veins traverse granite, and three of them, viz. the North Lode, the Great Gossan Lode, and the Muttrel Lode, afford the red copper-ore. In the North Lode, it is associated with fluor-spar. In the Great Gossan Lode, it occurs in considerable quantity, and occasionally intermixed with native copper: higher up in the same vein, there is abundance of fluor-spar, sometimes intermixed with copper-pyrites, and arsenical-pyrites. In the Muttrel Lode, the red copper-ore is occasionally accompanied with copper-glance or vitreous copper-ore, copper-black or black oxide of copper, olivenite, arsenical-pyrites, quartz, and fluor-spar. Native copper also occurs in considerable quantities, and generally intermixed with red copper-ore *. It is also found in the mines of Carvath and Hüel-Prosper, also in Cornwall. Small portions of this ore occur, along with native copper, in the trap-rocks of Nalsoe, one of the Faroe Islands; also in the mine of Aardal in Norway, and that of Garpa, in East Gothland in Sweden. It occurs but sparingly, and along with native copper, in the Rammelsberg in the Hartz; near Freyberg, along with native copper, ochry brown iron-ore, lamellar heavy-spar, and quartz; at Altenkirchen, along with brown hematite, native copper, malachite, olivenite, and quartz; in the Zillerthal in Bavaria; distinct crystals, imbedded in

 secondary

* Phillips, in Geological Transactions, vol. i. p. 23.—29.

secondary rocks, at Chessy, near Lyons in France; at Ensiedel in Hungary, with native copper, copper and iron pyrites; at Saska and Moldowa in the Bannat, associated with copper-glance or vitreous copper-ore, malachite, blue copper, native copper, and brown iron-ore.

Asia.—In the mines of Kolywan, along with native copper, and various ores of that metal; and in different mines in the Uralian Mountains.

America.—Chili and Peru.

Geognostic and Geographic Situations of the Capillary Subspecies.

The preceding account applies to the Compact and Foliated red copper-ores: the third subspecies, the Capillary ore, occurs less frequently. In Cornwall, it is found in Huel-Gorland, St Day, and Carharrack mines. On the Continent of Europe, beautiful specimens are met with at Rheinbreitenbach in Nassau, where it is associated with ochry brown iron-ore, native copper, copper-green, malachite, copper-pyrites, white lead-spar, phosphate of copper, copper-black or black oxide of copper, and quartz, in veins that traverse grey-wacke; at Saska in the Bannat, with brown iron-ore, malachite, tile-ore, native copper, foliated red copper-ore, steatite, and lithomarge; and also in the Saxon Erzgebirge, as at Freyberg and Glasshütte. It is also a production of the Siberian copper-mines.

Uses.

It is valued as an ore of copper.

Observations.

1. It is distinguished from *Copper-glance* or *Vitreous Copper*, by its colour; from *Red Silver*, by its crystallizations,

tions, brittleness, greater hardness, and accompanying minerals: from *Cinnabar*, by its colour, brittleness, greater hardness, weight and accompanying minerals: from *Red Antimony-ore* by its colour, red antimony having a cherry-red colour.

2. It is the richest ore of copper.

3. It is described by Cronstedt under the name *Kupferglas*.

4. Hausmann, in his Handbuch der Mineralogie, describes in the following manner a fourth subspecies of red copper-ore:

Earthy Red Copper-ore.

Erdiges Kupferroth.

The colour is intermediate between cochineal-red and brick-red. It occurs massive, and incrusting other ores. It is fine earthy, and dull. It is associated with malachite, tile-ore, native copper, and brown ironstone. It occurs in veins, probably also in beds, in primitive and transition rocks. It is a rare mineral, and has been hitherto found only at Rheinbreitenbach; and near Lauterberg in the Hartz.

Fourth Subspecies.

Tile-Ore.

Ziegelerz, *Werner*.

This subspecies is divided into two kinds, viz. Earthy Tile-ore, and Indurated Tile-ore.

First

First Kind.

Earthy Tile-Ore.

Erdiches Ziegelerz, *Werner.*

Id. Wern. Pabst. b. i. s. 70.—Earthy Brick-red Copper-ore, *Kirw.* vol. ii. p. 137.—Erdiges Ziegelerz, *Estner,* b. iii. s. 550. *Id. Emm.* b. ii. s. 219.—Le Ziegelerz terreuse, *Broch.* t. ii. p. 187.—Erdiges Ziegelerz, *Reuss,* b. iii. s. 443. *Id. Lud.* b. i. s. 227. *Id. Suck.* 2ter th. s. 194. *Id. Bert.* s. 382. *Id. Mohs,* b. iii. s. 226. *Id. Leonhard,* Tabel. s. 56.—Cuivre oxidulé ferrifere, *Brong.* t. ii. p. 220.—Erdiges Ziegelerz, *Karsten,* Tabel. s. 62.—Earthy Red Oxide of Copper, mixed with Brown Oxide of Iron, *Kid,* vol. ii. p. 105.—Cuivre oxydulé terreuse, *Haüy,* Tabl. p. 88.—Erdiges Kupferbraun, *Haus.* Handb. b. i. s. 241.—Erdiges Ziegelerz, *Hoff.* b. iii. s. 99.—Ferruginous Red Copper, *Aikin,* p. 88.

External Characters.

Its colour is hyacinth-red, sometimes also brownish-red, which passes into a reddish-brown, that borders on yellowish-brown.

It occurs massive, disseminated, and incrusting copper-pyrites.

It is composed of dull dusty particles, which are more or less cohering.

It soils slightly, and feels meagre.

Geognostic Situation.

It occurs in veins, and is usually accompanied with native copper and malachite, and sometimes with red copper-ore.

Geographic

Geographic Situation.

It is found at Lauterberg in the Hartz; in veins in the Bannat, along with copper-pyrites, red copper-ore, grey copper, ironshot copper-green, malachite, native copper, and ochry iron-ore; at Falkenstein in the Tyrol, with copper-green, malachite, grey copper, blue copper, calcareous-spar, and quartz; and at Rezbanya, along with copper-green, malachite, and calcareous-spar.

Second Kind.

Indurated Tile-Ore.

Festes Ziegelerz, *Werner.*

Minera Cupri picea, *Wall.* t. ii. p. 280.—Dichtes Ziegelerz, *Werner,* Pabst. b. i. s. 70.—Indurated Brick-red Copper-ore, *Kir.* vol. ii. p. 138.—Pecherz, *Estner,* b. iii. s. 553.—Ziegelerz *Emm.* b. ii. s. 220.—Le Ziegelerz endurcé, *Broch.* t. ii. p. 188. —Verhärtetes Ziegelerz, *Reuss,* b. iii. s. 444. *Id. Lud.* b. i. s. 228. *Id. Suck.* 2ter th. s. 196. *Id. Bert.* s. 383. *Id. Mohs,* b. iii. s. 229. *Id. Leonhard,* Tabel. s. 56. *Id. Karsten,* Tabel. s. 62. *Id. Hoff.* b. iii. s. 100.—Muschliches Kupferbraun, *Haus.* Handb. b. i. s. 241.

External Characters.

Its colours are dark hyacinth-red, brownish-red, reddish-brown, from which it passes into blackish-brown, and dark steel-grey; also dark clove-brown, yellowish-brown, and brownish-black.

It occurs massive, disseminated; also in curved lamellar and fibrous concretions.

Internally

Internally it is glimmering, seldom glistening, and is resinous.

The fracture is imperfect and flat conchoidal.

The fragments are indeterminate angular, and more or less sharp-edged.

The streak is feebly shining, and somewhat lighter in the colour.

It is intermediate between semi-hard and soft.

It is rather brittle, and rather easily frangible.

Chemical Characters.

Before the blowpipe it becomes black, but is very difficultly fusible. To borax it communicates a muddy green colour.

Constituent Parts.

Werner considers it to be an intimate combination of red copper-ore and brown iron-ochre. It contains from 10 to 50 *per cent.* of copper.

Geognostic Situation.

It occurs in veins, and is usually accompanied with red copper-ore, native copper, copper-pyrites, fibrous malachite, and brown iron-ochre.

Geographic Situation.

Europe.—It occurs in veins, along with red copper-ore, native copper, copper-pyrites, and other ores, in Huel-Gorland in Cornwall; also at Llanymynich Hill in Shropshire; at Aardals copper-mine in Norway, along with compact malachite and native copper; at Lauterberg in the Hartz; Kupferberg in Silesia; Rheinbreitenbach in Nassau, along

along with copper-pyrites, malachite, blue copper, copper-green, &c.; Saxon Erzgebirge; and Thuringia; at Falkenstein in the Tyrol, particularly the variety named Pecherz or Pitch-ore; Iglo, Rezbanya, and the Bannat in Hungary.

Asia.—In the mines of Frolowskoi, along with red copper-ore, and brown iron-ochre.

America.—In the mine of El Rosario in Mexico, associated with copper-green and copper-pyrites.

Observations.

1. The red varieties contain the greatest quantity of copper, and the brown the greatest quantity of iron.

2. It is rather a common ore of copper, and occurs almost always where red copper is found.

3. It passes, by increase of the quantity of brown iron-ochre, into brown ironstone.

4. The dark-brown variety of indurated tile-ore, on account of the resemblance of its fracture to pitch, has been denominated *Pitchore*, (Pecherz).

* Black Copper, or Black Oxide of Copper.

Kupferschwärze, *Werner.*

Ochra Cupri nigra, *Wall.* t. ii. p. 291.—Kupferschwärtze, *Wern.* Pabst. b. i. s. 88. *Id. Wid.* s. 755.—Black Copper-ore, *Kirw.* vol. ii. p. 143.—Kupferschwärtze, *Emm.* b. ii. s. 244. *Id. Estner,* b. iii. s. 525.—Oxide noire de Cuivre, *Lam.* p. 312.—Le Cuivre noire, *Broch.* t. ii. p. 180.—Kupferschwärze, *Reuss,* b. iii. s. 431. *Id. Lud.* b. i. s. 226. *Id. Suck.* 2ter th. s. 188. *Id. Bert.* s. 379. *Id. Mohs,* b. iii. s. 229. *Id. Leonhard,* Tabel. s. 58.

s. 58. *Id. Karsten,* Tabel. s. 62. *Id. Haus.* Handb. b. i. s. 243. *Id. Hoff.* b. iii. s. 133.—Black Copper, *Aikin,* p. 89.

External Characters.

Its colour is usually intermediate between bluish and brownish-black, but rather more inclining to brownish-black.

It occurs massive, sometimes disseminated, and thinly coating copper-pyrites, and other ores of copper.

It is composed of dull dusty particles, which scarcely soil.

It is always more or less cohering.

It becomes slightly shining in the streak *.

Chemical Characters.

Before the blowpipe it emits a sulphureous odour, melts into a slag, and communicates a green colour to borax. It forms a smalt-blue coloured solution with ammonia, the iron remaining undissolved.

Constituent Parts.

It is said to be an Oxide of Copper.

Geognostic Situation.

It occurs usually with copper-pyrites, malachite, copper-green, and copper-glance or vitreous copper-ore; sometimes with native copper, red copper-ore, grey copper, blue copper-ore, quartz, fluor-spar, heavy-spar, and brown-spar.

Geographic

* Bournon, in his *Catalogue Mineralogique,* says, that this ore is sometimes reniform, with a fibrous fracture like hæmatite.

Geographic Situation.

Europe.—It occurs at Carrarach and Tincroft mines in Cornwall; in veins in transition rocks in the Hartz; in the mines of Moss and Arendal in Norway; near Freyberg, in veins, along with grey copper, copper-pyrites, ochry brown iron-ore, and quartz; near Schwatz in the Tyrol, along with copper-pyrites, grey copper, malachite, and copper-green; at Kupferberg and Rudelstadt in Silesia; Markirch in Alsace; in the Schwarzwald; and also in Hungary.

Asia.—Along with iron-pyrites at Schlangenberg; and in different mines in the Uralian Mountains.

Observations.

1. It appears to be formed, sometimes by the decomposition of copper-pyrites and copper-glance or vitreous copper-ore, and in other instances to be an original formation.

2. It is placed after Red Copper-ore, but not inserted in the genus, until its characters shall be better ascertained.

GENUS III. TIN-ORE.

Zinnerz, *Mohs.*

THIS Genus contains one Species, viz. Pyramidal Tin-Ore.

1. Pyramidal Tin-Ore.

Pyramidales Zinnerz, *Mohs.*

THIS Species is divided into two Subspecies, viz. Common Tin-Ore or Tinstone, and Cornish Tin-Ore.

First Subspecies.

Common Tin-Ore or Tinstone.

Zinnstein, *Werner.*

Stannum Arsenico et Ferro mineralisatum, *Wall.* t. ii. p. 319. *et seq.*—Zinnstein, *Werner,* Pabst. b. i. s. 171. *Id. Wid.* s. 880.—Common Tin-stone, *Kirw.* vol. ii. p. 197.—Etain vitreux, *De Born,* t. ii. p. 238.—Zinnkies, *Emm.* b. ii. s. 420. —Oxide d'Etain, *Lam.* t. i. p. 274.—Etain oxidé, *Haüy,* t. iv. p. 137.—La Pierre d'Etain, ou la Mine d'Etain commune, *Broch.* t. ii. p. 334.—Zinnstein, *Reuss,* b. iv. s. 288. *Id. Lud.* b. i. s. 267. *Id. Suck.* 2ter th. s. 354. *Id. Bert.* s. 441. *Id. Mohs,* b. iii. s. 596.—Etain oxidé, *Lucas,* p. 150.—Zinnstein, *Leonhard,* Tabel. s. 75.—Etain oxydé, *Brong.* t. ii. p. 189. *Id. Brard,* p. 335.—Zinnstein, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 110.—Etain oxidé, *Haüy,* Tabl. p. 101.—Native Oxyd of Tin, *Kid,* vol. ii. p. 147.—Zinnstein, *Haus.* Handb. b. i. s. 314. *Id. Hoff.* b. iv. s. 56.—Tinstone, *Aikin,* p. 116.

External Characters.

Its most common colour is blackish-brown; from which it passes, on the one side, into brownish-black, velvet-black, and greyish-black, on the other side, into hair-brown, clove-brown, and reddish-brown; from which it passes further into yellowish-brown, yellowish-green, yellowish-grey, yellowish-white, and greenish-white; from yellowish-grey it passes into cream-yellow, wine-yellow, and hyacinth-red.

It occurs massive, disseminated, in rolled pieces, in grains, in granular distinct concretions, but most frequently crystallized, and in the following figures:

1. The

1. The primitive figure is a double four-sided pyramid, in which the angles are 133° 36′ and 67° 42′, Fig. 186. Pl. 9. The following are some of the secondary figures:

This figure is rarely perfect, being usually more or less deeply truncated on the edges of the common base, and sometimes the edge of the base is bevelled, and the edge of the bevelment truncated. The angles on the common base, and also of the summits, are occasionally truncated.

2. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes *, Fig. 187. Pl. 9.

3. The preceding figure, in which the lateral edges, and also those formed by the meeting of the acuminating planes, are truncated †. Fig. 188. Pl. 9. Sometimes in the same figure, the edges formed by the meeting of the acuminating planes are truncated, and the lateral edges are bevelled, and the bevelling edges truncated ‡. Fig. 189. Pl. 9.

4. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges ||. Fig. 190. Pl. 9.

5. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges, and the edges formed by the meeting of the acuminating and lateral planes truncated §. Fig. 191. Pl. 9.

When

* Etain oxydé pyramidé, Haüy.

† Etain oxydé equivalent, Haüy.

‡ Etain oxydé soustractif, Haüy.

|| Etain oxydé dodecaedre, Haüy.

§ Etain oxydé recurrent, Haüy.

When these truncating planes on the edges become very large, an eight-planed acumination is formed, as is represented in the following figure.

6. Long rectangular four-sided prism, acutely acuminated on both extremities with eight planes, of which two and two always meet together, under very obtuse angles, and are set on the lateral planes; and again flatly acuminated with four planes, which are set on the obtuse edges of the first acumination *, Fig. 192. Pl. 10. The edges of the second acumination are sometimes truncated †.

7. Twin-crystals of various descriptions; but of these the most frequent is that formed by the junction of two crystals, of the variety No. 2. which is represented in Fig. 193. Pl. 10 ‡.

The twin-crystal here figured, is one of the most common forms of the species.

The surface of the crystals is usually smooth, seldom more or less strongly streaked, and it is commonly splendent.

Internally it alternates from splendent to glistening, and the lustre is intermediate between resinous and adamantine, but more inclining to the latter.

In

* Etain oxydé opposite, Haüy.

† Etain oxydé distique, Haüy.

‡ The most complete account of the various crystallizations of tin-ore we possess, is that by Mr William Phillips, in the second volume of the Transactions of the Geological Society of London. His memoir is accompanied with a series of beautiful plates, of which I could not avail myself in this work, because of their number and minuteness.

In some varieties a cleavage is to be observed; two cleavages are in the direction of the lateral planes of the rectangular four-sided prism, and other two in the direction of the diagonals of the same prism.

The fracture is coarse and small-grained uneven, inclining to imperfect conchoidal.

The fragments are indeterminately angular, and rather blunt-edged.

It alternates from semi-transparent to opaque; the darker coloured varieties are opaque, the lighter translucent and semi-transparent, often even inclining to transparent; the intermediate varieties are only translucent and translucent on the edges.

It yields a greyish-white streak.

It is as hard as felspar, and sometimes even equal in hardness to quartz.

It is easily frangible, and brittle.

Specific gravity, 6.3, 7.0, *Mohs.*—6.300 to 6.989, *Gellert.*—6.750, *Brunnich.*—6.880, *Leysser.*—6.9009, the black, 6.9348, the red, *Brisson.*—5.845 to 6.970, *Klaproth.*

Chemical Characters.

Before the blowpipe it decrepitates, and becomes paler; when finely pounded, it is reducible on charcoal by the continued action of the blowpipe, to the metallic state. Acids dissolve the iron it contains, but only a very minute portion of the tin.

Constituent

Constituent Parts.

	From Alternon.	Schlackenwald.	Ehrenfriedersdorf.
Tin, -	77.50	75.00	68
Iron, -	0.25	0.50	9
Oxygen, -	21.50	24.50	16
Silica, -	0.75	......	7
	100	100	100
	Klaproth, Beit. b. ii. s. 256.		*Lampadius.*

Oxide of Tin, -	94.50
Oxide of Iron, -	1.00
Oxide of Manganese,	0.50
Silica, - -	1.00
Alumina, - -	3.00
	100

John, Chem. Unters. b, ii. s. 242.

	Zinnwald.
Oxide of Tin,	97.15
Oxide of Iron,	00.35
Alumina, -	2.50
	100

Kastner, Beit. z. Begrundung einer Wissench. Chem. b. . s. 26.

Geognostic Situation.

It occurs disseminated, in beds, in imbedded masses, and veins, in granite, gneiss, mica-slate, clay-slate, porphyry, and in an alluvial form, in what are in Cornwall named *Stream Works*. It is associated with wolfram, tungsten, molybdena, arsenical pyrites, copper-pyrites, specular iron-ore, blende, rock-crystal, topaz, shorl, hornblende, chlorite, mica, steatite and fluor-spar; less frequently with calcareous-spar, heavy-spar, and with ores of lead, silver, and iron.

Geographic Situation.

Europe.—Tin is not found in many different countries, but when it does occur, it is generally in considerable quantity. There are only three principal tin districts in Europe.

rope. The first and most considerable is in Cornwall, where it occurs in veins, or disseminated in granite and slate, whether clay-slate or chlorite-slate. It is sometimes raised in large blocks; for we are informed by Mr Phillips, that one block raised from the mine called Polberrow in St Agnes's, weighed 1200 lb. and produced more than half that of pure metal. It is rarely found in massive portions, being generally crystallized; and it is worthy of notice, that all the varieties of form are not found indiscriminately in the same vein or set of veins, but appear rather to be distributed in different veins or sets of veins. Thus, according to Mr Phillips, the tin-mine of Penandrae, near Redruth, affords scarcely any other form but that of a particular kind of twin-crystal; the veins of Huel Fanny Mine, only three particular varieties of crystallization; and the tin-mine of Polgooth near St Austle, only minute crystals of one particular form. Of the same nature nearly is the observation, that certain varieties of calcareous-spar are peculiar to Derbyshire, others to particular districts in Saxony, and some are only met in particular mines in France or Spain. Alluvial depositions of tin-ore are met with of considerable extent and depth, in several parts of Cornwall; these are named *Stream Works*, because the tin is extracted from them by passing a stream of water across them. It is worthy of remark, that the only traces of gold hitherto met with in Cornwall are in the stream works, where it is found generally detached, and sometimes accompanied with quartz *.

The second tin district is situated in the Erzgebirge, both on the Bohemian and Saxon sides of that mountain

* For other particulars in regard to the Tin of Cornwall, I refer to Mr Phillips's paper, in the second volume of Transactions of Geological Society.

group. There it occurs disseminated on the granite, and in beds that alternate with that rock, where it is associated with wolfram, tungsten, common quartz, rock-crystal, mica, talc, fluor-spar, &c. in massive or crystallized forms. It often also occurs in veins in granite, gneiss, and mica-slate, and also in clay-slate. Alluvial deposites of this ore, resembling the stream-works of Cornwall, are also met with in these districts.

The third tin district is situated at Monte Rey in Gallicia in Spain, where the ore occurs in beds in mica-slate.

Very lately this ore has been found in small quantity in grains and crystals, in veins which traverse the granite hill of Puy les Vignes, in the vicinity of St Leonhard, in the department of Haut-Vienne in France, where it is associated with wolfram, arsenical-pyrites, and martial arseniate of copper.

Asia.—It does not appear that tin has hitherto been met with in any of our possessions in India. It is found on the east coast of Sumatra, of Siam, and of Pegu; but it is principally imported into our Indian Empire as an article of commerce from Queda, Junk-Ceylon, Tavai in Lower Siam *, and the Island of Banca. The tin mines of Banca are said to be of great extent, and Mr Ellmore informs us, that there are exported from them annually no less than from forty to sixty thousand peculs of tin. It is said also to occur at a place five days journey from Nankin, in the province of Kianfu in China †. It is reported that a rich tin mine has been opened on the Onon, on the frontier of China.

America.

* Vid. Franklin's Tracts "On the Dominions of Ava," p. 64.

† Sage, in Journ. de Phys. t. 54. p. 113.

America.—Tin-ore is found in Mexico, where it is extracted from alluvial deposites by means of washing, in the intendancy of Guanuaxuata and Zacatecas. It has been found in small quantity at Ivikaet in South Greenland.

Uses.

It is worked as an ore of tin, and nearly all the tin of commerce is obtained from it.

Observations.

It is distinguished from *Wolfram*, by its superior hardness, as it readily scratches wolfram, but wolfram does not affect it; and also by the streak, which is of a greyish-white colour, whereas that of wolfram is dark reddish-brown. It is distinguished from *Blende* by its superior hardness, and its not emitting a sulphureous odour when triturated; from *Garnet* by its resino-adamantine lustre, higher specific gravity, and inferior hardness; and from *Schorl* by colour, form, lustre, and higher specific gravity.

Second Subspecies.

Cornish Tin-Ore, or Wood-Tin.

Kornisch Zinnerz, *Werner.*

Mine d'Etain mamelonné, ou en Stalactites, *Romé de Lisle,* t. iii. p. 428.—Kornisch Zinnerz, *Werner,* Pabst. b. i. s. 183. *Id.* *Wid.* s. 877.—Wood Tin-ore, *Kirw.* vol. ii. p. 198.—Etain limoneux, *De Born,* t. ii. p. 248.—Kornisch Zinnerz, *Emm.* b. ii. s. 427.—Mine d'Etain ferrugineux, *Lam.* t. i. p. 281.—Etain oxidé concretionné, *Haüy,* t. iv. p. 147.—La Mine d'Etain d'Etain grenue, ou l'Etain grenu, *Broch.* t. ii. p. 340.—Holzzinnerz, *Reuss,* b. iv. s. 300. *Id. Lud.* b. i. s. 269. *Id. Suck.* 2ter th. s. 358.—Cornisch Zinnerz, *Bert.* s. 443. *Id. Mohs,* b. iii. s. 593.—Etain oxydé concretionné, *Lucas,* p. 150.—Holzzinnerz, *Leonhard,* Tabel. s. 75.—Etain oxydé concretionné, *Brong.* t. ii. p. 190. *Id. Brard,* p. 336.—Holzzinnerz, *Karsten,* Tabel. s. 70.—Fasriger Zinnstein, *Haus.* s. 110.—Etain oxidé concretionné, *Haüy,* Tabl. p. 102.—Kornisch Zinnerz, *Hoff.* b. iv. s. 53.—Fasriges Zinnstein, *Haus.* Handb. b. i. s. 317.—Wood-tin, *Aikin,* p. 116.

External Characters.

Its most common colour is hair-brown, of different degrees of intensity, which passes into wood-brown, yellowish-grey, and sometimes into reddish-brown. In single pieces it is occasionally striped in a concentric manner.

It occurs in rolled pieces, which are generally wedge-shaped; also reniform, botryoidal, and globular; in distinct concretions, which are scopiform and stellular delicate fibrous, and collected into others which are curved lamellar, and angulo-granular.

Externally it is glistening.

Internally it is feebly glistening or glimmering, and the lustre is resinous, inclining to pearly.

The fragments are wedge-shaped and splintery.

It is opaque.

It is rather softer than common tinstone.

Its streak is grey, inclining to brown.

It is brittle, and easily frangible.

Specific gravity, 6.450, *Klaproth*—6.302, *Breithaupt.*

Chemical Characters.

Before the blowpipe it becomes brownish-red, and decrepitates;

crepitates, but is not fused, or reduced to the metallic state: when strongly heated in a charcoal crucible, it affords about 73 *per cent.* of metallic tin.

Constituent Parts.

			Mexican.
Oxide of Tin,	-	91	95
Oxide of Iron,	-	9	5
		100	100

Vauquelin, N. Journ. d. Chem. b. v. s. 231. *Collet-Descotils*, Ann. d. Chem. t. liii. p. 268.

Geognostic and Geographic Situations.

Europe.—It occurs loose, and in small quantities, along with stream tin, in alluvial deposites (stream-works), at Sithney, St Creet, Gossmoor, Pentowan, Gavrigan, St Mewan, St Columb, St Roach, and St Denis, in Cornwall.

America.—It is one of the most common ores of tin in Mexico. In that country, it is found at Guanuaxuato (Goanachuato), in veins that traverse trap-porphyry, and it is also met with in alluvial deposites *.

Observations.

It very much resembles *Brown Hematite*, but can be distinguished from it by its colour-suite, greater hardness, and higher specific gravity.

GENUS IV.

* Some time ago Mr Mawe of London sent me a drawing of a mass of Mexican wood-tin, now in his possession, which weighs ten ounces and a half. It is the largest specimen of this ore I am acquainted with.

Genus IV. WOLFRAM.

Scheel-erz. *Mohs.*

This Genus contains one species, viz. Prismatic Wolfram.

1. Prismatic Wolfram.

Prismatisches Scheel-erz, *Mohs.*

Wolfram, *Werner.*

Magnesia cristallina; Spuma Lupi, *Wall.* t. ii. p. 344.—Wolfram, *Wern.* Pabst. b. i. s. 223. *Id. Wid.* s. 983. *Id. Kirw.* vol. ii. p. 316. *Id. De' Born,* t. ii. p. 227. *Id. Emm.* b. ii. s. 574. *Id. Lam.* t. i. p. 404. *Id. Broch.* t. ii. p. 456.—Scheelen ferruginé, *Haüy,* t. iv. p. 314.—Wolfram, *Reuss,* b. iv. s. 541. *Id. Lud.* b. i. s. 303.—Eisen-Scheel, *Suck.* 2ter th. s. 461.—Wolfram, *Bert.* s. 509. *Id. Mohs,* b. iii. s. 618.—Scheelin ferruginé, *Lucas,* p. 182.—Wolfram, *Leonhard,* Tabel. s. 81.—Scheelin ferruginé, *Brong.* t. ii. p. 94. *Id. Brard,* p. 388.—Wolfram, *Karsten,* Tabel. s. 74.—Scheelin ferruginé, *Haüy,* Tabl. p. 118.—Wolfram, *Haus.* Handb. b. i. s. 307. *Id. Hoff.* b. iv. s. 242. *Id. Kid,* vol. ii. p. 226. *Id. Aikin,* p. 183.

External Characters.

Its colour is intermediate between dark greyish-black and brownish black, which sometimes inclines to velvet-black. It has rarely a temper-steel tarnish.

It occurs massive, and rarely disseminated; also in distinct concretions, which are thick or thin lamellar, either fortification-

fortification-wise bent, or concentrically curved, and sometimes longish granular. It is frequently crystallized; and the primitive figure is an oblique four-sided prism of 120°. The following are some of the secondary forms:

1. Oblique four-sided prism, of which the following varieties occur:
   a. Obtuse lateral edges, flatly, singly, or doubly bevelled.
   b. Obtuse lateral edges truncated.
   c. Obtuse lateral edges, bevelled and truncated, thus forming a reed-like crystal.
   d. Acute lateral edges truncated.
   e. Oblique four-sided prism, acuminated with four planes, which are set on the lateral edges.
   When the two acuminating planes, which are inclined to the acuter lateral edges become larger than the others, there is formed
   f. A rather flat bevelment on the terminal planes; but in this figure, the edges of the bevelment is truncated, and the edges between the bevelling and lateral planes are truncated. If, on the contrary, the bevelling planes that rest on the obtuse lateral edges become large, there is formed
   g. A very flat bevelment on the terminal planes of prism. Sometimes one of the bevelling planes almost disappears, when there is formed a
   h. Prism with oblique terminal planes.
2. Twin-crystal, known by its re-entering angle.

The crystals are middle-sized and large, and occur imbedded, or intersecting one another, but are seldom distinct.

The

The lateral planes are usually longitudinally streaked, and generally splendent.

The cleavage is shining or splendent; the fracture is glistening; the lustre is resinous, inclining to adamantine.

It has always one distinct cleavage, which is parallel with the shorter diagonal, and another less distinct in the direction of the longer diagonal of the prism.

The fracture is coarse and small grained uneven.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It yields a dark reddish-brown coloured streak.

It is harder than apatite, but not so hard as felspar.

It is rather brittle, and easily frangible.

Specific gravity, 7.1, 7.4, *Mohs*.—7.130, *Gellert*.—7.1195, *Brisson*.—7.000, *Leonardi*.—7.3333, *Haüy*.—7.006, *Kirwan*.

Chemical Characters.

It decrepitates before the blowpipe, but is infusible without addition. It colours glass of borax reddish, when exposed to the exterior flame of the blowpipe.

Constituent Parts.

Tungstic Acid, -	64.0	67.00
Oxide of Manganese,	22.0	6.25
Oxide of Iron, -	13.5	18.10
Silica, - - -	...	1.50
	99.5	92.75
	D'Elhuyar, Mem. de l'Acad. d. Toulouse, ii.	*Vauquelin*, in Journ. d. Min. N. 19. 18.

Geognostic

Geognostic Situation.

It occurs in primitive rocks, and generally along with tinstone and tungsten; less frequently in veins in greywacke, along with galena or lead-glance, grey copper, sparry iron, and quartz.

Geographic Situation.

It occurs in gneiss in the island of Rona, one of the Hebrides *; at Herland, Pednandre, Huel Fanny, Cliga, and Kit-hill, in Cornwall; in the Hartz, it is met with in veins that traverse greywacke; in primitive rocks at Ehrenfriedersdorf, Altenberg and Geyer, in Saxony; Zinnwald and Schlackenwald in Bohemia; Puy les Mines in France; and at Adonschelon in Siberia, along with beryl.

Observations.

1. It is distinguished from *Tine-ore*, among other characters, by its streak, which is reddish-brown, whereas that of tin-ore is grey.

2. This mineral was originally mistaken for antimony, which by the alchemists was called the *wolf;* probably because it acted violently upon, and, as it were, devoured the base metals in the process of refining gold; hence arose the term *spuma lupi;* the word *ram*, which signifies spuma, being commonly applied by the Germans to substances of a laminated texture.—*Kid*, vol. ii. p. 227.

GENUS V.

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* MacCulloch.

GENUS V. TANTALUM-ORE.

Tantal-Erz, *Mohs*

THIS Genus contains one species, viz. Prismatic Tantalum-ore. * Yttrotantalite.

1. Prismatic Tantalum-Ore.

Prismatisches Tantal-erz, *Mohs.*

Tantalite, *Karsten & Werner.*

Columbite, *Hatchett.*

Tantalit, *Eckeberg*, Kongl. Vetensk. Acad. Handl. 1802, Q. 1. p. 68.–83.—Tantalite, *Reuss*, b. ii. 4. s. 685.—Columbeisen, *Id.* b. ii. 4. s. 632.—Tantalit, *Leonhard*, Tabel. s. 83.—Tantal oxydé ferro-manganesifere, *Haüy*, Tabl. p. 120.—Tantalit, *Haus.* Handb. b. i. s. 310. *Id. Hoff.* b. iv. s. 191. *Id. Aikin*, p. 142.

External Characters.

Its colours are greyish and brownish black.

It occurs massive, disseminated, and crystallized in oblique four-sided prisms, the dimensions of which are unknown. These prisms are sometimes truncated on two, sometimes on all the lateral edges, and flatly bevelled on the extremities, the bevelling planes resting on the acute lateral edges.

The crystals are small, and appear to occur imbedded.

Externally

Externally and internally it is shining or glistening, and the lustre is resinous, inclining to the semi-metallic adamantine.

The fracture is coarse-grained uneven, or small and imperfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is opaque.

It is as hard as felspar.

The streak is dull and dark brownish-black.

It is brittle.

It is difficultly frangible.

Specific gravity, 6.0, 6.3, *Mohs.*—5.918, *Hatchett.*—7.15 to 7.65, *Wollaston.*—7.953, *Eckeberg.*—7.3, *Klaproth.*—6.464, *Leonhard* and *Vogel.*

Chemical Characters.

Before the blowpipe, without addition, it suffers no other change than a diminution of lustre. It is insoluble in glass of borax.

Constituent Parts.

	Finland.	Finland.	Finland.	N. American or Columbite.
Oxide of Tantalum,	83	85	88	80
Oxide of Iron, -	12	10	10	15
Oxide of Manganese,	8	4	2	5
	103	99	100	100
	Vauquelin, in Haüy, Tabl. p. 308.	*Wollaston*, in Ph. Tr. 1809.	*Klaproth*, Beit. b. v. s. 5.	*Wollaston*, in Ph. Tr. 1809.

Some

Some late analyses of Berzelius shew that it also contains Oxide of Tin.

Geognostic and Geographic Situations.

It occurs disseminated in a coarse red granite, at Brokärns Zinnsgute in the parish of Kemito in Finland; near Bodenmais in Germany*; and the specimen examined by Mr Hatchett is said to be from Massachusets Bay in North America.

Observations.

1. This species bears a considerable resemblance to several other minerals, particularly to magnetic iron-ore, tin-ore, wolfram, yttrotantalite, and gadolinite. It is distinguished from *Magnetic Iron-ore*, by its not affecting the magnetic needle, brownish-black streak, and its greater specific gravity; from compact *Black Tin-ore*, by its brownish-black powder, and also by the action of the blowpipe, for tinstone, when exposed, on charcoal, to the reducing flame of the blowpipe, is reduced; and from *Wolfram*, by the absence of the cleavage, and the action of the blowpipe, as wolfram, along with glass of borax, when exposed to the exterior flame of the blowpipe, becomes of a reddish colour.

2. The specific gravities vary so much, that it is probable either that some of them are erroneous, or that they characterize different varieties.

* Yttrotantalite.

* Yttrotantalite.

Ytter-Tantal, *Karsten.*

Yttertantalit, *Eckeberg,* Kongl. Vetensk. Acad. Handl. 1802, Q. 1.—Yttertantal, *Reuss,* Min. ii. 4. s. 637. *Id. Leonhard,* Tabel. s. 83. *Id. Karsten,* Tabl. s. 74.—Tantal oxydé yttrifère, *Haüy,* Tabl. p. 120.—Yttertantalit, *Haus.* Handb. b. i. s. 312.—Yttrotantalite, *Aikin,* p. 72.

External Characters.

Its colours are iron-black, and yellowish-brown.

It occurs in imbedded angular pieces, in granular distinct concretions, and it is said also crystallized in oblique four-sided prisms, having lateral edges of 95° and 85°, and also in six-sided prisms.

Internally it is shining or glistening, and the lustre resinous, inclining to metallic.

Its cleavage appears to be in the direction of the lateral planes of the oblique four-sided prism.

The fracture is conchoidal.

It is opaque, or translucent on the edges.

It is so hard as to scratch glass.

It yields a grey-coloured streak.

It is easily frangible.

Specific gravity 5.395, 5.882, *Berzelius.*

Chemical Characters.

It decrepitates feebly before the blowpipe, becomes dark-brown, but does not melt.

Constituent

Constituent Parts.

	Black Variety.	Yellow Variety.
Oxide of Tantalum,	57.00	60.124
Yttria, -	20.25	29.780
Lime, - -	6.25	0.500
Oxide of Iron, -	3.50	1.155
Oxide of Uranium,	0.50	6.622
Tungstic Acid, -	8.25	with Tin, 1.044
	95.75	99.225

Berzelius in Afhandlingar, t. iv. p. 267.

Geognostic and Geographic Situations.

It occurs along with gadolinite, in a bed of flesh-red felspar, in gneiss at Ytterby near Roslagen in Sweden.

Genus VI.—URANIUM-ORE.

Uran-Erz, *Mohs.*

This Genus contains one Species, viz. Indivisible Uranium-Ore.

1. Indivisible Uranium, or Pitch-Ore.

Untheilbares Uran-Erz, *Mohs.*

Uranpecherz, *Werner.*

Id. Wern. Pabst. b. i. s. 170.—Pech-Blende, *Wid.* s. 987.—Sulphurated Uranite, *Kirw.* vol. ii. p. 305.—Pech-Blende, ou Blende

Blende de Poix, *De Born*, t. ii. p. 159.—Schwarz Uranerz, *Emm.* b. ii. s. 580.—Mine d'Uranit sulphuré, *Lam.* t. i. p. 408. —Uran oxydulé, *Haüy*, t. iv. p. 280.—Le Pecherz, ou L'Urane noir, *Broch.* t. ii. p. 460.—Pecherz, *Reuss*, b. iv. s. 551. *Id. Lud.* b. i. s. 307.—Uranpecherz, *Suck.* 2ter th. s. 466.—Pecherz, *Bert.* s. 511. *Id. Mohs*, b. iii. s. 716.—Uran oxydulé, *Lucas*, p. 176.—Pecherz, *Leonhard*, Tabel. s. 80.—Uran oxydulé, *Brong.* t. ii. p. 102. *Id. Brard*, p. 378.—Pecherz, *Karsten*, Tabel. s. 74.—Uran oxydulé, *Haüy*, Tabl. p. 113.—Pech-Blende, *Kid*, vol. ii. p. 220.—Pech-Uran, *Haus.* Handb. b. i. s. 325.—Uranpecherz, *Hoff.* b. iv. s. 271. —Pitch-Blende, *Aikin*, p. 138.

External Characters.

Its most frequent colour is greyish-black, which sometimes inclines to iron-black, seldomer to brownish and greenish-black.

It generally occurs massive, seldom disseminated, sometimes reniform; also in distinct concretions, which are coarse and small angulo-granular, rarely in others which are reniform curved lamellar, and which are intersected with short wedge-shaped prismatic concretions.

Internally it is shining, inclining to glistening, and the lustre is resinous, inclining to semi-metallic.

The fracture is imperfect and flat conchoidal, which passes into coarse-grained uneven.

The fragments are indeterminate angular, and sharp-edged.

Its hardness is intermediate between that of apatite and felspar.

It is opaque.

In the streak it is black and shining.

It is brittle, and easily frangible.

Specific

Specific gravity, 6.4, 6.6, *Mohs*.—6.5304, *Haüy*.—6.440, *Breithaupt*.

Chemical Characters.

It is completely infusible, without addition, before the blowpipe. With soda or borax it forms a grey, muddy, slaggy-like globule; with phosphoric salts a transparent green bead. It dissolves imperfectly in sulphuric and muriatic acids; but it is nearly completely dissolved in nitric and nitro-muriatic acids; and from this solution, which has a pale orange-yellow colour, the uranium is precipitated brownish-red by prussiate of potash, and yellow by the alkalies.

Constituent Parts.

	Joachimsthal.
Oxide of Uranium, -	86.5
Black Oxide of Iron, -	2.5
Galena or Lead-glance, -	6.0
Silica, - -	5.0

Klaproth, Beit. b. ii. s. 221.

Geognostic Situation.

It occurs principally in primitive rocks, in veins, and most frequently in those which contain ores of silver. Its most frequent accompanying minerals are copper-pyrites, galena or lead-glance, uran-mica, and brown-spar; also red silver, and native silver.

Geographic Situation.

It is found at Tol Carn and Tincroft in Cornwall; in mica-slate at Johanngeorgenstadt, Schneeberg, and Wiesenthal

thal in Germany; in granite at Joachimsthal in Bohemia; and Kongsberg in Norway.

Observations.

It was at first considered as a variety of blende, and named *Pechblende*, and afterwards as an ore of iron, and described under the name *Eisenpecherz.*

2. It is distinguished from *Black-Blende*, by its fracture, streak, and greater specific gravity; from *Wolfram*, by its streak; and from *Pitchy Iron-ore*, by its streak, and greater specific gravity.

Genus VII. CERIUM-ORE.

Cerer-erz, *Mohs.*

This Genus contains two Species, viz. 1. Prismatic Cerium-Ore, 2. Indivisible Cerium-Ore.

1. Prismatic Cerium-Ore, or Allanite.

Allanite, Edinburgh Phil. Trans. vol. vi. p. 371.—Cerium oxydé silicifere noire, *Lucas*, t. ii. p. 498.—Cerium allanite, *Delam.*

External Characters.

Its colour is brownish-black.

It occurs massive, disseminated, and crystallized in the following figures:

1. Oblique four-sided prism, with lateral edges of 117° and 63°.
2. Six-sided prism, acuminated with four planes, set on the lateral planes.

Externally it is dull.

Internally it is shining, and resino-metallic.

The fracture is small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is opaque.

It affords a greenish-grey coloured streak.

It is brittle, and easily frangible.

Specific gravity 3.523 to 4.001, *Thomson*.

Chemical Characters.

Before the blowpipe it froths, and melts imperfectly, into a black scoria. Gelatinates in nitric acid *. In a strong heat it loses 3.98 *per cent.* of its weight.

Constituent Parts.

Oxide of Cerium, - -	33.9
Oxide of Iron, -	25.4
Silica, - -	35.4
Lime, - -	9.2
Alumina, -	4.1
Moisture, - -	4.0
	112.0

Thomson, in Edin. Phil. Trans. vol. vi. p. 385.

Geognostic

* This is doubted by Haüy.

Geognostic and Geographic Situations.

It occurs in a granite rock in West Greenland, where it was first discovered by Professor Giesecké of Dublin,—an intelligent naturalist, and a gentleman of great worth, who, with a rare zeal and intrepidity, and in defiance of the horrors and miseries of that forlorn region, courageously devoted many years of his life to the investigation of its natural history. It has been lately detected at Bastnaes in Sweden.

Observations.

It was first described and analysed by Dr Thomson, who named it Allanite, in honour of Thomas Allan, Esq. who was first aware of its being a particular and undescribed mineral substance.

2. Indivisible Cerium-Ore, or Cerite.

Untheilbares Cerer-erz, *Mohs.*

Bastnäs Tungsten, *Cronstedt,* (first description), in the Abh. d. Schwed. Akad. 1751, s. 235.—Cerit, *Hisinger & Berzelius,* S. Cerium en ny metall, funnen i Bastnäs Tungsten frau Riddarhyttan i Westmannland, Af. Hisinger & Berzelius, Stockholm, 1804, 8.—Cerit, *Hisinger & Berzelius,* in Afh. i Fys. Kem. och. Min. 1. 58. *Id. Leonhard,* Tabel. s. 83. *Id. Karsten,* Tabel. s. 74.—Cerium oxydé silicifere, *Hauy,* Tabl. p. 120.—Cerinstein, *Hoff.* b. iv. s. 286.—Cerite, *Aikin,* p. 141.

External Characters.

Its colour is intermediate between crimson-red, clove-brown, and reddish-brown; also dark or pale flesh-red, and very rarely inclines to yellow.

It occurs massive, and disseminated.

Internally it is glimmering and resinous.

The fracture is fine splintery.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is opaque.

It has nearly the same degree of hardness as prismatic cerium-ore.

Its streak is greyish-white.

Specific gravity, 4.6, 4.5, *Mohs.*—4.988, *Cronstedt.*—4.660, *Klaproth.*—4.619 and 4.489, *Hisinger* and *Berzelius.*

Chemical Characters.

It is infusible before the blowpipe; but when pulverized and heated, its colour changes from grey to yellow.

Constituent Parts.

Oxide of Cerium,	54.50	67
Silica,	34.50	17
Oxide of Iron,	3.50	2
Lime,	1.25	2
Water,	5.00	and Carbonic Acid, 12
	98.75	100
	Klaproth, Beit. b. iv. s. 147.	*Vauquelin*, in Annal. d. Mus. t. v. p. 412.

Geognostic and Geographic Situations.

It occurs in a bed of copper-pyrites, along with bismuth-glance, or sulphuretted bismuth, molybdena, wolfram? hornblende,

hornblende, actynolite, and mica. The bed is situated in gneiss near Ridderhytta in Westmannland in Sweden.

Observations.

The peculiar metal which characterizes this ore, was first detected by Hisinger and Berzelius, who bestowed on it the name *Cerium*, from the planet Ceres, discovered by Piazzi.

GENUS VIII. CHROME-ORE.

Chrom-erz, *Mohs.*

THIS Genus contains one species, viz. Prismatic Chrome-Ore.

1. Prismatic Chrome-Ore.

Prismatisches Chrom-erz, *Mohs.*

Chromeisenstein, *Hausmann.*

Eisenchrom, *Reuss,* Min. b. iv. s. 625.—Fer chromaté, *Brong.* t. ii. p. 181. *Id. Brard,* p. 33.—Eisenchrom, *Karsten,* Tabel. s. 74.—Fer chromaté, *Haüy,* Tabl. p. 99.—Chromeisenstein, *Haus.* Handb. b. i. s. 252. *Id. Hoff.* b. iii. s. 226.—Chromate of Iron, *Aikin,* p. 106.

External Characters.

Its colour is intermediate between steel-grey and iron-black, and sometimes passes into brownish-black.

It

It occurs massive, disseminated, and in granular distinct concretions ; also crystallized in oblique four-sided prisms, acuminated with four planes.

Internally it is shining or glistening, and the lustre is imperfect metallic.

It has an imperfect prismatic cleavage.

The fracture is small and fine-grained uneven, sometimes passing into small and imperfect conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is opaque.

Its hardness is intermediate between that of apatite and felspar.

The colour of the streak is dark brown.

Specific gravity 4.4, 4.5, *Mohs.*

Physical Characters.

Some varieties are magnetical, others are not.

Chemical Characters.

It is infusible before the blowpipe. Melted with borax, it forms a beautiful green-coloured mass, very different from the dark green-coloured glass formed when borax and magnetic iron-ore are melted.

Constituent Parts.

	France.	Siberia.
Oxide of Iron,	34.7	34
Oxide of Chrome,	43.0	53
Alumina, -	20.3	11
Silica, -	2.0	1
Oxide of Manganese, -		1
	100.00	100
	Havy, Traité, t. iv. p. 130.	*Laugier*, Ann. du Mus. t. iv. p. 325.

	Stiria.
Oxide of Iron,	33.00
Oxide of Chrome,	55.50
Alumina, -	6.00
Silica, -	2.00
Loss by heating,	2.00
	98.50
	Klaproth, Beit. b. iv. s. 132.

Geognostic

Geognostic Situation.

It occurs in beds, veins, or imbedded in primitive serpentine; in a variety of talc-slate, to which it has given a beautiful colour, intermediate between cochineal-red and peach-blossom-red; also in beds between clay-porphyry and wacke.

Geographic Situation.

Europe.—It occurs in serpentine in the islands of Unst, and Fetlar in Shetland; and also in the serpentine of Portsoy in Banffshire. On the Continent, it occurs in serpentine near to Gassin, in the department of Var, and in serpentine in the vicinity of Nantes; at Krieglach in Stiria, it is imbedded in talc-slate, to which it has communicated a beautiful red colour; Bohemia; Silberberg in Silesia; and Traversella in Piedmont.

Asia.—It is said to occur in beds between clay-porphyry and wacke in the Uralian Mountains.

America.—It occurs in considerable quantity in serpentine in the Bare Hills, near Baltimore; at Chesnut-hill in Pennsylvania; at Hoboken in New Jersey; and in the Milford Hills, near Newhaven in Connecticut *.

Uses.

When the chromic acid is combined with lead, it forms an uncommonly beautiful yellow pigment. In America, where the chrome ore occurs in considerable abundance, the chromic acid is extracted from it, and combined with lead, and forms the yellow pigment named *Chromic yellow*, which is now become an article of trade.

Observations.

* Hayden, in Bruce's American Min. Journal, p. 243,—248; and Cleaveland's Mineralogy, p. 507, 508.

Observations.

It is distinguished from *Magnetic Iron-ore* by its brown streak.

Genus IX.—IRON-ORE.

Eisen-erz, *Mohs.*

This Genus contains three Species, viz. 1. Octahedral Iron-Ore, 2. Rhomboidal Iron-Ore, 3. Prismatic Iron-Ore.

1. Octahedral Iron-Ore.

Octaedrisches Eisen-erz, *Mohs.*

This species is divided into two subspecies, viz. Common Magnetic Iron-Ore, and Granular Magnetic Iron-Ore. * Earthy Magnetic Iron-Ore.

First Subspecies.

Common Magnetic Iron-Ore.

Gemeiner Magneteisenstein, *Werner.*

Ferrum mineralisatum crystallisatum, et Ferrum mineralisatum, minera ferrum trahente et polos mundi ostendente, *Wall.* t. ii. p. 234.–235.—Æthiops martial natif, *Romé de Lisle,* t. iii. p. 176.—Magnetischer Eisenstein, *Werner,* Pabst. b. i. s. 144. *Id. Wid.* s. 787.—Common Magnetic Ironstone, *Kirw.* vol. ii. p. 158.—Gemeiner magnetischer Eisenstein, *Emm.* b. ii. s. 278. —Fer oxydulé, *Haüy,* t. iv. p. 10–38.—Le Fer magnetique commun,

commun, *Broch.* t. ii. p. 235.—Gemeiner Magneteisenstein, *Reuss,* b. iv. s. 38. *Id. Lud.* b. i. s. 240. *Id. Suck.* 2ter th. s. 247. *Id. Bert.* s. 401. *Id. Mohs,* b. iii. s. 355. *Id. Hab.* s. 113.—Fer oxydulé, *Lucas,* p. 136.—Gemeiner Magneteisenstein, *Leonhard,* Tabel. s. 63.—Fer oxydulé, *Brong.* t. ii. p. 156. *Id. Brard,* p. 310.—Gemeiner & Blättricher Magneteisenstein, *Karsten,* Tabel. s. 64.—Blättricher, körniger & dichter Magneteisenstein, *Haus.* s. 105.—Magnetic Iron-ore, *Kid,* vol. ii. p. 165.—Fer oxydulé, *Haüy,* Tabl. p. 93.—Gemeiner Magneteisenstein, *Hoff.* b. iii. s. 217.—Magnetic Iron-ore, *Aikin,* p. 97.

External Characters.

Its colour is iron-black, and very seldom with a temper-steel tarnish.

It occurs massive, disseminated, and in distinct concretions, which are large, small, and fine granular. Also crystallized in the following figures:

1. Octahedron *, fig. 193. Pl. 10. which sometimes ends in a line. This is the primitive figure.
   a. Truncated on the edges †, fig. 194. Pl. 10.
   b. Bevelled on the edges, fig. 195. Pl. 10.
   c. Truncated on the angles.
   d. Cuneiform ‡.
   e. Acuminated on all the angles with four planes.
2. Garnet or rhomboidal dodecahedron ||, fig. 196. Pl. 10.

3. Rectangular

* Fer oxydulé primitif, Haüy.

† Fer oxydulé emarginé, Haüy.

‡ Fer oxydulé cuneiforme, Haüy.

|| Fer oxydulé dodecaedre, Haüy.

3. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges, fig. 197. Pl. 10.
4. Cube, either perfect, or more or less deeply truncated on the angles, fig. 198. Pl. 10.
5. Tetrahedron, in which all the angles are truncated.
6. Equiangular six-sided table, in which the terminal planes are set on alternately oblique.
7. Twin-crystal, with three re-entering angles, formed by the meeting of two segments of the tetrahedron, or of two six-sided tables.

The planes of the rhomboidal dodecahedron are streaked in the direction of the larger diagonal of the rhomb; the planes of the four-sided prism are transversely streaked, and those of the octahedron are smooth.

The crystals are usually imbedded, or aggregated on one another.

The crystals are small and very small, seldom middle-sized.

Externally it is shining, glistening, or splendent.

Internally it is intermediate between shining and glistening, and the lustre is metallic.

It has a fourfold cleavage, the folia parallel with the planes of the octahedron.

The fracture is small and coarse-grained uneven, which sometimes approaches to even, seldom to imperfect and small conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

The colour of the streak is black.

Some varieties are harder than apatite, others harder than felspar, but none so hard as quartz.

It

It is brittle, and sometimes difficultly, sometimes easily frangible.

Specific gravity, 4.8, 5.2, *Mohs*.—From Dannemora, 4.9364, *La Metherie*.—4.760, *Klaproth*.—4.820, *Karsten*.

Physical Characters.

It is highly magnetic, with polarity.

Chemical Characters.

Before the blowpipe it becomes brown, and does not melt: it communicates to glass of borax a dark-green colour.

Constituent Parts.

Peroxide of Iron,	-	69
Protoxide of Iron,	-	31
		100 *Berzelius.*

Dr Thomson analysed a specimen of this ore from Greenland, and which he found to contain, besides the Iron, a small portion of Titanium.—Wern. Memoirs, vol. ii. part i. p. 55.

Geognostic Situation.

It occurs principally in beds, often of great magnitude, in primitive rocks, as gneiss, mica-slate, chlorite-slate, clay-slate, and greenstone, associated with hornblende, augite, actynolite, asbestus, epidote, garnet, felspar, calcareous-spar, fluor-spar, quartz, iron-pyrites, copper-pyrites, magnetic pyrites, arsenical pyrites, blende, galena or lead-glance, and other ores and minerals: also disseminated in granite, chlorite-slate, serpentine, gabbro, &c.; less frequently in beds and nests in transition rocks, as in transition porphyry.

Geographic

Geographic Situation.

Europe.—It occurs in serpentine, in Unst, one of the Shetland Islands; St Just in Cornwall; and Tavistock in Devonshire. In the iron-mines of Arendal in Norway, it occurs in beds in gneiss: these beds are short, but vary in thickness from four to sixty feet; they are frequently intermixed with the gneiss at their line of junction with it; cotemporaneous wedges of the gneiss also occur dispersed through the iron-ore, and sometimes an uninterrupted transition is to be observed from the iron-ore beds into the gneiss in which they are contained. In these interesting repositories, the iron-ore is associated with a great variety of different minerals: of these the most frequent are, granular garnet, augite, hornblende, epidote or pistacite, calcareous-spar, and the three constituents of gneiss. The garnet and augite are the most abundant, are generally in a granular form, and so intimately intermixed with the iron-ore, that an inattentive observer might confound them together. The minerals of less frequent occurrence in these beds, are the following: sphene, the subspecies of garnet named colophonite, apatite, scapolite, sahlite, actynolite, glassy tremolite, chlorite, common shorl, zeolite, iron-pyrites; and still rarer minerals are, prehnite, analcime, rutile, sparry iron, molybdena, copper-pyrites, blende, blue copper, copper-green, and graphite. These minerals are either intermixed with the ironstone in an irregular manner, or they are disposed in cotemporaneous veins included in it, or that shoot from the mass of the bed into the bounding strata of gneiss, just as is the case with cotemporaneous veins of granite shooting from massive granite into the adjacent strata. The remarkable hill named Taberg,

Taberg, in Smoland in Sweden, is a great mass of primitive greenstone, richly impregnated with magnetic iron-ore, and resting on gneiss *; and in the island of Utö, also in Sweden, there are extensive mines of magnetic iron-ore, in which the ironstone occurs as a wedge-shaped bed in gneiss, about 120 feet thick, and nearly half a mile long; but the most considerable of the Swedish iron-mines are those of Danemora, in which the magnetic iron-ore occurs as a bed several hundred feet thick, in gneiss, and is associated with tremolite, chlorite, asbestus, actynolite, and, what is worthy of particular notice, *mineral pitch*. There are also great beds of magnetic ironstone at Gellivara, in Luleo Lappmark, Luossavara, Kensivara, and Junossuwando. At Breitenbrunn, in the Saxon Erzgebirge, it is associated with common garnet, common hornblende, amianthus, actynolite, fluor-spar, iron-pyrites, magnetic pyrites, arsenical pyrites, blende, and tin-ore; at Geier, with magnetic pyrites, galena or lead-glance, and actynolite; at Kupferberg in Silesia, along with copper and iron pyrites; at Presnitz, also in Silesia, in beds in gneiss; in Bavaria; Franconia; Lusatia; Hartz; and Thuringia; at Cogne in Piedmont, there is a bed of this ore, about seventy-five feet thick, which is inclosed in a great bed of serpentine, subordinate to mica-slate; it is also found in Corsica, Sardinia, Switzerland, Spain, France, Hungary, and Transylvania.

Asia.—It is is found in the Mysore country in Hindostan †; Nertschinsk, Parmien, and other places in Siberia; Siam;

* Vid. Thomson's Travels in Sweden, and Hausmann's Travels in the same country, for descriptions of the Taberg.

† Dr Ainslie's Materia Medica of Hindoostan, and Artizans and Agriculturists Nomenclature, p. 55. 4to, printed at Madras in 1813.

Siam; China; the Philippine Islands; and New Holland.

North America.—It occurs in West Greenland; in New Spain; immense beds of it extend, with little interruption, from Canada to the neighbourhood of New York. Colonel Gibbs describes a bed of this ore as occurring at the Franconia Iron-works in New Hampshire *.

South America.—It occurs in Chili.

Uses.

When pure, it affords excellent bar-iron, but indifferent cast-iron; and as it is easily fusible, it requires but little flux. When it happens to have intermixed copper or iron pyrites, it affords a red-shot iron. Careful roasting of ore thus mixed, diminishes the bad effects of the sulphur, which is evidently the cause of the deterioration of the iron. In Sweden, particularly at Dannemora, the ore is quite pure, and affords excellent bar-iron, which is imported into Great Britain, for the purpose of steel-making.

Second Subspecies.

Granular Magnetic Iron-Ore, or Iron-Sand.

Eisensand, *Werner.*

Id. Werner, Pabst. b. i. s. 147. *Id. Wid.* s. 790.—Magnetic Sand, *Kirw.* vol. ii. p. 161.—Eisensand, *Emm.* b. ii. s. 284. —Le Fer magnetique sablonneux, *Broch.* t. ii. p. 241.—Sandiger Magneteisenstein, *Reuss,* b. iv. s. 48.—Eisensand, *Lud.*

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* Bruce's Mineralogical Journal, p. 5. and 6.

Lud. b. i. s. 241. *Id. Suck.* 2ter th. s. 252. *Id. Bert.* s. 402. *Id. Mohs,* b. iii. s. 363.—Magnetischer Eisensand, *Hab.* s. 144. —Sandiger Magneteisenstein, *Leonhard,* Tabel. s. 64.—Fer oxydulé sablonneux, *Brong.* t. ii. p. 157.—Fer oxydulé arenacé, *Brard,* p. 311.—Sandiger Magneteisenstein, *Karsten,* Tabel. s. 64.—Körniger Magneteisenstein, *Haus.* s. 105.—Fer oxydulé titanifere, *Haüy,* Tabl. p. 94.—Magnetischer Eisensand, *Hoff.* b. iii. s. 223.—Sandy Magnetic Iron-ore, *Aikin,* p. 98.

External Characters.

Its colour is very dark iron-black.

It occurs in grains, which are sometimes angular, sometimes roundish; and also in octahedral crystals.

The grains and crystals are small and very small.

The grains have a feeble glimmering, and rough surface.

Internally it is intermediate between shining and splendent, and the lustre is imperfect metallic.

The fracture is perfect and small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is equally hard with common magnetic iron-ore.

It is brittle, and easily frangible.

Its streak is black.

Specific gravity, 4.600, *Kirwan.*—4.76, *Thomson.*—4.890, *Cordier.*

Physical Characters.

It is magnetical, with polarity.

Constituent

Siam ;
land.
N
Spa
fron
nel
Fr

pphire, and hyacinth; at Greifeswald, on the he Baltic; at Puzzoli, near Naples, in the sand ore, along with pieces of pumice, lava, hornblende, n; also in the Island of Ischia; at Messina in a the Island of Milo in the Archipelago; in the France; Piedmont; and Hungary.

—On the shores of the Lake Baikal in Siberia.

rica.—In the United States; in the Islands of St go and Guadaloupe; West Greenland; Virginia; ayenne.

Uses.

s, although rarely, smelted as an ore of iron. In the l, near Naples, and in Virginia, it is smelted in consi-able quantity; and, owing to its purity, affords most ellent bar-iron.

* Earthy Magnetic Iron-ore.

Ochriger Magneteisenstein, *Hausmann.*

isenschwärze, *Schumacher,* Verzeichniss der Dän. Nord. Mineralien, s. 135. *Id. Reuss,* b. iv. s. 53.—Eisenmulm, *Leonhard,* Tabel. s. 69.—Fer oxydulé fuligineux, *Haüy,* Tabl. p. 94.—Erdiger Magneteisenstein, *Haus.* Handbuch. b. i. s. 249.

External Characters.

Its colour is bluish-black.

It occurs in blunt-edged rolled pieces, in which the surface is sometimes vesicular.

Internally it is dull, or feebly glimmering on spots.

The fracture is fine-grained uneven, passing into earthy.

Constituent Parts.

	Niedermenich.	Teneriffe.	Puy.	Shore of the Baltic.	River Dee, Aberdeenshire.
Oxide of Iron,	79.0	79.2	82.0	85.50	85.3
Oxide of Titanium,	15.9	14.8	12.6	14.00	9.5
Oxide of Chrome,	a trace.	a trace.	...	...	...
Oxide of Manganese,	2.6	1.6	4.5	0.50	...
Arsenic, -	...	...	...	...	1.0
Silica and Alumina,	1.0	0.8	0.6	...	1.5
	98.5	96.4	99.7	100.0	97.3

Cordier, Journal des Mines, N. 124. p. 249. *Klaproth*, Beit. b. v. s. 210. *Thomson*, Tr. R. Soc. Edin. May 1807.

Geognostic Situation.

It occurs imbedded in basalt, clinkstone, and wacke; in lavas of different kinds; loose in the beds of rivers, and in the sands of coasts and plains.

Geographic Situation.

Europe.—Imbedded in secondary or flœtz-trap roc[illegible] Fifeshire, and in the Island of Skye; in the river Dee in [illegible] deenshire, in a sand composed of quartz, felspar, a[illegible] and also in Argyleshire; at Hustanton, Norfolk, [illegible] low, near Wicklow, with native gold. On the C[illegible] is met with in Norway; in flœtz-trap rocks a[illegible] and in loose sand with hyacinth, iserine, [illegible] blende, and augite, in the province of M[illegible] in sand on the banks of the Elbe, at S[illegible] and at Sebnitz, in the same district, [illegible] of hyacinth, and nigrine; in the cl[illegible] Milleschau, in Bohemia; and at [illegible] also in Bohemia, intermixed wit[illegible]

pyrope, sapphire, and [illegible]: [illegible]
shore of the Baltic; at [illegible]
of the shore, along with [illegible]
and oliven; also in the [illegible]
Sicily; in the Island of [illegible]
Tyrol; France; [illegible] Spe-

Asia.—On the [illegible] Clay

America.—In the [illegible]
Domingo and [illegible]
and Cayenne.

[illegible]

It is, although [illegible] Common
Tyrol, near Naples, [illegible] ore.
derable quantity; and, [illegible]
excellent bar-iron.

[illegible]

* Earthy [illegible]

Ochriger [illegible] nera Ferri cœrules-
Eisenschwärze, [illegible] speculaire, *Romé de*
ralien, s. 135. [illegible] *Born*, t. ii. p. 265.—
Tabel. s. 69.—[illegible] b. i. s. 147. *Id. Wid.*
Erdiger [illegible] vol. ii. p. 162.—Gemeiner
[illegible] Fer speculaire, *Lam.* t i.
[illegible] *Haüy*, t. iv. p. 38.–56.—Le Fer
[illegible] t. ii. p. 242.—Gemeiner Eisen-
Its [illegible] *Id. Lud.* b. i. s. 242. *Id. Suck.*
It [illegible] s. 403. *Id. Mohs*, b. iii. s. 367.—
face is [illegible] *Leonhard*, Tabel. s. 64.—Fer oligiste
[illegible] p. 160.—Gemeiner, körniger, & schief-
[illegible] *rsten*, Tabel. s. 64.—Dichter, körniger,
[illegible] N 2 blättriger

blättriger Blutstein, *Haus.* s. 105, 106.—Specular Iron-ore, *Kid,* vol. ii. p. 168.—Fer oligiste, *Haüy,* Tabl. p. 94.—Gemeiner Eisenglanz, *Hoff.* b. iii. s. 228.—Red Iron-ore, *Aikin,* p. 99.

External Characters.

Its most common colour is dark steel-grey, which frequently borders on iron-black, and sometimes inclines to brownish-red. It occurs very frequently tarnished on the external surface, or on that of the distinct concretions. The tarnish is either that of tempered-steel, or is pavonine, columbine, or iridescent.

It occurs massive, and disseminated; also in distinct concretions, which are large, coarse and small granular, prismatic, and thin and curved lamellar; and frequently crystallized.

Its primitive form is a rhomboid, or double three-sided pyramid, in which the angles are 87° 9′ and 92° 51′.

The following are some of the secondary figures:

1. *a.* The primitive form bevelled on the common base. *b.* Truncated on the apices. *c.* Acuminated with three planes, which are set on the lateral planes. *d.* Acuminated with three planes, which are set on the lateral edges. Frequently several of these varieties occur in the same crystal.
2. Flat rhomboid, or double three-sided pyramid, in which the angles are 144° and 36′. Sometimes the lateral edges and apices are rounded off, or they are truncated. In other varieties, the angles on the common base are truncated. When the rounding of the edges and apices increases very much, a spherical lens is formed, in which the planes are very much streaked.

3. Equiangular

3. Equiangular six-sided table, in which the terminal planes are sometimes bevelled, and sometimes the edges of the bevelment are truncated.
4. Low equiangular six-sided prism, in which the terminal edges are obliquely truncated.
5. Very acute double six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and the apices of the pyramids more or less deeply truncated. Sometimes the alternate lateral edges are truncated, and occasionally the angles on the common base.

The crystals are middle-sized and small, and generally grouped in druses. The six-sided tables are sometimes singly superimposed.

The planes of the crystals are generally smooth; those of the primitive form are streaked in the direction of the longer diagonal.

Externally it alternates from splendent to glistening, but is most commonly splendent, and the lustre is metallic.

Internally it is generally glistening, but sometimes passes into shining and splendent, and the lustre is metallic.

It has a distinct threefold cleavage, the folia in the direction of the planes of the primitive rhomboid; also a very distinct cleavage in the direction of the lateral planes of the six-sided table. The cleavages are triply streaked.

The fracture is small and imperfect conchoidal, and coarse and small grained uneven.

The fragments are generally indeterminate angular, and rather sharp-edged, and sometimes rhomboidal.

It affords a cherry-red streak.

Its hardness is intermediate between that of felspar and quartz.

It

It is brittle, and rather difficultly frangible.

Specific gravity, 4.939, 5.218, *Brisson.*—5.139, *Kirwan.* —5.180–5.246, *Breithaupt.*

Physical Characters.

When pulverised, it is magnetic in a slight degree, but it does not, like magnetic ironstone, attract filings of iron.

Chemical Characters.

Before the blowpipe, without addition, it is infusible; melted with borax, it gives a muddy yellow-coloured scoria.

Constituent Parts.

	From Zocka.		From Grengesberget.
Oxide of Iron,	88.00	Reddish-brown Oxide of iron, -	94.38
Oxide of Manganese,	0.75	Phosphate of Lime,	2.75
Iron-pyrites, -	8.25	Magnesia, -	0.16
Silica, -	0.50	Mineral Oil ?	1.25
Magnesia, -	0.12	Loss by heating,	0.50
Loss, - -	2.53		
			98.94
Brocchi, Trattato Mineralogico e Chemico sulle Miniere de Turro del Departemento del Mella, vol. ii. p. 42.		*Hisinger*, Afhandlingar, iii. p. 32, 33.	

Geognostic Situation.

It generally occurs in beds, which are often very thick, in primitive mountains. In these beds, it is associated with magnetic

magnetic iron-ore, red iron-ore, iron-pyrites, copper-pyrites, arsenical pyrites, quartz, hornstone, and calcareous-spar. It also occurs in veins that traverse granite, gneiss, mica-slate, clay-slate, and grey-wacke, in which it is accompanied with red and brown iron-ores, iron-pyrites, tin-ore, quartz, lithomarge, brown-spar, fluor-spar, felspar, epidote or pistacite, and asbestus. It rarely occurs in vesicular cavities and fissures of volcanic rocks, and in veins in some sandstone and flœtz-trap rocks.

Geographic Situation.

Europe.—It occurs, along with red and brown iron-ore, at Cumberhead in Lanarkshire; in the iron-mines of Norberg in Westmannland; at Wika in Dalecarlia; Langbanshytta in Wärmeland; at Bitsberg; also in the mountains of Haukiwara, near Luossawara in Lapland; in Norway; and the government of Olnetz in Russia. It is found in many of the iron-mines in the Saxon Erzgebirge, and generally associated with red iron-ore, as is also the case in the iron-mines of Franconia, Bavaria, and Hessia. In Bohemia, it occurs in beds in mica-slate; in Silesia, in mica-slate, subordinate to gneiss, which rests immediately on granite, and also in the hornblende formation which rests on gneiss. The mountains of Switzerland do not afford much specular iron-ore; small portions of it are met with in St Gothard, and in mica-slate at the foot of the Great St Bernard. Although it is not a frequent ore in France, it is mentioned as occurring along with red iron-ore at Framont; in small quantity at Markirch in Alsace; and in Dauphiny; and in the Puy de Dôme, and Volvic. In the Island of Corsica, it is associated with brown iron-ore; and in the Island of Stromboli, in lava; but of all the

The surface of the crystals is smooth and splendent.

Internally it is splendent, which in some varieties passes into shining, and the lustre is metallic.

The cleavage is perfect and curved foliated, with a single cleavage.

The fragments are sometimes indeterminate angular, sometimes tabular.

It is slightly translucent on the edges; but translucent in thin plates.

Its streak is cherry-red.

It is nearly as hard as common specular iron-ore.

It is brittle, and uncommonly easily frangible.

Specific gravity 5.070, *Kirwan*.

Physical Characters.

It slightly affects the magnet.

Constituent Parts.

According to Bucholz, this subspecies consists entirely of Peroxide of Iron.—*Gehlen*'s Journal, 2d series, b. iii. s. 104.

Geognostic Situation.

It generally occurs in veins or in beds in mica-slate, and clay-slate; and in these repositories it is usually associated with red and brown iron-ores, and iron-pyrites, and sometimes with copper-pyrites, sparry iron, calcareous-spar, fluor-spar, and quartz.

Geographic Situation.

Europe.—It occurs in veins in primitive rocks near Dunkeld, and in Benmore in Perthshire; also in Fitful-

head,

head, and other places in Mainland, the largest of the Shetland Islands. In England, it is met with at Tavistock in Devonshire; Eskdalde in Cumberland; near Bristol; and in Caernarvonshire. The iron-mines in Norway and Sweden, afford small quantities of this ore; and it is also met with in the iron-mines of Olnetz in Russia, and in those in Saxony, Bohemia, Lusatia, Silesia, Franconia, Suabia, Bavaria, France, Island of Elba, and Hungary.

Asia.—In the mines of Catharinenburg in Siberia.

America.—Chili.

Uses.

It melts better than common specular iron-ore, but requires a greater addition of limestone. The iron which it affords is sometimes cold-short, but is well fitted for cast-ware.

Observations.

1. It is characterized by its high degree of lustre, openness of its cleavage, and easy frangibility; and these characters distinguish it from *Common Specular Iron-ore.* Its inflexibility, colour, and considerable hardness, distinguish it from *Black Mica;* its greater weight, and its not soiling, distinguish it from *Graphite;* and its greater hardness, and inferior weight distinguish it from *Brittle Silver.*

2. It passes into Red Scaly Iron-ore.

3. It affords from 70 to 80 *per cent.* of iron.

4. Common specular iron-ore occurs usually with quartz; whereas magnetic iron-ore is frequently accompanied with limestone.

5. It is the *Eisenmann* of older mineralogists.

Second

Second Subspecies.

Red Iron-Ore.

Rotheisenstein, *Werner.*

This species is divided into four kinds, viz. Scaly Red Iron-ore, Ochry Red Iron-ore, Compact Red Iron-ore, and Fibrous Red Iron-ore or Red Hematite.

First Kind.

Scaly Red Iron-ore or Red Iron-froth.

Rother Eisenrahm, *Werner.*

Hæmatites micaceus, *Wall.* t. ii. p. 248.—Rother Eisenrahm, *Werner,* Pabst. b. i. s. 153. *Id. Wid.* s. 807.—Red scaly Iron-ore, *Kirw.* vol. ii. p. 172.—Rother Eisenrahm, *Emm.* b. ii. s. 308.—Fer oxidé rouge luisant, *Haüy,* t. iv. p. 106.—Le Eisenrahm rouge, *Broch.* t. ii. p. 249.—Rother Eisenrahm, *Reuss,* b. iv. s. 76. *Id. Lud.* b. i. s. 244. *Id. Suck.* 2ter th. s. 264. *Id. Bert.* s. 406. *Id. Mohs,* b. iii. s. 385.—Schuppiger Rotheisenstein, *Hab.* s. 116.—Rother Eisenrahm, *Leonhard,* Tabel. s. 65.—Fer oxidé rouge luisant, *Brong.* t. ii. p. 164.—Schuppiger Rotheisenstein, *Karsten,* Tabel. s. 66.—Schaumiger Blutstein, *Haus.* s. 106.—Fer oligiste luisant, *Haüy,* Tabl. p. 95.—Rotheisenrahm, *Hoff.* b. iii. s. 239.—Red scaly Iron-ore, *Aikin,* p. 100.

External Characters.

Its most frequent colour is intermediate between dark steel-grey and brownish-red, which passes on the one side into cherry-red, and on the other into dark steel-grey.

It

It is friable, and consists of semi-metallic shining scaly parts, which are sometimes translucent, and soil strongly.

The particles are more or less coherent, and feel greasy.

Chemical Characters.

It is infusible before the blowpipe without addition, but it communicates to borax an olive and asparagus green colour.

Constituent Parts.

Iron, - - -	66.00
Oxygen, - - -	28.50
Silica, - - -	4.25
Alumina, - - -	1.25
	100 *Henry.*

Bucholz found it to be a pure red oxide of iron, mixed with a little quartz-sand.—*Gehlen's* Journal, 2d series, b. iii. p. 106.

Geognostic Situation.

It occurs in veins in primitive rocks, sometimes also in transition and in secondary rocks. It is usually accompanied with compact and ochry red iron-ore, red hematite, micaceous specular iron-ore, sometimes also magnetic iron-ore, sparry iron, quartz, heavy-spar, and brown-spar.

Geographic Situation.

Europe.—It is found at Ulverstone, and several other places on the borders of Lancashire; in the mine called Oerve-Aase in Norway, along with micaceous specular iron-

iron-ore; Iberg and Blankenberg in the Hartz, with compact red iron-ore; Schmalkalden in Hessia, with brown iron-ore; Schneeberg, with micaceous specular iron-ore; Ehrenfriedersdorf, with magnetic iron-ore; Eibenstock, with ochry red iron-ore; Berggieshübel, with common specular iron-ore; Suhl in Henneberg; and in Silesia, and Hungary.

America.—Chili.

Uses.

At Suhl, in the dutchy of Henneberg, where it occurs in very considerable quantity, it is melted, and yields good iron.

Second Kind.

Ochry Red Iron-ore or Red Ochre.

Ochriger Rotheisenstein, *Werner.*

Ochra Ferri rubra, *Wall.* t. ii. p. 259.—Rotheisenokker, *Wid.* s. 813.—Red Ochre, *Kirw.* vol. ii. p. 171.—Roth Eisenokker, *Emm.* b. ii. s. 317.—Fer oxidé rouge grossier, *Haüy,* t. iv. p. 106, 107.—L'Ocre de Fer rouge, *Broch.* t. ii. p. 256.—Ochriger Rotheisenstein, *Reuss,* b. iv. s. 83. *Id. Lud.* b. i. s. 246. *Id. Suck.* 2ter th. s. 269. *Id. Bert.* s. 408. *Id. Mohs,* b. iii. s. 386. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé rouge ocreux, *Brong.* t. ii. p. 166.—Ochriger Rotheisenstein, *Karsten,* Tabel. s. 66.—Ochriger Blutstein, *Haus.* s. 106.—Rotheisenocker, *Hoff.* b. iii. s. 241.—Red Ochre, *Aikin,* p. 100.

External Characters.

Its colour is light brownish-red, which passes into blood-red.

It

It is usually friable, but in some varieties it approaches and even passes into solid, and occurs as a coating on other ores of iron; also disseminated, and sometimes massive.

It consists of dusty particles, which are dull, or very faintly glimmering.

It soils strongly.

It feels more meagre than greasy.

Its streak is blood-red.

It is easily frangible.

Specific gravity, 2.947, *Wiedemann*.—3.00, *Aikin*.

Geognostic and Geographic Situations.

It occurs in veins, and is almost always accompanied with compact red iron-ore, and red hematite, and sometimes sparry iron, but it is seldom quite pure, being usually mixed with other species of iron-ore.

Its geographic situation is nearly the same as that of the other kinds of red ironstone. It occurs particularly abundant in the Irrgang, near Platte in Bohemia.

Uses.

It melts more easily than any of the other ores of iron, and affords excellent malleable iron.

Observations.

It is characterized by its friability, and dull dusty aspect.

Third

Third Kind.

Compact Red Iron-ore.

Dichter Rotheisenstein, *Werner.*

Hæmatites ruber solidus, *Wall.* t. i. p. 246.—Dichter Rotheisenstein, *Werner,* Pabst. b. i. s. 154. *Id. Wid.* s. 807.—Hématite compacte rouge, *De Born,* t. ii. p. 267.—Compact red Ironstone, *Kirw.* vol. ii. p. 170.—Dichter Rotheisenstein, *Emm.* b. ii. s. 310.—La Mine de Fer rouge Compacte, *Broch.* t. ii. p. 251.—Dichter Rotheisenstein, *Reuss,* b. iv. s. 79. *Id. Lud.* b. i. s. 244. *Id. Suck.* 2ter th. s. 265. *Id. Bert.* s. 406. *Id. Mohs,* b. iii. s. 386. *Id. Hab.* s. 116. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé rouge compact, *Brong.* t. ii. p. 165. —Dichter Rotheisenstein, *Karsten,* Tabel. s. 66.—Gemeiner Blutstein, *Haus.* s. 106.—Fer oligiste compacte, *Haüy,* Tabl. p. 95.—Dichter Rotheisenstein, *Hoff.* b. iii. s. 243.—Compact Red Iron-ore, *Aikin,* p. 100.

External Characters.

Its colour is intermediate between dark steel-grey and blood-red.

It occurs most commonly massive, sometimes also disseminated, specular, with impressions; and in the following supposititious crystals:

1. Acute double six-sided pyramid, from calcareous-spar.
2. Cube, from fluor-spar, and iron-pyrites.

The crystals are middle-sized, small, and sometimes very intimately grown together, and generally hollow.

The specular varieties are smooth and splendent, the others alternate from strongly glimmering to dull, and the high lustre is metallic, the low semi-metallic.

The

The fracture is usually even, from which, although but seldom, it passes into coarse-grained uneven and into large conchoidal, and is sometimes slaty.

The fragments are indeterminate angular, and more or less sharp-edged.

It yields a pale blood-red streak.

It is generally intermediate between hard and semi-hard; sometimes, however, it passes from hard into semi-hard, and nearly into soft.

It is more or less easily frangible.

Specific gravity 4.232, *Breithaupt*.

Physical Character.

When pure, it does not affect the magnet.

Chemical Characters.

It becomes darker before the blowpipe, but is infusible either alone or with glass of borax, to which, however, it communicates an olive-green colour.

Constituent Parts.

Oxide of Iron, -	70.50
Oxygen, - -	29.50
	100.00

Bucholz, in Gehlen's Journ. b. iii. s. 158.

Geognostic Situation.

It occurs in beds and veins in gneiss, clay-slate, grey-wacke, and various secondary rocks, usually associated with red hematite and ochry red iron-ore, quartz, hornstone, red jasper, and sometimes with red iron-flint, heavy-spar, and calcareous-spar. In some mines it is accompanied with specular iron-ore, or with uran-mica.

Geographic Situation.

Europe.—It occurs in considerable quantity at Ulverstone in Lancashire; in the mine called Oevre-Aase in Norway; at Leerbach, Elbingerode, Andreasberg in the Hartz; Konigsberg, near Giessen in Hessia; at Schellerhau near Altenberg, Schneeberg, Johangeorgenstadt, Eibenstock, Suhl, and Saalfeld, in Saxony; Rudelstadt in Silesia; in several iron-mines in Bohemia, Franconia, Bavaria, Salzburg, Spain, and France.

Uses.

As it affords good cast-iron, and also bar-iron, it is often smelted at iron-works. The slaty variety is the most esteemed as an ore.

Observations.

1. It passes on the one side into Common Specular Iron-ore; on the other into Clay Iron-ore, and sometimes also into Common Jasper.

2. It is characterized by fracture, streak, and weight. It is distinguished from indurated *Tile Ore* by streak, hardness, and geognostic situation.

Fourth

Fourth Kind.

Fibrous Red Iron-Ore, or Red Hematite.

Rother Glaskopf, *Werner.*

Hæmatites ruber, *Wall.* t. ii. p. 247.—Rother Glaskopf, *Werner,* Pabst. b. i. s. 156. *Id. Wid.* s. 811.—Hématite rouge, *De Born,* t. ii. p. 288.—Red Hematites, *Kirw.* vol. ii. p. 168.—Rother Glaskopf, *Emm.* b. ii. s. 313.—L'Hématite rouge, *Broch.* t. ii. p. 254.—Fer oxidé hématite rouge, *Haüy,* t. iv. p. 105. 109. 111, 112.—Fasriger Rotheisenstein, *Reuss,* b. iv. s. 85.—Rother Glaskopf, *Lud.* b. i. s. 245.—Fasriger Rotheisenstein, *Mohs,* b. iii. s. 387. *Id. Hab.* s. 117. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé rouge hematite, *Brong.* t. ii. p. 164.—Fasriger Rotheisenstein, *Karsten,* Tabel. s. 66.—Fasriger Blutstein, *Haus.* s. 106.—Fibrous Hematite, *Kid,* vol. ii. p. 171.—Fer oligiste concretionné, *Haüy,* Tabl. p. 95.—Fasriger Rotheisenstein, or Rothglaskopf, *Hoff.* b. iii. s. 246.—Red Hematite, *Aikin,* p. 100.

External Characters.

Its colour is usually intermediate between brownish-red and dark steel-grey. Some varieties incline to blood-red, others to dark steel-grey, and others to bluish.

It occurs most frequently massive, reniform, botryoidal, stalactitic, and globular; also in distinct concretions, which are straight, delicate, and stellular or scopiform fibrous; these are collected into large, small, and fine angulo-granular, and traversed by others which are curved lamellar; more rarely it occurs in cuneiform prismatic concretions. Sometimes in supposititious crystals, as in double six-sided pyramids from calcareous-spar.

 The

The external surface is generally rough and glimmering, seldom smooth and shining; that of the concretions is either smooth or streaked, and the colour inclines to iron-black, with a shining and metallic lustre.

Internally it is usually glistening, which sometimes passes into glimmering, and the lustre is semi-metallic.

The fragments are commonly cuneiform, seldom, as in the coarse fibrous, splintery.

It is opaque.

The streak is always blood-red.

It is hard, passing into semi-hard.

It is brittle, and rather easily frangible.

Specific gravity, 4.740, *Gellert.*—5.005, *Kirwan.*—4.8983, *Brisson.*—4.840, *Wiedemann.*—5.025, *Ullmann.*

Constituent Parts.

Oxide of Iron, -	90	94
Trace of Oxide of Manganese.		
Silica, - -	2	2
Lime, - - -	1	a trace.
Water, - - -	3	2
	96	98

Daubuisson, Ann. de Chimie, Sept. 1810.

Geognostic Situation.

It occurs in every situation where the compact kind is found, and like it in veins, beds, and lying masses *(liegende stöcke)* that approach in magnitude to mountain-masses, principally in primitive mountains, but also in transition and secondary mountains. The different kinds frequently occur

occur together, both in beds and in veins: in veins, it is the compact and ochry that predominate; the hematite occurs principally in drusy cavities, the walls of which are incrusted with the scaly kind.

Geographic Situation.

Europe.—It occurs in veins that traverse sandstone at Cumberhead in Lanarkshire; in veins in secondary greenstone at Salisbury Craigs, near Edinburgh; at Ulverstone in Lancashire; in Cumberland; and also in Devonshire; and near Bristol in Gloucestershire. It is found in considerable quantity in Saxony, from Berggieshübel to Voightland; in Bohemia, but not so abundantly as in Saxony; Bareuth; Wolfstein in the Palatinate; Silesia; Lauterberg, Walkenried, Andreasberg, Wernigerode in the Hartz; and Salzburg.

Asia.—In Siberia.

America.—Mexico.

Uses.

It affords excellent malleable and cast iron; and when ground, it is also used for polishing tin, silver, and gold vessels, and for colouring iron brown.

Observations.

The name *Hematite*, which is derived from the Greek, *αιμα*, *sanguis*, was given to this ore of iron from its red colour.

Third

Third Subspecies.

Red Clay Iron Ore or Stone.

This subspecies is divided into four kinds, viz. Ochry Red Clay Iron-ore, Columnar Red Clay Iron-ore, Lenticular Red Clay Iron-ore, and Jaspery Red Clay Iron-ore.

First Kind.

Ochry Red Clay Iron-Ore, or Red Chalk.

Roethel, *Werner*.

Ochra Ferri rubra, cretacea solida, rubrica, *Wall.* t. ii. p. 260. —Rother Eisenokker, *Wid.* s. 813.—Argile martiale rouge, Sanguine ou Crayon rouge, *De Born,* t. ii. p. 230.—Röthel, *Emm.* b. ii. s. 350.—Argile ocreuse rouge graphique, *Haüy,* t. iv. p. 445, 446.—Le Crayon rouge, *Broch.* t. ii. p. 271.—Röthel, *Reuss,* b. iv. s. 124. *Id. Lud.* b. i. s. 251.—Rother Thoneisenstein, *Suck.* 2ter th. s. 289.—Röthel, *Bert.* s. 425. *Id. Mohs,* b. iii. s. 418. *Id. Leonhard,* Tabel. s. 66.—Ochriger Thoneisenstein, *Karsten,* Tabel. s. 66.—Röthel, *Hoff.* b. iii. s. 275.

External Characters.

Its colour is light brownish-red, which sometimes inclines to cherry-red.

It occurs massive.

The principal fracture is glimmering; the cross fracture is dull.

The principal fracture is rather thick slaty; the cross fracture is fine earthy.

The

The fragments are sometimes tabular, and sometimes splintery.

Its streak is pale blood-red.

It is soft, and very soft.

It soils, and writes.

It is rather sectile.

It is easily frangible.

Specific gravity, 3.391, *Blumenbach*.—3.1391, *Brisson*. 3.805, *Ullmann*.—3.109, *Breithaupt*.

Chemical Characters.

Exposed to a red heat, it decrepitates and becomes black; at the temperature of 159° it melts into a greenish-grey spumous enamel.

Geognostic Situation.

It occurs in thin beds in clay-slate and grey-wacke-slate.

Geographic Situation.

Europe.—It occurs in Hessia, Thuringia, Upper Lusatia, Silesia, and Salzburg.

Asia.—Jelschansk in Siberia.

Uses.

It is principally used for drawing. The coarser varieties are used by the carpenter, the finer by the painter. It is either used in its natural state, or it is pounded, washed, and mixed with gum, and cast into moulds. The crayons thus formed, when intended for coarse drawings, are mixed with but a small portion of gum; but those which are to be used for small and delicate drawings, with

a

a much greater proportion, in order to give them sufficient hardness.

Observations.

1. It is usually called *Red Chalk*, or *Reddle*.
2. It is never smelted as an ore of iron.

Second Kind.

Columnar Red Clay Iron-Ore.

Stänglicher Thoneisenstein, *Werner*.

Id. Werner, Pabst. b. i. s. 167.—Var. of Gemeiner Thoneisenstein, *Wid*. s. 825.—Columnar or Scapiform Iron-ore, *Kirw*. vol. ii. p. 176.—Fer oxidé rouge bacillaire, *Haüy*, t. iv. p. 107. —Le Fer argilleux scapiforme, *Broch*. t. ii. p. 273.—Stänglicher Thoneisenstein, *Reuss*, b. iv. s. 115. *Id. Lud*. b. i. s. 251. *Id. Suck*. 2ter th. s. 283. *Id. Bert*. s. 422. *Id. Mohs*, b. iii. s. 419. *Id. Leonhard*, Tabel. s. 66.—Fer terreux argilleux bacillaire, *Brong*. t. ii. p. 173.—Stänglicher Blutstein, *Haus*. s. 106.—Stänglicher Thoneisenstein, *Karsten*, Tabel. s. 66. *Id. Hoff*. b. iii. s. 278.—Columnar Clay Ironstone, *Aikin*, p. 104.

External Characters.

Its colour is brownish-red, which passes on the one side into cherry-red, and on the other into black. Sometimes it has a faint columbine tarnish.

It occurs massive, and also in columnar distinct concretions, which are straight or curved, and thick or thin; usually parallel; sometimes scopiform diverging; and also jointed.

The

The surface of the concretions is rough and dull.

The streak is blood-red.

It is soft.

It is brittle, and uncommonly easily frangible.

It adheres slightly to the tongue.

In single pieces it gives a ringing sound.

It feels very rough.

Specific gravity 3.126–3.422, *Breithaupt*.

Chemical Characters.

It becomes black before the blowpipe, bubbles up with borax, and communicates to it an olive green and blackish colour.

Constituent Parts.

Oxide of Iron, - -	50.00
Water, - - -	13.00
Silica, - - -	32.00
Alumina, - - -	7.00

Brocchi, Trattato, &c. vol. ii. p. 119.

Geognostic and Geographic Situations.

It is a rare mineral, and is in general a pseudo-volcanic product; for it occurs along with earthy-slag, porcelain-jasper, and burnt-clay, in the neighbourhood of pseudo-volcanoes.

It is found at Hoschnitz and Delau, in the Saatzer circle, Straska and Schwintshitz in the circle of Leutmeritz in Bohemia; Amberg in the Upper Palatinate; Dutweiler in Saarbruck.

Third

Third Kind.

Lenticular Red Clay Iron-Ore.

Linsenförmiger Thoneisenstein, *Werner*.

Id. Werner, Pabst. b. i. s. 167. *Id. Wid.* s. 826.—Acinose Iron-ore, *Kirw.* vol. ii. p. 177.—Körniger Thoneisenstein, *Emm.* b. ii. s. 342.—Le Fer argilleux grenu ou lenticulaire, *Broch.* t. ii. p. 274.—Körniger Thoneisenstein, *Reuss,* b. iv. s. 120. —Linsenförmiger Thoneisenstein, *Lud.* b. i. s. 252. *Id. Suck.* 2ter th. s. 285. *Id. Bert.* s. 423. *Id. Mohs,* b. iii. s. 420. *Id. Leonhard,* Tabel. s. 66.—Körniger Thoneisenstein, *Karsten,* Tabel. s. 66.—Körniger Blutstein, *Haus.* s. 106. —Körniger Thoneisenstein, *Hoff.* b. iii. s. 283.—Lenticular Clay Ironstone, (in part), *Aikin,* p. 104.

External Characters.

Its colours are brownish-red, and reddish-brown.

It occurs massive, and in distinct concretions, which are lenticular.

Internally it is always strongly semi-metallic glimmering, which passes into glistening.

On account of the smallness of the concretions, it is difficult to ascertain the kind of fracture, yet it appears to be sometimes fine earthy, and sometimes slaty.

The fragments are indeterminate angular, and blunt-edged.

It yields a red-coloured streak.

It is soft; some varieties pass into very soft; others into semi-hard.

It is brittle, and easily frangible.

Specific gravity, 3.770, 3.810, *Ullmann.*—3.655, *Breithaupt.*

Physical

Physical Character.

The black variety is slightly affected by the magnet.

Constituent Parts.

	From Radnitz in Bohemia.
Oxide of Iron,	64.0
Alumina,	23.0
Silica,	7.5
Water,	5.0
	99.5

Lampadius.

Geognostic Situation.

It occurs principally in beds in an amygdaloid, subordinate to clay-slate and grey-wacke.

Geographic Situation.

It is found in considerable abundance in Bohemia.

Uses.

It melts excellently, and affords a malleable iron nearly as good as that obtained from the best kinds of red iron-ore. It also affords excellent cast-iron.

Fourth

Fourth Kind.

Jaspery Red Clay-Iron-Ore.

Jaspisartiger Thoneisenstein, *Werner*.

Jaspisartiger Thoneisenstein, *Reuss*, b. iv. s. 126. *Id. Lud.* b. i. s. 252. *Id. Suck.* 2ter th. s. 290. *Id. Mohs*, b. iii. s. 422. *Id. Leonhard*, Tabel. s. 66. *Id. Karsten*, Tabel. s. 66.—Jaspisartiger Gelbeisenstein, *Haus.* s. 107.—Jaspisartiger Thoneisenstein, *Hoff.* b. iii. s. 277.

External Characters.

Its colour is reddish-brown, sometimes passing into brownish-red.

It occurs massive.

Internally it is feebly glimmering, sometimes approaching to glistening.

The fracture is large and flat conchoidal.

The fragments are rhomboidal, and sometimes cubical and trapezoidal.

In the streak it becomes somewhat lighter.

It is semi-hard.

It is brittle, and rather easily frangible.

Specific gravity 3.194, *Breithaupt*.

Geognostic and Geographic Situations.

It occurs at Fischau in Austria, where it forms considerable beds in a flœtz or secondary formation.

Observations.

Observations.

1. Its hardness, and shape of its fragments, distinguish it from the other kinds of red clay iron-ore.

2. It is named *Jaspery*, on account of its resemblance to jasper in external aspect.

3. Prismatic Iron-Ore.

Prismatisches Eisen-erz, *Mohs.*

Braun Eisenstein, *Werner.*

This species is divided into four subspecies, Ochry Brown Iron-ore, Compact Brown Iron-ore, Fibrous Brown Iron-ore or Brown Hematite, Brown Clay Iron-ore. * Bog Iron-ore. ** Pitchy Iron-ore. *** Iron-Sinter.

First Subspecies.

Ochry Brown Iron-Ore.

Ockriger Brauneisenstein, *Werner.*

Ochra ferri flava? *Wall.* t. ii. p. 258.—Ochra ferri fusca, *Ibid.* p. 344.—Braune Eisenokker, *Wid.* s. 819.—Brown Iron-Ochre, *Kirw.* vol. ii. p. 167.—Braune Eisenokker, *Emm.* b. ii. s. 327.—Fer oxydé rubigineux pulverulent, *Haüy,* t. iv. p. 108. d.—L'Ocre de Fer brune, *Broch.* t. ii. p. 263.—Ockriger Brauneisenstein, *Reuss,* b. iii. s. 96. *Id. Lud.* b. i. s. 248. *Id. Suck.* 2ter th. s. 275. *Id. Bert.* s. 412. *Id. Mohs,* b. iii. s. 394. *Id. Hab.* s. 119. *Id. Leonhard,* Tabel. s. 65. —Fer oxydé brun ocreux, *Brong.* t. ii. p. 172.—Ochriger Brauneisenstein, *Karsten,* Tabel. s. 66. *Id. Haus.* s. 108.—Fer oxydé pulverulent? *Haüy,* Tabl. p. 98.—Ockriger Brauneisenstein,

eisenstein, *Hoff.* b. iii. s. 254.—Ochrey Brown Iron-ore, *Aikin*, p. 102.

External Characters.

Its colour is light yellowish-brown.

It occurs massive and disseminated.

Internally it is dull.

The fracture is coarse earthy, sometimes approaching to uneven.

It retains its colour in the streak.

It soils slightly.

It is very soft.

It is sectile, and easily frangible.

Constituent Parts.

Peroxide of Iron, - - -	83
Water, - - - - -	12
Silica, - - - - -	5
	100

Daubuisson, Ann. de Chim. Septembre 1810.

Geognostic Situation.

It occurs along with the compact and fibrous subspecies.

Geographic Situation.

It is found at Shotover Hill in Oxfordshire; Kongsberg and Arendal in Norway; Iberg, near Grund in the Hartz; Grosskamsdorf in Saxony; Nassau; Orpes and Kupferberg in Bohemia; Upper Palatinate; Rott in Bavaria; Hüttenberg in Carinthia; Salzburg.

Uses.

Uses.

It affords excellent bar-iron.

Second Subspecies.

Compact Brown Iron-Ore.

Dichter Brauneisenstein, *Weruer.*

Id. Werner, Pabst. b. i. s. 160. *Id. Wid.* s. 815.—Compact Brown Ironstone, *Kirw.* vol. ii. p. 165.—Dichter Brauneisenstein, *Emm.* b. ii. s. 321.—La Mine de Fer brune compacte, *Broch.* t. ii. p. 259.—Dichter Brauneisenstein, *Reuss,* b. iv. s. 93. *Id. Lud.* b. i. s. 247. *Id. Suck.* 2ter th. s. 247. *Id. Bert.* s. 410. *Id. Mohs,* b. iii. s. 394.—Dichter Brauneisenstein, *Hab.* s. 119. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé brun compacte, *Brong.* t. ii. p. 168.—Gemeiner Brauneisenstein, *Karsten,* Tabel. s. 66.—Dichter Brauneisenstein, *Haus.* s. 108. *Id. Hoff.* b. iii. s. 255.—Compact Brown Iron-ore, *Aikin,* p. 102.

External Characters.

Its colour is yellowish-brown and clove-brown. It frequently exhibits a pavonine and bronze-like tarnish.

It occurs massive, disseminated; frequently also cylindrical; and very rarely in supposititious crystals, of which the following are known:

1. Small cube, from common iron-pyrites.
2. Pentagonal dodecahedron, from common iron-pyrites.
3. Double four-sided pyramid, from radiated pyrites.

The crystals are middle-sized and small; the varieties

1,

1, 2. are generally imbedded in a porphyritic manner, and the variety 3. is often aggregated in druses.

The cubes are alternately streaked.

Externally it alternates from shining to dull.

Internally it is dull, or semimetallic glimmering.

The fracture is most commonly even, sometimes also fine-grained uneven.

The fragments are indeterminate angular, and more or less blunt-edged.

The streak is yellowish-brown, passing into ochre-yellow.

It is semi-hard, sometimes inclining to soft.

It is rather brittle, and easily frangible.

Specific gravity, 3.5027, the cubic, } *Brisson*.
3.4771, }
3.551, from Bayreuth, } *Kirwan*.
3.753, from the Tyrol, }
3.073, *Wiedemann*.
3.40, *Daubuisson*.

Chemical Characters.

Before the blowpipe, its colour darkens, and it becomes magnetic; to glass of borax it communicates an olive-green colour.

Constituent Parts.

	Bergzabern.	Vicdessos.	Pyrenees.
Peroxide of Iron,	84	81	81
Water, - -	11	12	11
Oxide of Manganese,	1	--	a trace
Silica, - - - -	2	4	2
Alumina, - -	--	--	a trace.
	98	97	94

Daubuisson, Annal. de Chim. Sept. 1810.

Geognostic

Geognostic Situation.

It occurs in the same geognostic situation as the following subspecies. It is always accompanied with ochry and fibrous brown iron-ore.

Geographic Situation.

Europe.—It is found near Sandlodge in Mainland, the largest of the Shetland Islands; in Derbyshire; Lauterberg, and Blankenburg in the Hartz; Schmalkalden in Hessia; Saye and Altenkirchen in Westerwald; Schwarzenberg, Schneeberg, Scheibenberg, Grosskamsdorf, Voightsberg in Voightland; Sahlberg, Konitz, and Suhl, in Thuringia; Nassau; Kupferberg, Auspaner mountains near Pressnitz; Wisterschan near Töplitz; Stiahlan near Rakowa in Bohemia; gold mine near Schreiberau, Silesia; Upper Palatinate; Lower Palatinate; Dutchy of Deux-Ponts; Naila in Bayreuth; Suabia; Tyrol; Salzburg; Stiria; Vellach, Hüttenberg, and Eisenaach, in Carinthia; Hungary; Transylvania; France.

Asia.—Beresof and Catharinenburg in Siberia.

America.—United States.

Uses.

It affords about 50 *per cent.* of iron. It is easily fusible. It affords excellent bar-iron.

Observations.

It is distinguished from *Compact Tile-ore* by its colour; from *Compact Hepatic-ore* by inferior specific gravity.

Third Subspecies.

Fibrous Brown Iron-Ore, or Brown Hematite.

Brauner Glaskopf, *Werner*.

Id. Werner, Pabst. b. i. s. 161. *Id. Wid.* s. 817.—Brown Hematite, *Kirw.* vol. ii. p. 163.—Brauner Glaskopf, *Emm.* b. ii. s. 323.—Fer oxidé Hematite brun, *Haüy,* t. iv. p. 105.—L'Hematite brun, *Broch.* t. ii. p. 261.—Fasriger Brauneisenstein, *Reuss,* b. iv. s. 98.—Brauner Glaskopf, *Lud.* b. i. s. 248. *Id. Suck.* 2ter th. s. 273. *Id. Bert.* s. 411. *Id. Mohs,* b. iii. s. 400. —Fasriger Brauneisenstein, *Hab.* s. 120.—Fer oxydé brun fibreux, *Brong.* t. ii. p. 168.—Fasriger Brauneisenstein, *Karsten,* Tabel. s. 66. *Id. Haus.* s. 107.—Brown hematitic Iron-ore, *Kid,* vol. ii. p. 176.—Fer oxidé hematite, & Fer oxidé noire vitreux, *Haüy,* Tabl. p. 98.—Fasriger Brauneisenstein, *Hoff.* b. iii. s. 258.—Brown Hematite, *Aikin,* p. 101.

External Characters.

The surface of the fresh fracture is clove-brown, which in some varieties passes into blackish-brown, hair-brown, and in others into yellowish-brown. The external surface is tarnished velvet-black and bluish-black; sometimes also steel-grey, pinchbeck-brown, pavonine, and iridescent.

It seldom occurs massive, more frequently stalactitic, coralloidal, reniform, botryoidal, tuberose; sometimes also cylindrical, fructicose, dendritic, large and small cellular; also in distinct concretions, which are delicate fibrous, and generally stellular and scopiform: these are collected into other concretions which are longish granular and lamellar, and

and the lamellar intersect the granular concretions. It sometimes occurs in double six-sided pyramids, being supposititious crystals from calcareous-spar; and also in true crystals. The primitive form is an oblique four-sided prism, the dimensions of which have not been ascertained. This prism occurs in small capillary crystals, which form druses.

The external surface of the particular external shapes is sometimes smooth, sometimes granulated, but seldom rough or drusy.

Externally it is usually splendent.

Internally it is glimmering, sometimes passing into glistening; and the lustre is intermediate between pearly and resinous.

The fragments are sometimes splintery; sometimes wedge-shaped; seldom indeterminate angular.

It is generally opaque; the brownish-black variety is weakly translucent on the edges.

The streak is pale yellowish-brown.

It is harder than apatite, but not so hard as felspar.

It is brittle, and easily frangible.

Specific gravity, 3.789, *Gellert.*—3.951, *Kirwan.*—4.029, *Wiedemann.*—3.764, *Breithaupt.*

Chemical Characters.

It becomes black before the blowpipe, and dissolves with some ebullition in glass of borax, to which it communicates an olive-green colour.

Constituent Parts.

Fibrous.	Bergzabern.	Vicdessos.
Peroxide of Iron,	79	82
Water, - -	15	14
Oxide of Manganese,	2	2
Silica, - -	3	1
	99	99

Daubuisson, Ann. de Chim. Sept. 1810.

Resinous and Conchoidal.	
Oxide of Iron,	80.25
Water, - -	15.00
Silica, - -	3.75
	99.00

Vauquelin, Haüy, Tabl. Comp. 274.

Observations.

Brown Iron-ore is readily distinguished from *Red Iron-ore*, by its yellow streak, and inferior specific gravity; also by the water which it contains, it being a hydrate of iron: further brown iron-ore is generally associated with sparry iron, but rarely with red iron-ore.

Chemical Properties, Geognostic and Geographic Situations of the three preceding Subspecies.

A. *Chemical Properties, &c.*

1. These subspecies of iron-ore melt easily, and afford usually from 40 to 60 *per cent.* of iron. The cast-iron which they afford is indifferent, and the vessels made of it are not so fine as those manufactured from the cast-iron of red iron-ore, and other ores of iron. The wrought iron obtained from these ores is very malleable, and at the same time hard: hence it is advantageously used in cases where softer iron would not answer. It also affords excellent steel, which is conjectured to be owing to the manganese it contains.

2. When they are intermixed with quartz, they afford a cold-short iron; but if with copper-pyrites, a red-short iron.

iron. It would appear, however, to require a greater quantity of sulphur to produce red-short iron from these subspecies than from most of the other ores of iron, and this is conjectured to be owing to the manganese which they contain.

3. They melt usually without a flux; and when one is necessary, clay-slate is that which is generally used.

B. *Geognostic Situation.*

They occur in primitive, transition, and secondary mountains, but more frequently in the two latter: and when in primitive mountains, in those only which are considered as of newer formation. Their repositories are veins, beds, lenticular masses *(liegende stöke)*, and mountain-masses *(stüke gebirge)*. When they occur in veins and lying masses, the compact and ochry subspecies form the principal part of the mass. The brown hematite occurs often in cavities in these veins or beds. They are usually accompanied with sparry iron, calcareous-spar, brown-spar, and heavy-spar; less frequently with black hematite, and rarely with quartz, and red iron-ore. Quartz, which occurs so frequently with red iron-ore, seldom appears with brown iron-ore: on the contrary, it is accompanied with heavy-spar, calcareous-spar, and in some places with fluor-spar.

C. *Geographic Situation.*

Europe.—They occur in veins in sandstone, along with heavy-spar, at Cumberhead in Lanarkshire; in a similar repository in Mainland, one of the Shetland Islands; and in the Island of Hoy, one of the Orkney group. Small veins filled with these ores are met with in the flœtz greenstone of Salisbury Craigs, near Edinburgh. They also occur

cur at Schneebrg, Scheibenberg and Raschau in the Erzgebirge; and at Kamsdorf, where they (principally the ochry subspecies) occur in flœtz rocks, in beds, which are sometimes so thick that they nearly form lying masses. A part of this deposition passes into Schwarzburg, as far as Pönitz, and even reaches to Henneberg, where there are very extensive ironworks. Further, they are found in very considerable quantity all around the Fichtelgebirge, and there are ironworks for smelting these ores, both on the Saxon and Bohemian sides, and in that part of it which belongs to Bayreuth. They occur in beds in the Upper Palatinate, and in Franconia. They are less abundant in the Hartz, where, at Iberg near Grün, the ochry brown iron-ore occurs in *putzenwerke* in limestone. Very considerable mines of these ores are met with in Nassau, Hessia, and Westerwald; and they also occur in the Tyrol, Carinthia, Stiria, Upper Italy, and in the southern provinces of France.

It may be remarked, that northern countries, such as Sweden and Lapland, which possess so great an abundance of magnetic iron-ore and specular iron-ore, contain but small quantities of this species, which occurs so abundantly in the Hartz, Stiria, Carinthia, Hungary, Saxony, Westphalia, the county of Nassau, and other districts.

Fourth Subspecies.

Brown Clay Iron-Ore.

This subspecies is divided into five kinds, viz. Common Brown Clay Iron-ore, Pisiform Brown Clay Iron-ore, Reniform

niform Brown Clay Iron-ore, Granular Brown Clay Iron-ore, and Umber.

First Kind.

Common Brown Clay Iron-ore.

Gemeiner Gelbeisenstein, *Haus.* b. i. s. 282.

External Characters.

Its colours are yellowish-brown and yellowish-grey; also ochre-yellow.

It occurs massive.

Internally it is dull or feebly glimmering.

The fracture is large and flat conchoidal; also even and uneven.

It is opaque.

The fragments are indeterminate angular and blunt edged.

Its streak is brown, inclining to grey.

It is soft; or soft passing into semi-hard.

Constituent Parts.

Oxide of Iron,	69
Oxide of Manganese,	3
Water,	13
Silica,	10
Alumina,	3
	98

Daubuisson, Annal. de Chim. Sept. 1810.

Geognostic

Geognostic and Geographic Situations.

It occurs in England; also in Saxony, Bohemia, Silesia, and Westphalia, in beds in secondary rocks.

Second Kind.

Pisiform Brown Iron-Ore or Pea-Ore.

Bohnerz, *Werner.*

Minera Ferri subaquosa globosa, *Wall.* t. ii. p. 257.—Mine de Fer en grains, *Romé de Lisle,* t. iii. p. 300.—Bohnerz, *Werner,* Pabst. b. i. s. 168. *Id. Wid.* s. 827.—Pisiform or granular Ironstone, *Kirw.* vol. ii. p. 178.—Bohnerz, *Emm.* b. ii. s. 347.—Fer oxydé rubigineux globuliforme, *Haüy,* t. iv. p. 111.—Le Fer pisiforme, *Broch.* t. ii. p. 280.—Kuglicher Thoneisenstein, *Reuss,* b. iv. s. 135. *Id. Lud.* b. i, s. 254. *Id. Suck.* 2ter th. b. ii. s. 288. *Id. Bert.* s. 424. *Id. Mohs,* b. iii. s. 426.—Hagelförmig, körniger, thoniger Brauneisenstein; Braunes Bohnerz, *Hab.* s. 122.—Bohnerz, *Leonhard,* Tabel. s. 67.—Fer oxidé brun granuleux, *Brong.* t. ii. p. 170.—Kuglicher Thoneisenstein, *Karsten,* Tabel. s. 66.—Kuglicher Gelbeisenstein, *Haus.* s. 107.—Pea-ore, *Kid,* vol. ii. p. 181.—Fer oxidé globuliforme, *Haüy,* Tabl. p. 98.—Körniger Gelbeisenstein, *Haus.* Handb. b. i. s. 281.—Bohnerz, *Hoff.* b. iii. s. 288.—Pisiform Clay Ironstone, *Aikin,* p. 104.

External Characters.

[illegible]ly its colour is yellowish-brown of different de[illegible] intensity, which sometimes passes into blackish-[illegible] Externally it is reddish, yellowish, and liver brown, [illegible] yellowish-grey, which are, however, accidental,

dental, as they depend on the kind of clay in which it is imbedded.

It occurs in small spherical round grains, which are not hollow, and these are composed of concentric curved lamellar concretions.

Internally it passes from dull to glistening, in such a manner that the centre of the grain is dull, and the lustre increases in strength towards the surface; the lustre is resinous.

The fracture is fine earthy in the centre of the grain, but towards the surface even.

The fragments are indeterminate angular, and not particularly sharp-edged.

The streak is yellowish-brown.

It is soft.

It is rather brittle, and easily frangible.

Specific gravity, 3.142, *Breithaupt.*

Constituent Parts.

	Pené, in the district of Gaillac.	Mardorf.
Oxide of Iron,	48	60
Alumina,	31	13
Silica, -	15	12
Water, -	6	15
	100	100
	Vauquelin, Journ. des Mines, xii.	*Mollinghof*, Crell's Annalen 1802, s. 110.

	Hegau.	Berri.
Oxide of Iron,	53.00	70
Oxide of Manganese,	1.00	trace
Alumina, -	23.00	7
Silica - -	6.50	6
Water, -	14.50	15
	98.00	98
	Klaproth, Beit. b. iv. s. 131.	*Daubuisson*, Annal. de Chim. for 1810.

Geognostic Situation.

It occurs in hollows in shell limestone.

Geographic

Geographic Situation.

It is found at Galston in Ayrshire. On the Continent, it occurs at Eichstadt in Franconia; Mardorf near Homburg in Hessia; Nardern, Duttlengen, Heerbrechtlingen in Suabia; Basle, Aarau near Bern, and in the Jura mountains, where it occurs in an extensive bed, which rests on limestone; Salzburg; Alsace, Burgundy, Languedoc, &c. in France; Dalmatia; also in Smoland in Sweden.

Uses.

It yields from 30 to 40 *per cent.* of iron; and at Aarau it supplies very considerable ironworks. In Dalmatia, it is said to be used by the inhabitants in place of shot.

Observations.

1. It is distinguished from *Reniform Brown Clay Iron-ore* by its form.
2. It is named in Sweden, Myrmalm, Sjömalm, Pennigmalm, and Skragmalm.

Third Kind.

Reniform or Kidney-shaped Brown Clay Iron-ore.

Eisenniere, *Werner.*

Ætites, *Wall.* t. ii. p. 614.—Pierre d'Aigle, *Romé de Lisle,* t. iii. p. 300.—Eisenniere, *Werner,* Pabst. b. i. s. 167.—Var. of Bohnerz, *Wid.* s. 827.—Nodular Ironstone, *Kirw.* vol. ii. p. 178.—Fer limoneux spheroidal, *De Born,* t. ii. p. 283.—Eisenniere, *Emm,* b. ii. s. 344.—Pierre d'Aigle, *Lam.* t. i. p. 245.

p. 245.—Fer oxydé rubigineux geodique, *Haüy*, t. iv. p. 107, &c.—Le Fer reniforme, *Broch.* t. ii. p. 278.—Eisenniere, *Reuss*, b. iv. s. 132. *Id. Lud.* b. i. s. 253. *Id. Suck.* 2ter th. s. 286. *Id. Bert.* s. 423, *Id. Mohs*, b. iii. s. 425. *Id. Leonhard*, Tabel. s. 67.—Fer oxidé brun ætite, *Brong.* t. ii. p. 169.—Schaaliger Thoneisenstein, *Karsten*, Tabel. s. 66.—Schaaliger Gelbeisenstein, *Haus.* s. 107.—Ætites or Eaglestone, *Kid*, vol. ii. p. 181.—Fer oxydé geodique, *Haüy*, Tabl. p. 98.—Eisenniere, *Hoff.* b. iii. s. 286.

External Characters.

Its colour is yellowish-brown, but it shews various degrees of intensity, even in the same specimen; externally it is darker, approaching to blackish-brown; internally the colour is very light, and sometimes it includes an ochre-yellow kernel.

It occurs massive, in irregular single balls, also in reniform, lenticular and elliptical forms, which are sometimes hollow. These forms are composed of concentric lamellar concretions, which often include a loose nodule.

The lustre of the external layers is glimmering and semi-metallic; that of the internal layers is dull; the surface of the concretions is rough and glimmering.

The fracture towards the interior is fine earthy; towards the exterior, even; in the dark yellowish-brown varieties, nearly conchoidal; that of the ochre-yellow, even.

The fragments are indeterminate angular.

The external layers are soft, sometimes inclining to semi-hard; the internal very soft, sometimes inclining to friable.

The streak is pale yellowish-brown, bordering on ochre-yellow, and is glistening.

It is rather sectile, and easily frangible.

Constituent

Constituent Parts.

Peroxide of Iron, - - -	76	78
Water, - - - - -	14	13
Silica, - - - - - -	5	7
Oxide of Manganese, - -	2	trace
Alumina, - - - - -		1
Lime, - - - - - -		trace
	97	99

Daubuisson, Ann. d. Chimie for 1810.

Geognostic Situation.

It occurs imbedded in ironshot clay, in secondary rocks of different kinds, and also in loam and clay beds that lie over black coal.

Geographic Situation.

Europe.—It is found in different places in the counties of Mid-Lothian and East Lothian; at Colebrookedale in England; Norway; Denmark; at Wehrau in Upper Lausitz; Bohemia; Upper Palatinate; Oppeln, Beuthen, Tarnowitz, in Silesia; Mountains of Cracau in Poland; Transylvania; and France.

Asia.—Siberia.

Uses.

It is one of the best kinds of ironstone, yields an excellent iron, and is smelted in many places.

Fourth

Fourth Kind.

Granular Brown Clay Iron-Ore.

External Characters.

Its colour is yellowish and reddish-brown.
It occurs massive, and in small globular united grains.
The fracture is thick slaty.
The streak is yellowish-brown.
It is soft.
It is rather brittle, and very easily frangible.
Specific gravity, 3.005, *Breithaupt*.

Geognostic and Geographic Situations.

It occurs in beds between the red sandstone of the salt formation and the lias limestone. It often contains petrifactions of shells. It is found in Bavaria, Salzburg, the Tyrol, and France.

Uses.

It affords about 40 *per cent.* of good iron.

Fifth Kind.

Umber.

External Characters.

Its colour is clove-brown, which passes into blackish-brown and yellowish-brown.

It

It occurs massive.
Internally it is dull or glimmering, and resinous.
The fracture is flat conchoidal, passing into fine earthy.
The fragments are blunt-edged.
It is soft, inclining to very soft.
It is rather sectile.
It soils strongly.
It is very easily frangible.
It feels meagre.
It adheres strongly to the tongue.
It readily falls to pieces in water.
Specific gravity 2.060, *Ullmann.*

Constituent Parts.

	From Cyprus.
Oxide of Iron, - -	48
Oxide of Manganese, -	20
Silica, - - - -	13
Alumina, - - - .	5
Water, - - - - -	14
	100

Klaproth, Beit. b. iii. s. 140.

Geognostic and Geographic Situations.

It occurs in beds in the Island of Cyprus.

Uses.

It is used as a pigment.

Observations.

Other minerals are known under the name Umber, particularly Earth-coal, the Humus umbra of Wallerius.

* Bog Iron-*Ore*.

Raseneisenstein, *Werner*.

There are three kinds of this ore, viz. Morass-ore, Swamp-ore, and Meadow-ore.

First Kind.

Meadow-Ore, or Friable Bog Iron-Ore.

Morasterz, *Werner*.

Id. Werner, Pabst. b. i. s. 168. *Id. Wid.* s. 830.—Morassy Iron-ore, *Kirw.* vol. ii. p. 183.—Morasterz, *Emm.* b. ii. s. 352.—Fer oxydé rubigineux massif, *Haüy*, t. iv. p. 138.—La Mine des Marais, ou le Morasterz, *Brock.* t. ii. p. 283.—Morasterz, *Reuss*, b. iv. s. 138. *Id. Lud.* b. i. s. 254. *Id. Mohs*, b. iii. s. 431. *Id. Leonhard*, Tabel. s. 67.—Fer oxidé limoneux, le Mine des Marais, *Brong.* t. ii. p. 174.—Zerreiblicher Raseneisenstein, *Karsten*, Tabel. s. 66.—Lowland Iron-ore, *Kid*, vol. ii. p. 182.—Morasterz, *Hoff.* b. iii. s. 292.

External Characters.

Its colour is pale yellowish-brown, which frequently passes into ochre-yellow.

It is sometimes friable, sometimes nearly coherent.

The coherent varieties occur massive, corroded, in grains, and sometimes tuberose. The friable is composed of dull dusty particles.

The coherent varieties are externally and internally dull.

The fracture is earthy.

It

It soils pretty strongly.
It feels meagre, but fine.
It is light.

Observations.

It is characterised by colour, dull earthy aspect, and low specific gravity.

Second Kind.

Swamp-Ore, or Indurated Bog Iron-Ore.

Sumpferz, *Werner*.

Id. Werner, Pabst. b. i. s. 168. *Id. Wid.* s. 831.—Swampy Iron-ore, *Kirw.* vol. ii. p. 183.—Sumpferz. *Emm.* b. ii. s. 353.—La Mine des Lieux bourbeux, ou le Sumpferz, *Broch.* t. ii. p. 283.—Sumpferz, *Reuss*, b. iv. s. 140. *Id. Lud.* b. i. s. 254. *Id. Mohs*, b. iii. s. 43. *Id. Leonhard*, Tabel. s. 67.—Fer oxidé limoneux, la Mine des lieux bourbeux, *Brong.* t. ii. p. 174.—Verhärteter Raseneisenstein, *Karsten*, Tabel. s. 66.—Sumpferz, *Hoff.* b. iii. s. 295.

External Characters.

Its colour is dark yellowish-brown, sometimes passing into dark yellowish-grey.

It occurs corroded and vesicular, also amorphous.

Internally it is commonly dull, but the darker varieties are glimmering, and sometimes even glistening.

The fracture is earthy, sometimes passing into fine-grained uneven.

The fragments are indeterminate angular, and blunt-edged.

The streak is yellowish-brown.

It is very soft.

It is sectile.

It is easily frangible.

Specific gravity, 2.944, from Sprottau, *Kirwan.*

Observations.

It is distinguished from the preceding kind by its greater specific gravity, and greater compactness.

Third Kind.

Meadow-Ore, or Conchoidal Bog Iron-Ore.

Weisenerz, *Werner.*

Id. Werner, Pabst. b. i. s. 168. *Id. Wid.* s. 832.—Meadow Iron-ore, *Kirw.* vol. ii. p. 182.—Wiesenerz, *Emm.* b. ii. s. 354.—La Mine des Prairies, ou le Weisenerz, *Broch.* t. ii. p. 284.—Weisenerz, *Reuss,* b. iv. s. 142. *Id. Lud.* b. i. s. 256. *Id. Mohs,* b. iii. s. 432. *Id. Leonhard,* Tabel. s. 67.—Fer terreux limoneux, la Mine des Prairies, *Brong.* t. ii. p. 174.—Muschlicher Raseneisenstein, *Karsten,* Tabel. s. 66.—Limonite, *Haus.* s. 107.—Weisenerz, *Hoff.* b. iii. s. 297.

External Characters.

On the fresh fracture it is blackish-brown, which sometimes passes into brownish-black. Externally it has different colours, according to the earth in which it is found.

It occurs massive, in roundish grains, perforated, tuberose, and amorphous.

Internally it extends from shining to glistening, and the lustre is resinous.

The fracture is usually imperfect and small conchoidal, from which it sometimes passes into small-grained uneven; the uneven sometimes inclines to earthy.

The fragments are indeterminate angular, and blunt-edged.

It yields a light yellowish-grey streak.

It is soft.

It is rather brittle, and easily frangible.

Specific gravity 2.603, *Karsten*.

Constituent Parts.

Oxide of Iron,	66.00
Oxide of Manganese,	1.50
Phosphoric Acid,	8.00
Water, - -	23.00
	98.50

Klaproth, Beit. b. iv. s. 127.

Oxide of Iron,	61.0
Oxide of Manganese,	7.0
Phosphoric Acid, with a trace of Sulphur,	2.5
Water, - -	19.0
Silica, - -	6.0
Alumina, -	2.0
	97.5

Daubuisson, Annal. de Chim. 1800.

It would appear from the experiments of Vauquelin, that this ore also contains Chrome, Magnesia, Silica, Alumina, and Lime; and the late experiments of Lescherin shew, that Zinc and Lead also occasionally occur in it. These last mentioned ingredients must be accidental.—Vid. Annal. du Mus. t. viii. p. 435,–460.; also Journ. des Mines, t. 31. p. 45. to 54.

Geognostic Situation.

This ore belongs to a very new formation. According to Werner, it is formed in the following manner:—The water

water which flows into marshy places is impregnated with phosphoric acid, formed from decaying animal and vegetable matter, which enables it to dissolve the iron in the rocks over which it flows, or over which it stands. This water having reached the lower points of the country, or being poured into hollows, becomes stagnant, and by degrees evaporates; the dissolved iron being accumulated in quantity by fresh additions of water, there follow successive depositions, which at first are yellowish, earthy, and of little consistence, and this is *Morass-ore*; but in course of time they become harder, their colour passes to brown, and thus *Swamp-ore* is formed. After the water has completely evaporated, and the swamp is dried up, the swamp-ore becomes much harder, and at length passes into *Meadow-ore*, which is already covered with soil and grass *.

From the preceding observations, it is evident that there is a complete transition of the different kinds of bog iron-ore into each other, and that masses may be found in which we can observe the different degrees of induration.

Geographic Situation.

It is found in various places in the Highlands of Scotland, in the Hebrides, and Orkney and Shetland Islands. In Saxony it occurs at Torgau; in Upper and Lower Lusatia; in a part of the Mark Brandenburg; in Mecklenburg; Pomerania; and in the kingdom of Hanover. It also extends through Prussia, Poland, Courland, Liefland, into Russia, and the southern parts of Sweden, particularly in Smoland, where it is found in very considerable quantity. It is also found in small quantity in the northern

parts

* In some of the Swedish lakes, this ore is deposited so abundantly, that it is dredged up every twenty or thirty years.—Vid. Swedenborg's Regnum Subterraneum.

parts of Westphalia; in Silesia; in the island of Seeland in the Baltic; in the Upper Palatinate; and Hungary.

It occurs in general more abundantly in the northern than in the western and southern European countries.

Uses.

The three kinds of ore appear different in working. The Morass-ore is the most easily fusible, and also affords the best iron. The Meadow-ore is more difficultly fusible. When melted with other ores of iron, red and brown iron-stone are to be preferred. Of these the ochry kind smelts the most advantageously; but where these cannot be obtained, and we are obliged to use the compact and hematitical kinds, we must be careful that they be previously well roasted. Even in the first melting, bog-iron affords an iron for the finest kinds of cast-ware. Owing, however, to the phosphoric acid it contains, this iron is not so tenacious as that obtained from some other ores. The malleable iron prepared from this mineral, has always a tendency to be cold-short, and can scarcely be used for plate-iron, and never for iron-wire. It is however well fitted for nails, because it takes a good point, and welds well. The usual flux is limestone.

** Pitchy Iron-Ore.

Eisenpecherz, *Hoffmann.*

Triplit, *Hausmann.*—Mangan phosphaté, *Haüy.*—Eisenpecherz, *Hoff.* b. iii. s. 300.

External Characters.

Its colours are blackish-brown and brownish-black.

It

It occurs massive and disseminated.

Internally it is shining or glistening, and the lustre is resinous, inclining to adamantine.

The fracture is imperfect flat conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is translucent on the edges, or opaque.

It is hard.

The streak is yellowish-grey.

It is brittle, and easily frangible.

Specific gravity, 3.562, *Breithaupt.*—3.430, *Vauquelin.*

Constituent Parts.

Phosphoric Acid,	-	-	27
Manganese,	-	-	42
Oxide of Iron,	-	-	31
			100

Vauquelin, Journal des Mines, N. 64. p. 299.

Geognostic and Geographic Situations.

It occurs at Chauteloube, near Limoges in France, in a quartz vein in granite, along with massive beryl.

Observations.

This mineral is different from the *Eisenpecherz* of Karsten, of which a description follows.

*** Iron-Sinter.

*** Iron-Sinter.

Eisen-Sinter, *Werner*.

Fer oxydé resinite, *Haüy*.—Eisenpecherz, *Karsten*.—Pittizit, *Hausmann*.

External Characters.

Its colours are yellowish, reddish, and blackish-brown.

It occurs massive, in crusts, reniform, and stalactitic; and occasionally in thin and curved lamellar concretions.

Internally it is shining or glistening, and the lustre is resinous.

The fracture is flat conchoidal, sometimes inclining to even.

The fragments are indeterminate angular, and rather sharp-edged.

It alternates from transparent to translucent on the edges.

It is soft.

It is rather brittle, and uncommonly easily frangible.

Specific gravity 2.40, *Karsten*.

Constituent Parts.

Water, - -	25	38.25
Oxide of Iron, -	67	55.00
Sulphuric Acid, -	8	6.25
	100	99.50
	Klaproth.	*Zellner.*

Geognostic

Geognostic and Geographic Situations.

It occurs in the galleries of old mines in Saxony and Silesia.

Observations.

1. It is characterized by its colour, form, lustre, fracture, and low specific gravity.

2. It is distinguished from *Brown Iron-ore*, by its inferior hardness and weight; and from *Opal* and *Opal Jasper* also by its inferior hardness, and more easy frangibility.

3. It appears to be formed by the decomposition of iron-pyrites.

GENUS X.—MANGANESE-ORE.

Mangan-erz, *Mohs.*

This Genus contains but one species, viz. Prismatic Manganese ore.

1. Prismatic Manganese-Ore.

Prismatisches Mangan-erz, *Mohs.*

This species contains three subspecies, viz. Grey Manganese-ore, Black Manganese-ore, and Scaly Brown Manganese-ore.

First

First Subspecies.

Grey Manganese-Ore.

Grau Braunsteinerz, *Werner.*

This Subspecies is divided into five kinds, viz. Fibrous Grey Manganese-ore, Radiated Grey Manganese-ore, Foliated Grey Manganese-ore, Compact Grey Manganese-ore, and Earthy Grey Manganese-Ore.

First Kind.

Fibrous Grey Manganese-Ore.

Faseriges Grau-Braunsteinerz, *Werner.*

Haarförmiges Grau-Braunstein, *Mohs,* b. iii. s. 449. *Id. Haus.* Handb. b. i. s. 290.—Faseriges Grau-Braunsteinerz, *Ullmann,* System. Tabell. Ubers. s. 402.

External Characters.

Its colour is dark steel-grey, passing into iron-black.

It occurs massive, disseminated, in crusts, reniform, botryoidal, also in distinct concretions, which are stellular, scopiform, and promiscuous fibrous, and these again are collected into others which are coarse granular or wedge-shaped, prismatic. It also occurs crystallized in very delicate capillary and acicular crystals, and in very thin and long rectangular four-sided tables, in which the longer terminal planes are set on obliquely.

The crystals are small and very small, and scopiformly or promiscuously aggregated.

The lateral planes of the crystals are generally longitudinally

dinally streaked; the surface of the particular external shapes is very delicately drusy.

Externally it is glistening, passing into glimmering; the crystals are shining and splendent.

Internally it is glistening, or shining, and the lustre is metallic.

The fragments are indeterminate angular, and blunt-edged, or wedge-shaped.

The streak is dull and black.

It soils strongly.

It is soft.

It is brittle, and easily frangible.

Geognostic and Geographic Situations.

It occurs in several veins of brown ironstone in the Westerwald; also at Stahlberg, near Schmalkalden in Saxony; and Christiansand in Norway.

Second Kind.

Radiated Grey Manganese-Ore.

Strahliges Grau Braunsteinerz, *Werner.*

Magnesia fuliginosa striata, *Wall.* Syst. Min. t. ii. p. 329.—Strahliges Grau Braunsteinerz, *Wern.* Pabst. b. i. s. 216. *Id.* *Wid.* s. 948.—Striated Grey Ore of Manganese, *Kirw.* vol. ii. p. 291.—Strahliges grau Braunsteinerz, *Emm.* b. ii. s. 522. Le Manganese gris rayonné, *Broch.* t. ii. p. 414.—Manganese oxidé metalloide, *Haüy,* t. iv. p. 246.—Strahliges Graubraunsteinerz, *Reuss,* b. i. s. 448. *Id. Lud.* b. i. s. 291. *Id. Mohs,* b. iii. s. 442. *Id. Leonhard,* Tabel. s. 69.—Manganese metalloide chalybdin, *Brong.* t. ii. p. 107.—Strahliges Grau Manganerz,

Manganerz, *Karsten*, Tabel. s. 72.—Strahliger Braunstein, *Haus*. s. 108.—Manganese oxidé metalloide gris, *Haüy*, Tabl. p. 110.—Strahliger Grauer Braunstein, *Hoff*. b. iii. s. 138.—Grey Manganese, *Aikin*, p. 131.

External Characters.

Its colour is dark steel-grey, which inclines more or less to iron-black, and in some rare varieties to pale steel-grey. It is sometimes tarnished with pitch-black, velvet-black, or tempered-steel colours.

It occurs massive, reniform, botryoidal, disseminated; also in distinct concretions, which are scopiform and stellular radiated, and these are again collected into others which are granular or wedge-shaped. It is sometimes crystallized. The primitive figure is an oblique four-sided prism, in which the largest angle is about 100°. The following are the secondary forms:

1. Oblique four-sided prism, in which the obtuse edges are either bevelled or rounded off, so that it acquires a reed-like form. The prism is generally variously modified on the extremities.
   - *a.* Prism flatly bevelled on the extremities, the bevelling planes set on the obtuse lateral edges; and sometimes the proper edge of the bevelment is truncated.
   - *b.* Sometimes the prism is acutely acuminated on the extremities with four planes, which are set on the lateral planes.
2. The crystals are sometimes spicular.

The surface of the crystals is longitudinally streaked, and shining, passing to splendent.

Internally

Internally it is glistening and shining, and the lustre is metallic.

The cleavage is prismatic.

The fragments in the small are wedge-shaped and splintery, but in the great, indeterminate angular and blunt-edged.

The streak is black and dull.

When rubbed it soils strongly.

It is soft.

It is brittle, and rather difficultly frangible.

Specific gravity, 4.2491 to 4.7563, *Brisson.*—4.264–4.316, *Breithaupt.*—4.4–4.8, *Mohs.*

Constituent Parts.

	Ilefeld.	Moravia.
Black Oxide of Manganese,	90.50	89.00
Oxygen, - - -	2.25	10.25
Water, - - -	7.00	0.50
	99.75	99.75

Klaproth, Beit. b. iii. s. 308. & 310.

Geographic Situation.

Europe.—It occurs in the vicinity of Aberdeen; also in Cornwall, Devonshire, Somersetshire and Derbyshire; Christiansand in Norway; Nassau; Ilefeld in the Hartz; Ilmenau and Saalfeld in Thuringia; Konradswaldau, Kupferberg, &c. in Silesia; Miess in Bohemia; Hüttenberg in Carinthia; St Gothard in Switzerland; Piedmont; and Ischio near Vicenza in Italy.

Asia.—Kolyvan in Siberia.

Third Kind.

Foliated Grey Manganese-Ore.

Blâttriges Grau Braunsteinerz, *Werner.*

Id. Werner, Pabst. b. i. s. 218. *Id. Emm.* b. ii. s. 525.—Le Manganese gris lamelleux, *Broch.* t. ii. p. 417.—Blättriges Grau Braunsteinerz, *Reuss,* b. iv. s. 453. *Id. Lud.* b. i. s. 292. *Id. Mohs,* b. iii. s. 447. *Id. Leonhard,* Tabel. s. 69.—Manganese metalloide chalybin, texture lamelleuse, *Brong.* t. ii. p. 108. —Blättriges Grau Manganerz, *Karsten,* Tabel. s. 72.—Blättricher Braunstein, *Haus.* s. 108. *Id. Hoff.* b. iii. s. 144.

External Characters.

Its colour is intermediate between steel-grey and iron-black.

It occurs massive, disseminated; also in granular distinct concretions; and crystallized in short oblique four-sided prisms, of the same varieties as in the former kind.

Internally it alternates from shining to splendent, and the lustre is metallic.

The cleavage is prismatic.

The fracture is uneven.

The fragments are indeterminate angular, and blunt-edged.

It yields a dull black streak.

It soils.

It is soft.

It is brittle, and easily frangible.

Specific gravity 3.742, *Hagen.*

Geographic Situation.

It is found in Devonshire; Ilefeld in the Hartz; Johanngeorgenstadt in the kingdom of Saxony; Bohemia; Salzburg; and Transylvania.

Fourth Kind.

Compact Grey Manganese-ore.

Dichtes Grau Braunsteinerz, *Werner.*

Id. Werner, Pabst. b. i. s. 219.—Indurated Grey Ore of Manganese, *Kirw.* vol. ii. p. 249.—Le Manganese gris compacte, *Broch.* t. ii. p. 418.—Dichtes Graubraunstein, *Reuss,* b. iv. s. 454. *Id. Lud.* b. i. s. 293. *Id. Mohs,* b. iii. s. 447. *Id. Leonhard,* Tabel. s. 69.—Manganese terne compact, *Brong.* t. ii. p. 109.—Dichtes Graumanganerz, *Karsten,* Tabel. s. 72. —Dichter Braunstein, *Haus.* s. 109.—Manganese oxydé gris compacte, *Haüy,* Tabl. p. 110.—Dichter grau Braunstein, *Hoff.* b. iii. s. 146.—Compact Grey Manganese, *Aikin,* p. 132.

External Characters.

Its colour is intermediate between iron-black and steel-grey.

It occurs massive, seldom disseminated, or small botryoidal, and dendritic and fruticose.

Internally it is glistening, passing into glimmering, and the lustre is metallic.

The fracture is even, sometimes inclining to flat conchoidal, and uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It

It becomes darker, and dull in the streak.
It soils.
It is soft.
It is brittle, and easily frangible.
Specific gravity, 4.407, *Karsten*.—4.073, *Vauquelin*.

Constituent Parts.

The four following analyses made by Cordier, Beaunier, Vauquelin, and Dolomieu, are said by Brochant to be of this kind.

	St Micaud.	Perigueux.	Romaneche.	Laveline.
Yellow Oxide of Manganese, - -	35	50.0	50.0	65
Oxygen, - -	33	17.0	33.7	17
Red Oxide of Iron,	18	13.5		
Charcoal, - -			0.4	
Lime, with Magnesia, Iron and Manganese,	7	6.0		
Carbonate of Lime, -				7
Barytes, - -	4	5.0	14.7	9
Silica, - - -	3	7.0	1.2	6
Loss, - - -		1.5		6
	100	100	100	100

Journal des Mines, N. 58. p. 778.

Geographic Situation.

It occurs at Upton Pyne in Devonshire; Wurzelberg in the Hartz; Nassau; and at Christiansand in Norway.

Fifth

Fifth Kind.

Earthy Grey Manganese-Ore.

Erdiches Grau Braunsteinerz, *Werner*.

Erdiger Braunstein, *Wid.* s. 953.—Ochre of Manganese, *Kirw.* vol. ii. p. 293.—Erdiches Graubraunsteinerz, *Emm.* b. ii. s. 529.—Le Manganese gris terreux, *Broch.* t. ii. p. 420.—Erdiches Graubraunsteinerz, *Lud.* b. i. s. 293. *Id. Suck.* 2ter th. s. 419. *Id. Bert.* s. 492. *Id. Mohs*, b. iii. s. 450.—Manganese terne terreux, *Brong.* t. ii. p. 110.—Zerreibliches Graubraunsteinerz, *Karsten*, Tabel. s. 72.—Ochriger Braunstein, *Haus.* s. 108.—Manganese oxydé noire brunâtre pulverulent et ramuleux, *Haüy*.—Erdiger grauer Braunstein, *Hoff.* b. iii. s. 148.

External Characters.

Its colour is intermediate between iron-black and steel-grey, sometimes slightly inclining to blue.

It occurs massive, disseminated, in membranes, and dendritic *.

It is friable.

It consists of feebly semi-metallic glimmering fine scaly particles, which soil strongly, and are more or less cohering.

Geographic Situation.

It occurs in the mine Johannis, near Langeberg in the Saxon Erzgebirge.

Chemical

* The dendritic appearances observed in the fissures of different minerals, appear in general to be earthy grey manganese-ore.

Chemical Characters of the Subspecies.

It is infusible without addition before the blowpipe. It tinges borax purple: it effervesces with muriatic acid, giving out oxymuriatic acid.

Geognostic Situation of the Subspecies.

This mineral occurs in granite, gneiss, mica-slate, porphyry, and sandstone, either in veins, or in large imbedded cotemporaneous masses. Several different formations are enumerated and described by mineralogists: in one formation, situated in porphyry, the ores which are principally the radiated and foliated kinds, occur in veins, along with heavy-spar; and in another, the ores, principally the compact and earthy kinds, are in veins, along with red and brown iron-ore.

Uses.

It is added to glass, in small quantity, when we wish to destroy the brown colour which that material receives from intermixed inflammable substances, or in larger quantity when we wish to give to it a violet-blue colour. It affords a fine brown colour, which is used for painting on porcelain. It is employed in the laboratory, as the cheapest and most convenient material from which to procure oxygen gas. All the oxymuriatic acid used in bleacheries, and for the purpose of destroying contagious matter, is prepared from manganese, and the usual materials of muriatic acid.

Second

Second Subspecies.

Black Manganese-Ore.

THIS Subspecies is divided into three kinds, viz. Compact Black Manganese-ore, Fibrous Black Manganese-ore or Black Hematite, and Foliated Black Manganese-ore.

First Kind.

Compact Black Manganese-Ore.

Dichter Schwarzeisenstein, *Werner.*

Black Ironstone, *Kirw.* vol. ii. p. 167.—Mine de Fer noire compacte, *Broch.* t. ii. p. 268.—Dichter Schwarzeisenstein, *Reuss,* b. iv. s. 103. *Id. Mohs,* b. iii. s. 414. *Id. Leonhard,* Tabel. s. 66. *Id. Karsten,* Tabel. s. 66.—Dichter Manganschwärze, *Haus.* s. 109.—Black Hematitic Iron-ore, *Kid,* vol. ii. p. 176. Dichter Schwarzbraunstein, *Haus.* b. i. s. 294.—Dichter Schwarzeisenstein, *Hoff.* b. iii. s. 270.—Black Iron-ore, *Aikin,* p. 102.

External Characters.

Its colour is intermediate between bluish-black and dark steel-grey, but more inclining to the first.

It occurs massive, tuberose, small reniform, botryoidal, fruticose, and claviform; also in concentric curved lamellar concretions.

The external shapes have a rough glimmering, or faintly glistening surface.

Internally it is glimmering, passing into glistening, and the lustre is imperfect metallic.

The fracture is usually conchoidal, but sometimes passes into fine and small grained uneven.

 The

The fragments are indeterminate angular, and more or less sharp-edged.

The streak is shining, but its colour remains unchanged.

It is semi-hard.

It is brittle and easily frangible.

Specific gravity 4.750, *Ullmann*.

Second Kind.

Fibrous Black Manganese-Ore or Black Hematite.

Schwarzer Glaskopf, *Werner*.

Black Ironstone, *Kirw.* vol. ii. p. 167.—Mine de Fer noire compact, *Broch.* t. ii. p. 268.—Fasriger Schwarzeisenstein, *Reuss*, b. iv. s. 105. *Id. Mohs*, b. iii. s. 415. *Id. Leonhard*, Tabel. s. 66. *Id. Karsten*, Tabel. s. 66.—Fasriger Manganschwärze, *Haus.* s. 109.—Fasriger schwarz Braunstein, *Haus.* Handb. b. i. s. 293.—Fasriger Schwarzeisenstein, *Hoff.* b. iii. s. 273. Black Iron-ore, *Aikin*, p. 102.

External Characters.

Its colour is the same as that of the preceding kind.

It occurs massive, reniform, and botryoidal; also in distinct concretions, which are delicate and scopiform, or stellular fibrous, and these are collected into others which are granular and curved lamellar.

Internally it is glimmering, often even glistening, and the lustre is imperfect metallic.

The fragments are cuneiform and splintery.

In other characters it agrees with the preceding kind.

Chemical Characters.

When melted before the blowpipe with borax, it yields a violet-blue coloured glass.

Constituent

Constituent Parts.

Its principal constituent part is manganese.

Geognostic Situation.

It occurs in veins, in primitive, transition, and secondary mountains, and is usually accompanied with brown iron-ore and quartz.

Geographic Situation.

It occurs in several places in the Saxon Erzgebirge, and the Hartz; but more frequently in Thuringia and Westphalia; and the compact and fibrous kinds generally occur together.

Uses.

It is very easily fusible, and yields a good iron; but it acts very powerfully on the sides of the furnace.

Third Kind.

Foliated Black Manganese-Ore.

Schwarzer Braunstein, *Werner.*

External Characters.

Its colour is brownish-black, and sometimes intermediate between brownish-black and reddish-black.

It occurs massive, disseminated; and crystallized in very acute double four-sided pyramids.

Externally it is shining; internally shining and glistening: and the lustre adamantine, approaching to resinous.

[illegible] curved foliated.

[illegible] angular, and rather [illegible]

[illegible]

[illegible] Situation.

[illegible] in the man- [illegible] in Thurin- [illegible]

[illegible]

[illegible] : it is dis- [illegible] : and from [illegible] oxide of man- [illegible]

[illegible]

[illegible] Ore.

[illegible] Werner.

[illegible] s. 214.—Brown scaly [illegible] Eisenrahm, Emm. [illegible] Brock. t. ii. p. 258.— [illegible] Id. Lud. b. i. s. 247. [illegible] s. 409. Id. Mohs, b. iii. [illegible]—Schuppiger Brauneisen- [illegible] Manganese oxydé metalloide [illegible] brunâtre, Haüy.—Brau- [illegible] 351.—Scaly Brown Iron-ore, Ai- [illegible]

[illegible]

External Characters.

Its colour is intermediate between steel-grey and clove-brown.

It occurs in crusts, massive, spumous, fruticose, and irregular dendritic.

It is friable, or friable passing into solid.

It is composed of scaly particles, which are intermediate between shining and glistening, with a metallic lustre.

It soils strongly.

It feels greasy.

Chemical Characters.

It blackens before the blowpipe, but does not melt, and gives to glass of borax an olive-green colour.

Geognostic Situation.

It generally occurs in drusy cavities in brown hematite. These cavities occur more frequently in hematite which is found in veins, than in that which is found in beds.

Geographic Situation.

Europe.—It is found near Sandlodge in Mainland, one of the Shetland Islands; and in various iron mines on the Continent of Europe.

America.—In iron mines in Chili.

Observations.

1. At Kamsdorf in Saxony, it is known under the names *Eisenmann* and *Eisenblüthe*.

2. The *Wad* of English mineralogists is a brown-coloured loose aggregated compound of oxides of manganese and iron.

ORDER III.

ORDER III.—PYRITES.

GENUS I.—NICKEL PYRITES, OR COPPER-NICKEL.

Nickelkies, *Mohs.*

This Genus contains one species, viz. Prismatic Nickel Pyrites. * Black Nickel. ** Nickel Ochre.

1. Prismatic Nickel Pyrites.

Prismatischer Nickelkies, *Mohs.*

Kupfer Nikel, *Werner.*

Niccolum Ferro et Cobalto mineralisatum; Cuprum Niccoli, *Wall.* t. ii. p. 188.—Kupfernickel, *Romé de Lisle,* t. iii. p. 135. *Id. Werner,* Pabst. b. i. s. 206. *Id. Wid.* s. 943.—Sulphurated Nickel, *Kirw.* vol. ii. p. 286.—Kupfernickel, *Emm.* b. ii. s. 513. *Id. Lam.* t. i. p. 384.—Nickel arsenical, *Haüy,* t. iii. p. 508.—Le Kupfernickel, *Broch.* t. ii. p. 408.—Kupfernickel, *Reuss,* b. iv. s. 430. *Id. Lud.* b. i. s. 289.—Nickelerz, *Suck.* 2ter th. s. 412.—Kupfernickel, *Bert.* s. 489. *Id. Mohs,* b. iii. s. 656.—Nickel arsenical, *Lucas,* p. 123.—Kupfernickel, *Leonhard,* Tabel. s. 77.—Nickel arsenical, *Brong.* t. ii. p. 209. *Id. Brard,* p. 468.—Kupfernickel, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 74.—Nickel arsenical, *Haüy,* Tabl. p. 84.—Nickel alloyed with Arsenic, *Kid,* vol. ii. p. 213.—Kupfernickel, *Hoff.* b. iii. s. 164. *Id. Haus.* Handb. b. i. s. 118.—Copper-Nickel, *Aikin,* p. 130.

External Characters.

Its colour is copper-red of different degrees of intensity; but tarnishes first grey, and then black.

It

It occurs most frequently massive and disseminated; seldom reticulated, dendritic, fruticose, small globular, botryoidal; rarely in coarse and small granular distinct concretions; and sometimes crystallised in oblique four-sided prisms.

Internally it alternates from shining to glistening, and the lustre is metallic.

The fracture is usually imperfect conchoidal, sometimes passing into coarse, small and fine grained uneven: The uneven has the least, the conchoidal the greatest degree of lustre.

The fragments are indeterminate angular and sharp-edged.

It is harder than apatite, but not so hard as felspar.

It is rather brittle.

It is rather difficultly frangible.

Specific gravity, 7.5—7.7 *Mohs*; 7.560, *Gellert*; 6.6086—6.6481, *Brisson*.

Chemical Characters.

Before the blowpipe it gives out an arsenical vapour, and then fuses, though not very readily, into a dark scoria, mixed with metallic grains; is soluble in nitro-muriatic acid, forming a dark-green liquor, from which caustic alkali throws down a pale-green precipitate, whereas from a solution of copper the precipitate is dark-brown.

Constituent Parts.

It is a compound of Nickel and Arsenic, with accidental intermixtures of cobalt, iron, and sulphur.

Geognostic

Geognostic Situation.

It generally occurs in primitive rocks, such as gneiss, mica-slate, syenite and clay-slate, along with octahedral or tin-white cobalt pyrites, and hexahedral or silver-white cobalt-pyrites; also in transition rocks and secondary rocks, particularly in limestone. The minerals with which it is most generally associated are nickel-ochre, octahedral and hexahedral cobalt pyrites, ores of copper, and of silver, along with calcareous-spar, brown-spar, heavy-spar, and quartz.

Geographic Situation.

Europe.—It occurs in small quantity in the lead-mines of Lead Hills and Wanlockhead; also in veins along with nickel-ochre, galena or lead-glance, brown-blende, and heavy-spar, in a bed of limestone in the coal field of Linlithgowshire. On the Continent, it occurs in veins in primitive rocks at Schneeberg and Johanngeorgenstadt in Saxony; at Joachimsthal in Bohemia; at Schladring in Upper Stiria; and Allemont in France. It is found in a bed along with native gold and cobalt-pyrites and copper-pyrites, in porphyritic syenite, at Cravicza in the Bannat. It is met with in veins that traverse transition rocks at Andreasberg in the Hartz. In the county of Mansfeldt, it occurs in veins that traverse bituminous marl-slate. It is also found at Wittichen in Swabia; Salzburg, and Gistain in Arragon in Spain.

Asia.—Koliwan in Siberia.

Observations.

1. It very nearly resembles native copper, but its brittleness very readily distinguishes it from that mineral.

2. Magnetic

2. Magnetic needles are made with the pure metal, and these are preferred to those of steel.

3. This mineral was first mentioned by Heärne, but it was Cronstedt who discovered the peculiar metal which characterises it.

4. Nickel is a characteristic ingredient in meteoric iron, and, like all the metals found in meteoric iron, and meteoric stones, is magnetical.

* Black Nickel.

Nickelschwärze, *Hausmann*.

Id. Haus. Handb. b. i. s. 331.

External Characters.

Its colour is dark greyish-black, which inclines to brownish-black.

It occurs massive, disseminated, and in crusts.

It is dull.

The fracture is earthy.

It is soft.

It becomes shining and resinous in the streak.

It soils slightly.

Chemical Characters.

It forms an apple-green coloured solution with nitric acid, which lets fall a white precipitate of arsenic acid.

Constituent Parts.

It has not been analysed; but is conjectured to be a compound of oxide of nickel and oxide of arsenic.

Geognostic

Geognostic and Geographic Situations.

It occurs in veins that traverse bituminous marl-slate, along with copper-nickel, and nickel-ochre, in the district of Riegelsdorf, particularly in the mine named Friedrich-Wilhelm *.

** Nickel-Ochre.

Nickelocker, *Werner*.

Flos Niccoli, *Wall.* t. ii. p. 300.—Nickelocker, *Werner*, Pabst. b. i. s. 207. *Id. Wid.* s. 945.—Nickel Ochre, *Kirw.* vol. ii. p. 283.—Oxide de Nikel, *De Born*, t. ii. p. 210.—Nickel-ocker, *Emm.* b. ii. s. 516.—Oxide de Nickel, *Lam.* t. i. p. 383. —Nickel oxidé, *Haüy*, t. iii. p. 516.—L'Ocre de Nikel, *Broch.* t. ii. p. 411.—Nickelocher, *Reuss*, b. iv. s. 435. *Id. Lud.* b. i. s. 290. *Id. Suck.* 2ter th. s. 414. *Id. Bert.* s. 496. *Id. Mohs*, b. iii. s. 661.—Nickel oxidé, *Lucas*, p. 123. *Id. Brard*, p. 278.—Nickelocker, *Leonhard*, Tabel. s. 77.—Nickel oxidé, *Brong.* t. ii. p. 209.—Nickelocher, *Karsten*, Tabel. s. 72. *Id. Haus.* s. 112.—Nickel oxydé, *Haüy*, Tabl. p. 84.—Nickel-blüthe, *Haus.* Handb. b. iii. s. 1129.—Native Oxyd of Nickel, *Kid*, vol. ii. p. 213.—Nickel Ochre, *Aikin*, p. 131.

External Characters.

Its colour is apple-green, seldom inclining to grass-green. On exposure to the air for some time, it becomes greenish-white.

It occurs almost always as a thin coating or efflorescence; seldom massive or disseminated.

It

* Hausmann is of opinion, that this ore is formed by the decomposition of copper-nickel.

It is dull.

The fracture is sometimes splintery, passing on the one side into even, on the other into uneven: or it is coarse or fine earthy.

The splintery and conchoidal varieties are translucent on the edges; but those with earthy fracture are opaque.

It is very soft or friable.

It feels meagre.

The varieties with earthy fracture adhere to the tongue.

Chemical Characters.

It is infusible without addition before the blowpipe; with glass of borax it is reduced, and the glass acquires a hyacinth-red colour; and it is insoluble in cold nitric acid.

Geognostic Situation.

It occurs in veins in primitive and secondary rocks, along with copper-nickel, black nickel, and other metalliferous compounds.

Geographic Situation.

It occurs at Lead Hills and Wanlockhead; at Alva in Stirlingshire, and in Linlithgowshire; at Andreasberg in the Hartz; Riegelsdorf in Saxony; and at Allemont in France.

Observations.

1. It occurs in very small quantities.

2. It is placed along with copper nickel until its true place in the system shall be ascertained.

GENUS II.

GENUS II.—ARSENICAL PYRITES.

Arsenikkies, *Werner*.

This Genus contains two species, viz. Prismatic Arsenical Pyrites, and Di-Prismatic Arsenical Pyrites.

1. Prismatic Arsenical Pyrites.

Prismatischer Arsenikkies, *Mohs*.

Fer sulphuré blanc, *Haüy*, (in part).

External Characters.

Its colour is pale steel-grey.

It occurs massive, and in the form of oblique four-sided prisms, whose dimensions have not been hitherto accurately determined.

Its lustre is metallic and shining.

Its cleavage is unknown.

It is as hard as apatite, but not so hard as felspar.

Specific gravity 6.9, 7.4, *Mohs*.

Observations.

The above description of this species I owe to Professor Mohs.

2. Di-prismatic Arsenical Pyrites.

Di-prismatischer Arsenikkies, *Mohs*.

This species contains two subspecies. Common Arsenical Pyrites, and Argentiferous Arsenical Pyrites.

First

First Subspecies.

Common Arsenical Pyrites.

Gemeiner Arsenikkies, *Werner.*

Id. Wern. Pabst. b. i. s. 212. *Id. Wid.* s. 968.—Arsenical Pyrites, or Marcasite, *Kirw.* vol. ii. p. 256.—Gemeiner Arsenikkies, *Emm.* b. ii. s. 553.—La Pyrite arsenicale commune, *Brock.* t. ii. p. 438.—Fer arsenical, *Haüy,* t. iv. p. 57.—Gemeiner Arsenikkies, *Reuss,* b. iv. s. 505. *Id. Lud.* b. i. s. 298. *Id. Suck.* 2ter th. s. 446. *Id. Bert.* s. 501. *Id. Mohs,* b. iii. s. 314.—Fer arsenical, *Lucas,* p. 138. *Id. Brard,* p. 314.—Gemeiner Arsenikkies, *Leonhard,* Tabel. s. 78. *Id. Karsten,* Tabel. s. 74. *Id. Haus.* s. 73.—Fer arsenical, *Haüy,* Tabl. p. 95.—Arsenic alloyed with Iron, *Kid,* vol. ii. p. 203.—Arsenikkies, *Haus.* Hand. b. i. s. 153. *Id. Hoff.* b. iv. s. 211. Mispickel, *Aikin,* p. 126.

External Characters.

On the fresh fracture it is silver-white, which rarely inclines to tin-white, but by exposure it acquires a yellowish tarnish; sometimes it has a pavonine, columbine, or iridescent tarnish, even in its natural repository.

It occurs massive, and disseminated; also in prismatic, distinct concretions, which are straight, diverging, or promiscuous, and these sometimes pass into granular.

It is frequently crystallized, and the primitive figure is an oblique four-sided prism, in which the large angle is 111° 18′. This oblique prism is generally bevelled on the terminal planes, and the bevelment is either flat or very flat. In this figure the bevelment is considered as an horizontal prism, and the oblique prism as a perpendicular prism, hence the figure is named Di-prismatic. The lateral planes are [illegible] following varieties [illegible]

[illegible] prism appears [illegible] planes.

[illegible] edges and the [illegible] these increase [illegible] bevelment is [illegible]

[illegible] truncated, [illegible] lateral [illegible] magnitude, [illegible]

[illegible] bevell- [illegible] planes [illegible] angles of [illegible]

[illegible] prism [illegible] is formed [illegible] acute [illegible]

[illegible] sometimes [illegible] but the be- [illegible] usually diagonally [illegible]

[illegible] internally it is [illegible] is metallic. [illegible] grained.

[illegible] of the perpendicular [illegible]

[illegible] angular, and rather [illegible]

[illegible] sometimes as hard as fel-

It

It is brittle, and rather difficultly frangible.

When rubbed it emits an arsenical smell.

Specific gravity, 5.753, *Gellert;* 5.600, *Lametherie;* 5.7,—6.2, *Mohs.*

Chemical Characters.

Before the blowpipe it emits a copious arsenical vapour, which incrusts the charcoal white; and it leaves a reddish-brown oxide of iron behind. It colours borax blackish.

Constituent Parts.

Arsenic,	48.1	43.4	54.55
Iron,	36.5	34.9	45.46
Sulphur,	15.4	20.1	
	Thomson.	*Chevereul.*	*Berzelius.*

Geognostic Situation.

It occurs in beds and veins in primitive rocks, as gneiss, mica-slate, clay-slate, chlorite-slate, and serpentine. It is usually associated with tin, galena or lead-glance, black-blende, copper-pyrites and iron-pyrites, magnetic pyrites, and also quartz, brown-spar, fluor-spar, calcareous-spar, common hornblende, and garnet. It also occurs in transition-rocks, as grey-wacke, along with galena or lead-glance, grey copper-ore, sparry iron, and fluor-spar; and sometimes in secondary rocks.

Geographic Situation.

It occurs at Alva in Stirlingshire; and abundantly in Cornwall and Devonshire, accompanying ores of copper and

and tin. It occurs in beds in serpentine at Reichersdorf in Silesia; in beds at Kupferhügel, also in Silesia; at Gottesgab in Bohemia in beds in clay-slate, accompanied with tinstone, copper-pyrites, magnetic-pyrites, magnetic iron-ore, native silver, quartz, prase, garnet, and actynolite; at Joachimstahl in Bohemia, and Johanngeorgenstadt in Saxony in primitive mountains, along with tinstone, wolfram, galena or lead-glance, blende, sparry iron, and common iron-pyrites. It is also found at Kongsberg in Norway; Sahlberg in Sweden; in Salzburg, Stiria, Hungary and the Bannat.

Asia.—In Siberia, it is found along with beryl; it is also met with in China, and in the island of Sumatra †.

America.—In granite, in the vicinity of Bostou in Massachusets.

Use.

It is from this ore that the White Oxide of Arsenic is principally obtained, and artificial Orpiment is also prepared from it.

Observations.

1. Its crystallizations, colour, and hardness, distinguish it from *Tin-white Cobalt;* and its colour and specific gravity distinguish it from *Iron-pyrites.*

2. It is known under the names Mispickel, Rauschgelbkies, and Giftkies.

3. Some varieties contain so much gold, that they are named Auriferous Arsenical Pyrites, and are considered as ores of gold.

Second

* Marsden's Sumatra, p. 157.

Second Subspecies.

Argentiferous Arsenical Pyrites.

Weiserz, *Werner.*

Id. Werner, Pabst. b. i. s. 216. *Id. Wid.* s. 970.—Argentiferous Arsenical Pyrites, *Kirw.* vol. ii. p. 257.—Weiserz, *Emm.* b. ii. s. 557.—La Pyrite arsenical argentifere, *Broch.* t. ii. p. 442. —Fer arsenical argentifere, *Haüy,* t. iv. p. 63.—Weiserz, *Reuss,* b. iv. s. 503. *Id. Lud.* b. i. s. 299. *Id. Suck.* 2ter th. s. 449. *Id. Bert.* s. 503. *Id. Mohs,* b. iii. s. 321. *Id. Leonhard,* Tabel. s. 67.—Fer arsenical argentifere, *Brong.* t. ii. p. 150.—Edler Arsenikies, *Karsten,* Tabel. s. 74.—Weiserz, *Haus.* s. 73.—Fer arsenical argentifere, *Haüy,* Tabl. p. 96.—Argentiferous Mispickel, *Aikin,* p. 126.

External Characters.

Its colour is silver-white, inclining to tin-white, and is generally tarnished yellowish on the surface.

It seldom occurs massive, almost always disseminated, rarely in granular distinct concretions, and in very small acicular oblique four-sided prisms.

Externally it is shining; internally it is glistening, sometimes glimmering, and the lustre is metallic.

The fracture is fine-grained uneven.

The fragments are indeterminate angular.

In the remaining characters, it agrees with the preceding subspecies.

Constituent Parts.

Besides arsenic and iron, it contains from .01 to 0.10 parts of silver.

Geognostic and Geographic Situations.

Its geognostic situation is the same as that of common arsenic pyrites, with which it is usually associated. It is also accompanied with dark red silver, galena or lead-glance, and copper-pyrites; sometimes with white silver, brown blende, and generally with quartz and brown-spar.

It is a rare fossil, and has been hitherto found only at Braunsdorf and Freyberg in Saxony; Rathhausberg in Gastein in Salzburg; and in Chili.

Use.

It is used as an ore of silver.

Observations.

1. It is distinguished from the first subspecies by its inferior lustre, smallness of its crystals, fineness of the grain in the fracture, and its granular distinct concretions.

2. Hausmann describes as a distinct species, a sulphuret of iron, with 4 *per cent.* of arsenic. He names it *Arsenical kies*, and considers it as synonymous with the *Minera arsenicalis flavescens* of Wallerius. It is found at Goslar in the Hartz.

GENUS III.

Genus III.—COBALT-PYRITES *.

Kobalt-Kies, *Mohs.*

This genus contains two species, viz. Hexahedral Cobalt-Pyrites, and Octahedral Cobalt-Pyrites. * Kobalt-Kies, *Haus.*

1. Hexahedral Cobalt-Pyrites, or Silver-white Cobalt.

Hexaedrischer Kobalt-Kies, *Mohs.*

Glanz Kobold, *Werner.*

Minera Cobalti tessularis, *Wall.* Syst. Min. t. ii. p. 176.—Minera Cobalti crystallisata, *Wall.* Syst. Min. t. ii. p. 179. (in part).—Bright white Cobalt-ore, *Kirw.* vol. ii. p. 273.—Le Cobalt eclatant, *Broch.* t. ii. p. 390.—Cobalt gris, *Haüy,* t. iv. p. 204.—Kobaltglanz, *Lud.* b. i. s. 284. *Id. Suck.* 2ter th. s. 400. *Id. Bert.* s. 482. *Id. Mohs,* b. iii. s. 639. *Id. Leonhard,* Tabel. s. 76.—Cobalt gris, *Lucas,* p. 160. *Id. Brong.* t. ii. p. 116. *Id. Brard,* p. 354.—Glanzkobalt, *Karsten,* Tabel. s. 72.—Cobalt-glanz, *Haus.* s. 73.—Cobalt gris, *Haüy,* Tabl. p. 107.—Glanz Kobold, *Hoff.* b. iv. s. 186. *Id. Haus.* Handb. b. i. s. 157.—Bright-white Cobalt, *Aikin,* p. 128.

* Miners have been in all ages remarkable for their superstitious notions. The great mines in Germany were said to be haunted by evil spirits, named *Koboldén* by the miners; and those minerals having the appearance of rich ores, but which afforded nothing valuable, were considered as the work of these evil spirits, and were named *Kobold.* The different cobaltic minerals known to mineralogists, through the ignorance of the miners were thrown away as useless, and were named *Kobold*; hence the technical name *Cobalt.*

External Characters.

Its colour is silver-white, slightly inclining to copper-red. Sometimes it is tarnished yellowish or columbine.

It occurs commonly massive and disseminated; also reticulated, and occasionally in granular distinct concretions; and crystallized in the following figures:

1. Cube, which is either perfect, or truncated on the angles.
2. Octahedron.
3. Cube, in which all the edges are truncated, and in such a manner, that each face supports two opposite truncating planes: It is the middle figure, between the cube and the pentagonal dodecahedron.
4. Pentagonal dodecahedron.
5. Middle figure between the dodecahedron and the icosahedron.
6. Icosahedron.

The surface is smooth or streaked.

Externally it is splendent.

Internally it is intermediate between shining and glistening, and the lustre is metallic.

The cleavage is hexahedral.

The fracture is small conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is semihard in a low degree.

It is brittle and easily frangible.

Its streak is of a grey colour.

Specific gravity, 6.1—6.3, *Mohs;* 6.198, *Lowry;* 6.2319, *Strohmeyer.*

Chemical

Chemical Character.

Before the blowpipe it gives out an arsenical odour; and after being roasted, colours glass of borax smalt-blue.

Constituent Parts.

	Tunnaberg.		Tunnaberg.	Modum.
Cobalt, -	44.00		36.66	33.1012
Arsenic, - -	55.00		49.00	43.4644
Sulphur, -	0.50	Iron,	6.50	3.2324
	——	Sulphur,	5.66	20.0840
	99.50		——	————
	Klaproth, Beit. b. ii. s. 307.		*Tassaert* in Annal d. Chim. xxviii. p. 82.	*Strohmeyer*.

Geognostic Situation.

It occurs in primitive rocks, particularly in a quartzose mica-slate, and in gneiss, in imbedded masses, intermixed with the rock at their line of junction; also disseminated, and in imbedded crystals. It is associated with copper-pyrites, iron-pyrites, and red cobalt.

Geographic Situation.

It occurs principally at Skutterend in the parish of Modum, in Norway; at Tunnaberg in Sweden; and in small quantity at Queerbach in Silesia.

Uses.

This is one of the most common species of cobalt, and is that from which the cobalt of commerce is principally obtained.

tained. When roasted and melted in certain proportions with pounded quartze and potash, it forms *smalt*, a compound which is highly useful in the painting of porcelain, and in the colouring of glass, and also for painting.

The other kinds of cobalt are employed for similar purposes.

Observations.

1. This species is distinguished by its silver-white colour, crystallisations, distinct cleavage, hardness and weight.

2. It is distinguished from the octahedral species by its colour, its wanting the pentagonal, dodecahedral and octahedral figure; further, by its distinct cleavage and specific gravity.

3. It very nearly agrees with common iron-pyrites in form; hence Hausmann and others are of opinion that the form is owing to the combined sulphuret of iron.

2. Octahedral Cobalt-Pyrites.

Octaedrischer Cobalt-Kies, *Mohs.*

This species is divided into two subspecies, viz. Tin-White Octahedral Cobalt-Pyrites, and Grey Octahedral Cobalt-Pyrites. * Kobalt-Kies.

First Subspecies.

Tin-White Octahedral Cobalt-Pyries.

Weisser Speisskobold, *Werner.*

This subspecies is divided into two kinds, viz. Compact Tin-White Cobalt-Pyrites, and Radiated Tin-White Cobalt-Pyrites.

First

First Kind.

Compact Tin-White Octahedral Cobalt-Pyrites.

Gemeiner Weisser Speisskobold, *Werner*.
Cobalt Arsenical, (greatest part), *Haüy*.

External Characters.

Its colour is tin-white, which is sometimes rather dark. It has frequently a grey and iridescent tarnish.

It occurs massive, disseminated, cylindrical, reticulated, fruticose, and specular; also in distinct concretions, which are small angular, granular, or curved lamellar.

It is sometimes crystallised, and the following are its various regular figures:

1. Cube, in which the faces are sometimes convex; the edges and angles are sometimes more or less deeply truncated. This figure is frequently cracked and burst in different directions.
2. Octahedron.
3. Rhomboidal dodecahedron, truncated on the six four-edged angles.

The crystals are from middle sized to small, are superimposed, and generally in druses.

It is characteristic of this subspecies, that the crystals are generally rent and cracked, and the rents frequently filled with quartz, and sometimes the crystals contain a nucleus of copper-nickel.

Externally it is generally smooth, shining or splendent, and the lustre metallic.

Internally

Internally it is glistening and metallic.

The cleavage is a very imperfect and octahedral.

The fracture is coarse and small-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is brittle and easily frangible.

Hardness same as the preceding species.

Specific gravity 6.0, 6.6, *Mohs*.

Constituent Parts.

			From Riegelsdorf.
Arsenic,	-	-	74.2174
Cobalt,	-	-	20.3135
Iron,	-	-	3.4257
Copper,	-	-	0.1586
Sulphur,	-	-	0.8860
			100

Strohmeyer.

The Saxon varieties contain a small portion of silver as an accidental mixed part.

Chemical Characters.

Before the blowpipe it gives out a copious arsenical vapour on the first impression of the heat; it melts only partially, and that with great difficulty, and is not attractable by the magnet; on the addition of borax it immediately melts into a grey metallic globule, colouring the borax of a deep blue.

Geognostic Situation.

This, which is the most frequent cobaltic species, occurs in veins and beds of granite, gneiss, mica-slate, and clay-slate;

slate; seldomer in transition clay-slate and limestone; but more frequently in flœtz rocks, as red sandstone and bituminous marl-slate. In primitive rocks, it is associated with copper-nickel, nickel ochre, native bismuth, bismuth-glance, black cobalt, ores of silver, and fluor-spar, calcareous-spar, brown-spar, lamellar heavy-spar and quartz; in transition rocks it is accompanied with copper-pyrites and quartz; in flœtz rocks with the various cobalt minerals, different ores of copper, calcareous-spar and lamellar heavy-spar.

Geographic Situation.

It occurs at Huel Sparnon, Redruth and Dolcoath in Cornwall; at Schneeberg, Annaberg and Johanngeorgenstadt in Saxony; Joachimsthal in Bohemia; Thuringia; Hessia; Stiria; Crawitza in the Bannat.

Observations.

This mineral is distinguished from *Grey Cobalt* by its colour, crystallisations, fracture and hardness; from *Silver-white Cobalt* by its silver-white colour, and very imperfect cleavage, and also by its crystallisations; in this mineral the predominating forms being the rhomboidal dodecahedron and cube, whereas the pentagonal dodecahedron and icosahedron are the characteristic forms of silver-white cobalt.

Second

Second Kind.

Radiated Tin-White Octahedral Cobalt-Pyrites.

Strahliger Weisser Speisskobold, *Werner.*

External Characters.

Its colour is tin-white, but generally very dark and inclining to grey.

It occurs massive, disseminated, and reniform; also in distinct concretions, which are scopiform and stellular radiated, sometimes passing into fibrous.

Internally it is glistening and metallic.

The fracture is uneven.

The fragments are indeterminate angular or wedge-shaped and splintery.

It is softer than the compact kind.

Other characters as in the preceding kind.

Constituent Parts.

Arsenic, - -	65.75
Cobalt, - -	28.00
Oxide of Iron, -	5.00
Oxide of Manganese, -	1.25
	100 *John.*

Geognostic and Geographic Situations.

It occurs rarely in veins in clay-slate at Schneeberg: Wallerius mentions, in the following terms, a mineral found near Kongsberg in Norway, which may be a variety of of this cobalt: "Minera cobalti crystallisata, figura globosa, stricta."

Second Subspecies.

Grey Octahedral Cobalt-Pyrites.

Grauer Speisskobold, *Werner.*

Grauer Speisskobalt, *Lud.* b. i. s. 284. *Id. Mohs*, b. iii. s. 644. *Id. Leonhard*, Tabel. s. 76. *Id. Karsten*, Tabel. s. 72.—Speisskobalt, *Haus.* s. 75. (in part.)—Cobalt arsenical amorphe, *Haüy.*—Arsenical Cobalt, *Aikin*, p. 128.

External Characters.

On the fresh fracture its colour is light steel-grey, which sometimes inclines to whitish lead-grey; but by exposure it gradually acquires a tempered-steel or greyish-black tarnish.

It occurs massive, disseminated, tubiform, and specular.

Externally it is generally dull and tarnished.

Internally strongly glimmering or glistening, and the lustre is metallic; but the specular variety is splendent.

The fracture is even, which sometimes passes into flat and large conchoidal, sometimes into fine-grained uneven.

The fragments are indeterminate angular, and pretty sharp-edged.

It becomes shining in the streak, without change of colour.

In hardness agrees with the hexahedral cobalt-pyrites.

It is brittle and easily frangible.

When struck, emits an arsenical odour.

Specific gravity 6.135, *Breithaupt.*

Constituent

Constituent Parts.

According to Klaproth, it contains 19.60 parts of Cobalt, with Iron and Arsenic. Vid. *Klaproth* in d. Beob. u. Entd. b. i. s. 182.

Geognostic Situation.

It occurs in veins in granite, gneiss, mica-slate and clay-slate, associated with the tin-white octahedral cobalt-pyrites; but it is neither so frequent nor abundant.

Geographic Situation.

Europe.—It is found in Cornwall at Herland, along with native silver, in Huel Sparnon, near Redruth, along with bismuth, and in copper veins at Norway; Annaberg, Schneeberg, and Freyberg in the electorate of Saxony; Joachimsthal in Bohemia; Krobsdorf, Hindorf, and Kupferberg in Silesia; Wittichen in Swabia; Nassau; Salzburg; Allemont in France; Stiria; and Hungary.

America.—At Chatham in Connecticut, in North America, in hornblende rock.

Use.

Grey octahedral pyrites affords deeper and more beautiful blue colours than any of the other cobaltic minerals. From this circumstance it is named in Germany, *Fabriken-Kobold*.

Observations.

1. This mineral is characterised by its colour, fracture, hardness and weight. It is distinguished from *Grey Copper-ore* by fracture, greater weight and hardness, and its want

want of crystallisations; from *Compact Grey Manganese-ore*, and *Compact Galena*, by its hardness; and from *Silver-white Cobalt-pyrites* by colour, form, fracture and weight.

* Cobalt-kies, *Hausmann.*

Cobaltum pyriticosum, (ferro sulphurato mineralisatum), *Lin.* Syst. Nat. t. iii. p. 129.—Minera Cobalti sulphurea, *Waller.* Syst. Min. t. ii. p. 178.—Kobolt, med jern och suafelsyra, *Brandt,* in K. vet. Acad. Handl. 1746, p. 119.—Kobolt, med forsvafladt jern, *Cronstedt,* Mineralogie, § 250,—Svafvelbunden Kobolt, *Hisinger,* in Afhandl. i Fysik, Kemi och Min. iii. 316.—Kobaltkies, *Haus.* Entw. s. 73. *Id. Haus.* Handb. b. i. s. 158.—Cobalt sulphuré, *Lucas,* t. ii. p. 516.

External Characters.

Its colour is pale steel-grey; which by tarnishing approaches to copper-red.

It occurs massive, disseminated, and it is said also crystallised in a cubical form.

Its lustre is shining and metallic.

Its fracture is uneven, passing into imperfect conchoidal, and sometimes shews an imperfect cleavage.

It is semihard.

Chemical Characters.

Before the blowpipe it emits a sulphureous odour, and after being roasted colours glass of borax smalt-blue.

Constituent

Constituent Parts.

Cobalt,	-	-	43.20
Sulphur,	-	-	38.50
Copper,	-	-	14.40
Iron,	-	-	3.53

Hisenger in Afhandl. i Physik. Kemi och Min. iii. 321.

It is distinguished from the other pyritical cobalts by its want of arsenic.

Geognostic and Geographic Situations.

It occurs along with copper-pyrites, and common actynolite, in a bed in gneiss, at Naya Bastnas at Riddarhyttan, in Sweden.

Observations.

This mineral was well known to the older Swedish mineralogists; and Brandt, the discoverer of Cobalt, describes it in the Transactions of the Swedish Academy of Sciences, 8. B. s. 120. for 1746, German translation.

Genus IV.—IRON PYRITES.

Eisen-Kies, *Mohs.*

This Genus contains three Species, viz. 1. Hexahedral Iron-Pyrites, 2. Prismatic Iron-Pyrites, and, 3. Rhomboidoidal Iron-Pyrites.

1. Hexahedral Iron-Pyrites, or Common Iron-Pyrites.

Hexaedrischer Eisen-Kies, *Mohs.*

Gemeiner Schwefelkies, *Werner.*

Pyrites colore aureo, *Plin.* Hist. Nat. xxxvi. (ed. Bip. v. 371.) *. —Sulphureus et Marcasita, *Waller.* Syst. Min. t. ii. p. 126. —Gemeiner Schwefelkies, *Werner,* Pabst. b. i. s. 130. *Id. Wid.* s. 794.—Common Sulphur Pyrites, *Kirw.* vol. ii. p. 76. —Gemeiner Schwefelkies, *Emm.* b. ii. s. 289.—Fer sulphuré, *Haüy,* t. iv. p. 65.–97.—La Pyrite martiale commune, *Broch.* t. ii. p. 221.—Gemeiner Schwefelkies, *Reuss,* b. iv. s. 14. *Id. Lud.* b. i. s. 236.—Eisenkies, *Suck.* 2ter th. s. 234.—Gemeiner Schwefelkies, *Bert.* s. 412. *Id. Mohs,* b. iii. s. 322. *Id. Hab.* s. 110.—Fer sulphuré, *Lucas,* p. 139.—Gemeiner Schwefelkies, *Leonhard,* Tabel. s. 62.—Fer sulphuré crystallisé, *Brong.* t. ii. p. 151.—Gemeiner Schwefelkies, *Karsten,* Tabel. s. 64. *Id. Haus.* s. 72.—Sulphuret of Iron, *Kid,* vol. ii. p. 184.—Fer sulphuré, *Haüy,* Tabl. p. 96. Schwefelkies, *Haus.* Handb. b. i. s. 146.—Gemeiner Schwefelkies, *Hoff.* b. iii. s. 191.—Common Pyrites, *Aikin,* p. 96.

External Characters.

Its colour is perfect bronze-yellow; sometimes tarnished, reddish, brownish, or with a brass-yellow colour.

It occurs most commonly massive, disseminated, globular, with impressions, and in membranes; also in granular distinct concretions, and frequently crystallised. Its crystallisations are as follows:

1. *Cube,*

---

* The *πυριμαχος* or *πυρομαχος* of the Greeks is not our iron-pyrites, as is maintained by Henckel and Wallerius, but flint.—Vid. Beckmann, in his Notes to Aristot. lib. de Mirab. auscult. p. 96.

1. Cube, in which the faces are either straight, or spherical-convex or spherical-concave *, fig. 199. It is the most common crystallization of this species.
2. Cube, truncated on its edges, in such a manner that each truncation is more inclined towards one face than the other, and each face supports two opposite truncating planes †, fig. 200.
3. When the truncating planes of the preceding figure become so large that the original planes disappear, the *pentagonal dodecahedron* is formed ‡, fig. 201.
4. Cube truncated on all the angles ||, fig. 202.
5. When the truncations in the preceding figure become so large as to obliterate the original planes of the cube, an *octahedron* is formed §, fig. 203.
6. Octahedron bevelled on all the edges; the bevelment once broken, fig. 204.
7. Octahedron, in which the angles are accuminated with four planes, which are set on the lateral planes, and the summits of the truncations truncated, fig. 205.
8. Octahedron bevelled on all the angles ¶, fig. 206.
9. When the bevelling planes of the octahedron become large, the figure passes into the *icosahedron* **, fig. 207.

10. Cube,

* Fer sulphuré primitif, Haüy.

† Fer sulphuré cubo-dodecaedre, Haüy.

‡ Fer sulphuré dodecaedre, Haüy.

|| Fer sulphuré octaedre, Haüy.

¶ Fer sulphuré icosaedre, variet. *a.* Haüy.

** Fer sulphuré icosaedre, Haüy.

3

10. Cube, in which each angle is acuminated with three planes, which are set on the lateral edges *, fig. 208. Sometimes the acuminating planes become so large, that the original faces of the cube appear as small rhombs †, fig. 209.
11. Cube, in which each angle is acuminated with three planes, which are set on the lateral planes: sometimes the acuminating planes become so large, that the original faces of the cube entirely disappear, when there is formed
12. The *leucite crystallization*, or very acute double eight-sided pyramid, in which the lateral planes of the one are set on those of the other, and both extremities are acuminated with four planes, which are set on the alternate lateral edges ‡.

The cube alternates from large to small. The icosahedron and dodecahedron are in general only small.

The crystals are sometimes singly imbedded, or they occur in druses, or aggregated in balls and other forms.

It seldom occurs in supposititious crystals, which have been formed in crusts over pyramids of quartz, and tables of heavy-spar. Sometimes in extraneous external forms, particularly in ammonites, &c.

The surface of the crystals is sometimes smooth, sometimes alternately streaked, and the lustre extends from specular-splendent to glistening.

Internally it is usually shining and glistening, and the lustre is metallic.

The cleavage is hexahedral.

 The

* Fer sulphuré quadriépointé, Haüy.

† Fer sulphuré tricontaedre, Haüy.

‡ Fer sulphuré trapezoidal, Haüy.

The fracture is coarse, small, or fine-grained uneven, and sometimes conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is harder than felspar, but not so hard as quartz.

It is brittle, and rather easily frangible.

When rubbed, or struck with steel, it emits a strong sulphureous smell.

Specific gravity, -	4.7, 5.0,	*Mohs.*
Dodecahedral pyrites,	4.830,	*Hatchett.*
Pyrites in smooth-planed cubes,	4.831,	*Id.*
Pyrites from Cornwall,	4.789,	*Kirwan.*
Id. cubic pyrites, -	4.7016,	*Brisson.*

Chemical Characters.

Before the blowpipe it emits a strong sulphureous odour, and burns with a bluish flame. It afterwards changes into a brownish-coloured globule, which is attractable by the magnet, and by continuance of the heat, passes into a blackish slag, which communicates a muddy-green colour to borax.

Constituent Parts.

	Dodecahedral Pyrites.	Pyrites in striated Cubes.	Pyrites in smooth Cubes.
Sulphur,	52.15	52.50	52.70
Iron,	47.85	57.50	47.30
	100	100	100

Hatchett, Phil. Trans. for 1804.

Some varieties, particularly those in striated cubes and dodecahedrons, contain a portion of gold, and hence have been named Auriferous Pyrites: other varieties contain silver.

Geognostic

Geognostic Situation.

It occurs in beds, in primitive, transition, and secondary mountains; also disseminated through various rocks, as granite, gneiss, mica-slate, clay-slate, primitive greenstone, porphyry, grey-wacke, sandstone, slate-clay, limestone, &c. In veins in primitive mountains, it is associated with galena or lead-glance, copper-pyrites, arsenical-pyrites, blende, frequently with native gold, seldomer with ores of silver: in transition mountains, with galena or lead-glance, blende, copper-pyrites, sparry iron, calcareous and fluor spar; and in secondary rocks, with ores of lead, copper, and zinc, and quartz, calcareous-spar, and fluor-spar. It is also disseminated in alluvial rocks, and in meteoric stones.

It is worthy of remark, that quartz is one of the most constant attendants of common iron-pyrites.

Geographic Situation.

This mineral is so universally distributed, that it is not necessary to enter here into any geographical details in regard to it.

Uses.

It is never worked as an ore of iron; it is principally valued on account of the sulphur which can be obtained from it by sublimation, and the iron-vitriol which it affords by exposure to the air, either with or without previous roasting. It was formerly cut into ornaments, but they are now out of use; and at one period it was used in place of flint in gun-locks.

Observations.

1. It is distinguished from *Pale-yellow Native Gold*, by its brittleness, the gold being malleable: from *Copper-pyrites*, by colour, crystallisation, fracture, and hardness: from *Arsenical pyrites*, by colour.

2. Some varieties on exposure are gradually changed into a brown ironstone; others are converted into sulphat of iron.

3. Iron-pyrites sometimes contains gold, silver, and copper; and it is remarked, that these metals generally occur in the striated cubes, the pentagonal dodecahedron, and the intermediate varieties of form between the cube and the dodecahedron.

4. Marcasite, according to Henckel, is a word used by the Arabians to express any substance in an imperfectly metallic state, and not easily reduced, and he supposes it may be derived from the Hebrew word "*marach*," "flavescere." Apothecaries at one time applied this name to bismuth, antimony, and several other metals. Miners apply the name to the crystallised varieties of iron-pyrites.

5. Polished pieces of a yellow-coloured mineral have been found in the graves of the early inhabitants of Peru, and are known by the name *Piedra de los Incas*. All of them appear to be either large crystals of iron-pyrites, or massive pieces of the same mineral more or less polished, and which appear to have been used as mirrors.

6. The most complete treatise on the natural and economical history of Pyrites, is that of Henckel, of which an English translation was published in London in 1757.

7. It has been described under the following names: Marcasite, Cat-gold, Gold-pyrites, Vitriolic-pyrites, Pyrite, and Gesundheitstein.

2. Prismatic

2. Prismatic Iron-Pyrites.

Prismatischer Eisenkies, *Mohs.*

This species is divided into five subspecies, viz. Radiated-pyrites, Hepatic-pyrites, Cellular-pyrites, Spear-pyrites, and Cockscomb-pyrites.

First Subspecies.

Radiated Pyrites.

Strahlkies, *Werner.*

Globuli pyritacei, *Wall.* Syst. Min. t. ii. p. 129.—Strahlkies, *Werner,* Pabst. b. i. s. 136. *Id. Wid.* s. 797.—Striated Pyrites, *Kirw.* vol. ii. p. 78.—Strahlkies, *Emm.* b. ii. s. 293.—Fer sulphuré radié, *Haüy,* t. iv. p. 59.—La Pyrite rayonnée, *Broch.* t. ii. p. 225.—Strahlkies, *Reuss,* b. iv. s. 25. *Id. Lud.* b. i. s. 337. *Id. Mohs,* b. iii. s. 337. *Id. Hab.* s. 111. *Id. Leonhard,* Tabel. s. 63.—Fer sulphuré radié, *Brong.* t. ii. p. 152.—Strahliger Schwefelkies, *Karsten,* Tabel. s. 64. *Id. Haus.* s. 74.—Fer sulphuré aciculaire-radié, *Haüy,* Tabl. p. 97.—Fer sulphuré prismatique rhomboidal, *Bournon,* Cat. Min. p. 301.

External Characters.

Its colour is very pale bronze-yellow, which, in the pyramidal varieties, inclines to brass-yellow.

It has sometimes an iridescent and pavonine tarnish.

It occours massive, but most commonly dendritic, reniform, stalactitic, globular, botryoidal, fruticose, tuberose with impressions: also in thin diverging prismatic or radiated

diated concretions, which are sometimes collected into others having granular figures, and these are traversed by curved lamellar concretions. It is frequently crystallised.

Its primitive form is an oblique four-sided prism, in which the obtuse angle is 106° 36′. The following are the principal varieties of secondary form:

1. Oblique four-sided prism, flatly bevelled on the extremities, the bevelling planes set on the acute lateral edges, fig. 210.
2. The preceding figure, in which the edge formed by the meeting of the two bevelling planes is deeply truncated, fig. 211: sometimes the obtuse edges are deeply truncated, fig. 212.
3. N° 1. in which the angles formed by the meeting of the bevelling and lateral planes on the obtuse edges are truncated.
4. N° 1. bevelled on the acute lateral edges.
5. Broad wedge-shaped double four-sided pyramid, in which the smaller lateral faces are sometimes curved.

The crystals are usually small and very small; externally shining, and glistening inclining to glimmering.

The fracture is uneven.

The fragments are wedge-shaped.

It is harder than felspar, but not so hard as quartz.

It is brittle.

It is very easy frangible, and breaks more readily in the direction of the lamellar than in the direction of the granular concretions.

When rubbed, or struck with steel, it emits a sulphureous odour.

Specific

Specific gravity, 4.7, 5.0, *Mohs*. 4.775, *Hatchett*. 4.729, *Wiedeman*.

Constituent Parts.

Sulphur,	-	53.60	54.34
Iron,	-	46.40	45.66
		100	100

Hatchett, Phil. Trans. for 1804.

Geognostic Situation.

It is much rarer than common iron-pyrites; occurs principally in small variously shaped masses, in chalk, clay, &c. and in veins, which contain lead and silver ores.

Geographic Situation.

It is found in Cornwall, Isle of Sheppy, Kent, Derbyshire, and other places in England; Freyberg, Gersdorf, Schneeberg, Annaberg, Johanngeorgenstadt, in Saxony; Bohemia; Zellerfeld and Goslar in the Hartz; Arendal in Norway; the islands of Morn and Seeland in Denmark; Schlangenberg in Siberia.

Observations.

It decomposes more readily than common iron-pyrites, particularly when it is exposed to a varying temperature in damp places, and then its surface becomes covered with greyish-white capillary iron-vitriol. In other instances the sulphur is volatilised, and the mineral remains unaltered in form, but in the state of an oxide of iron, forming what Haüy calls *cristaux epigenes*.

" Mr

"Mr Proust is of opinion, that the pyrites which contain the smallest quantity of sulphur, are those which are most liable to vitriolisation; and, on the contrary, that those which contain the largest proportion, are the least affected by the air or weather. This opinion of the learned Professor, by no means accords with such observations as I have been able to make; for the cubic, dodecahedral, and other regularly crystallised pyrites, are liable to oxidisement, so as to become what are called Hepatic Iron-ores, but not to vitriolisation; whilst the radiated pyrites (at least those of this country) are by much the most subject to the latter effect: and therefore, as the results of the preceding analyses shew that the crystallised pyrites contain less sulphur than the radiated pyrites, I might be induced to adopt the contrary opinion. But I am inclined to attribute the effect of vitriolisation, observed in some of the pyrites, not so much to the proportion, as to the state of the sulphur in the compound; for I much suspect, that a predisposition to vitriolisation in these pyrites, is produced by a small portion of oxygen being previously combined with a part, or with the general mass of the sulphur, at the time of the original formation of these substances, so that the state of the sulphur is tending to that of oxide, and thus the accession of a farther addition of oxygen becomes facilitated."—*Hatchett*, Phil. Trans. 1804.

Second

Second Subspecies.

Hepatic or Liver-Pyrites *.

Leberkies, *Werner.*

Pyrites fuscus, *Wall.* t. ii. p. 133.—Pyrite hepatique, *Romé de Lisle,* t. iii. p. 265.—Leberkies, *Werner,* Pabst. b. i. s. 139. *Id. Wid.* s. 800.—Hepatic Pyrites, *Kirw.* vol. ii. p. 83.—Leberkies, *Emm.* b. ii. s. 298.—La Pyrite hepatique, *Broch.* t. ii. p. 228.—Leberkies, *Reuss,* b. iv. s. 20. *Id. Lud.* b. i. s. 238. *Id. Mohs,* b. iii. s. 349.—Graugelber Eisenkies, *Hab.* s. 112. Leberkies, *Leonhard,* Tabel. s. 63. *Id. Karsten,* Tabel. s. 64. Dichter Schwefelkies, *Haus.* s. 72.—Hepatic Pyrites, *Aikin,* p. 97.

External Characters.

Its colour is very pale brass-yellow, which inclines more or less to steel-grey.

It changes its colour on the fresh fracture, and becomes brown, or acquires a columbine tarnish.

It occurs massive, disseminated, globular, tuberose, reniform, stalactitic, with impressions, and straight and small cellular.

Internally it is usually glimmering, seldom approaching to glistening, and the lustre is metallic.

The fracture is even, which sometimes passes into small-grained uneven, sometimes into flat conchoidal.

The fragments are indeterminate angular, and sharp-edged.

Specific gravity, 4.834, *Karsten.*

Geognostic

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* The name of the species is from the brown colour it exhibits on the fracture surface.

Geognostic Situation.

It occurs only in veins in primitive rocks, and is usually accompanied with red silver, native silver, galena or lead-glance, common pyrites, black and brown blende, sparry-iron, iron-ochre, seldomer with silver-white cobalt, red cobalt, cinnabar, and grey antimony-ore: the accompanying vein-stones are, quartz, heavy-spar, brown-spar, fluor-spar, and calcareous-spar.

Geographic Situation.

It is found in Derbyshire; Freyberg, Johanngeorgenstadt in Saxony; Wolfstein in the Palatinate; Salzburg; Goslar in the Hartz; Hungary; Transylvania; Bohemia; Iceland; Norway; Sweden; and Siberia.

Observations.

It is the Wasserkies of some authors.

Third Subspecies.

Cellular Pyrites.

Zellkies, *Werner.*

Zellkies, 2. Unterart, *Reuss,* b. iv. s. 34. *Id. Mohs,* b. iii. s. 347. *Id. Leonhard,* Tabel. s. 63. *Id. Karsten,* Tabel. s. 64.

External Characters.

The colour is bronze-yellow, which inclines very much to steel-grey, and slightly to green.

By exposure it acquires a grey tarnish.

It occurs massive, but most frequently cellular, and of this

this form it exhibits the hexagonal, polygonal, and indeterminate varieties.

The surface of the cells is drusy.

Internally it is strongly glimmering; seldom, and only when it passes into common pyrites, glistening.

The fracture is even and flat conchoidal, seldom passing into fine-grained uneven.

The fragments are indeterminate angular, and pretty sharp-edged.

In other characters it agrees with the foregoing subspecies.

Geognostic and Geographic Situations.

It occurs in veins at Johanngeorgenstadt in the kingdom of Saxony, where it is accompanied with hepatic pyrites, common pyrites, galena or lead-glance, sparry iron, iron-ochre, brown-spar, heavy-spar, fluor-spar, and quartz.

Observations.

It is the least liable to decomposition of all the subspecies of pyrites.

Fourth Subspecies.

Spear-Pyrites *.

Sparkies, *Werner*.

External Characters.

Its colour is intermediate between bronze-yellow and steel-grey.

It

* It is named *Spear-pyrites*, because the crystals are grouped in a spear-like form.

It rarely occurs massive, generally crystallised, and always in twin or triple crystals.

The crystals are small and superimposed.

Externally it is shining; internally glistening, and the lustre is metallic.

The fracture is uneven, or imperfect conchoidal.

In other characters agrees with the preceding subspecies.

Geognostic and Geographic Situations.

It occurs in veins in primitive rocks, but more frequently in newer rocks, associated with brown-coal. It is found in Bohemia and in Saxony.

Fifth Subspecies.

Cockscomb-Pyrites.

Kamkies, *Werner.*

Fer sulphuré (blanc) dentélé, *Haüy.*

External Characters.

Its colour is bronze-yellow, inclining to pale steel-grey. Externally it has a mixture, which approximates the colour to brass-yellow.

It rarely occurs massive, almost always crystallised, and in the form of flat double four-sided pyramids. These crystals are grouped in rows, and are attached together by their smaller lateral planes, so that the aggregate somewhat resembles the comb of a cock.

Externally it is generally smooth.

Internally it is shining, or glistening and metallic.

The fracture is small-grained uneven.

The

The fragments are indeterminate angular, and rather sharp-edged.

In other characters it agrees with the preceding.

Geognostic and Geographic Situations.

It occurs in Derbyshire, and in some mines in Saxony.

Observations.

It is particularly characterised by the mode of grouping of its crystals: and is readily distinguished from *Arsenical-Pyrites* by its colour; and from *Copper-Pyrites* by crystallization and hardness.

3. Rhomboidal Iron-Pyrites, or Magnetic Pyrites.

Magnetkies, *Werner.*

Id. Werner, Pabst. b. i. s. 144. *Id. Wid.* s. 792.—Magnetic Pyrites, *Kirw.* vol. ii. p. 79.—Magnet-kies, *Emm.* b. ii. s. 286. —La Pyrite magnetique, *Broch.* t. ii. p. 232.—Magnetkies, *Reuss,* b. iv. s. 35. *Id. Lud.* b. i. s. 239. *Id. Suck* 2ter th. s. 245. *Id. Bert.* s. 416. *Id. Mohs,* b. iii. s. 352. *Id. Hab.* s. 112. *Id. Leonhard,* Tabel. s. 63.—Fer sulphuré magnetique, *Brong.* t. ii. p. 155.—Fer sulphuré ferrifere, *Haüy,* Tabl. p. 98.—Magnetic Pyrites, *Aikin,* p. 96.

This species is divided into two subspecies, viz. Foliated Magnetic Pyrites, and Compact Magnetic Pyrites.

First

First Subspecies.

Foliated Magnetic Pyrites.

Blättricher Magnetkies, *Hausmann.*

Blättriger Magnetkies, *Karsten,* Tabel. s. 64. *Id. Leonhard,* Tabel. s. 63. *Id. Haus.* Handbuch. b. i. s. 145.

External Characters.

Its colour is intermediate between bronze-yellow and copper-red, and sometimes inclines to pinchbeck-brown.

It occurs massive, disseminated, in coarse granular concretions; and very rarely crystallised.

The primitive figure Mohs considers to be a rhomboid, the dimensions of which are still unknown. The following crystallisations, which also occur in this mineral, may be traced back to the rhomboidal form:

1. Regular six-sided prism; sometimes truncated on the lateral edges, sometimes on the terminal edges, and occasionally on the terminal angles.
2. Six-sided pyramid, truncated on the apex.

Internally it is splendent, and the lustre is metallic.

The cleavage is rhomboidal.

The fracture is small and imperfect conchoidal.

The fragments are indeterminate angular and blunt-edged.

It is brittle and easily frangible.

Some varieties are harder than calcareous-spar; others harder than fluor-spar.

Specific gravity 4.4, 4.6, *Mohs.*

Geognostic and Geographic Situations.

It occurs at Breitenbrunn in Saxony; and at Bodenmais in Bavaria, in beds in primitive mountains, along with common iron-pyrites, magnetical iron-ore and blende.

Observations.

1. It was formerly conjectured, that the iron in this species was less oxidised than that in common iron-pyrites, and in this way its magnetic property was accounted for. Mr Hatchett has shewn, however, that iron, when combined naturally or artificially with 36.50 or 37 of sulphur, is not only still capable of receiving the magnetic fluid, but is also rendered capable of retaining it, so as to become in every respect a permanent magnet; and the same, he thinks, may, in a great measure, be inferred respecting iron, which has been artificially combined with 45.50 *per cent.* of sulphur.

2. Mr Hatchett has also shewn that magnetic pyrites agrees in chemical properties with artificial sulphuret of iron or pyrites.

Second Subspecies.

Compact Magnetic Pyrites.

Dichter Magnetkies, *Hausmann.*

Gemeiner Magnetkies, *Karsten,* Tabel. s. 64.—Dichter Magnetkies, *Haus.* s. 73. *Id. Haus.* Handb. b. i. s. 144.

External Characters.

Its colour is intermediate between bronze-yellow and copper-

copper-red, and sometimes inclines to pinchbeck-brown. On exposure to the air, its lustre gradually disappears, and it acquires a brownish tarnish.

It occurs only massive and disseminated.

Internally it is shining and glistening, and the lustre is metallic.

The fracture is fine and coarse-grained uneven, which sometimes passes into imperfect conchoidal.

The fragments are indeterminate angular, and blunt-edged.

It affects the magnetic needle.

In other characters it agrees with foliated magnetic pyrites.

Chemical Characters.

Before the blowpipe it emits a feeble sulphureous smell, and melts easily into a greyish-black globule, attractable by the magnet.

Constituent Parts.

According to Hatchett, it contains in 100 parts,

Sulphur, - - -	36.50
Iron, - - -	63.50
	100

Geognostic Situation.

This mineral occurs principally in primitive mountains, in beds, in gneiss, mica-slate, and primitive limestone, associated with iron-pyrites, copper-pyrites, arsenical-pyrites, magnetic iron-ore, galena or lead-glance, blende, quartz, garnet, actynolite, common hornblende, and rare-

ly

ly with tinstone. It is also found, either massive or disseminated, in transition greenstone and clay-slate.

Geographic Situation.

Europe.—It occurs in the Criffle, Windy-Shoulder, and other hills in Galloway; and at the base of the mountain called Moel Elion in Caernarvonshire. On the Continent of Europe, it is met with at Gillebeck and Kongsberg in Norway; Andreasberg and Treseberg in the Hartz; Breitenbrun in the Saxon Erzgebirge; Kupferberg in Silesia; Bodenmais in Bavaria; and in the Muhlbachthal in Salzburg.

Asia.—In the mines of Catharinenburg in Siberia.

America.—Zacatecas in Mexico.

Uses.

It is used for the same purposes as common iron-pyrites.

GENUS V.—COPPER-PYRITES.

This genus contains two species, viz. Octahedral Copper-Pyrites, and Tetrahedral Copper-Pyrites.

1. Octahedral Copper-Pyrites, or Yellow Copper *.

Octaedrischer Kupferkies, *Mohs.*

Kupferkies, *Werner.*

Minera Cupri flava, *Wall.* t. ii. p. 282.—Mine de Cuivre jaune, *Romé de Lisle,* t. iii. p. 309.—Kupferkies, *Werner,* Pabst. b. i. s. 75. *Id. Wid.* s. 746.—Copper-Pyrites or Yellow Copper-Ore, *Kirw.* vol. ii. p. 140.—Mine de Cuivre jaune, *De Born,* t. ii. p. 313.—Kupferkies, *Estner,* b. iii. s. 494. *Id. Emm.* b. ii. s. 232.—Cuivre pyriteux, *Lam.* t. i. p. 197.—La Pyrite cuivreux, *Broch.* t. ii. p. 169.—Kupferkies, *Reuss,* b. iii. s. 415. *Id. Lud.* b. i. s. 223. *Id. Suck.* 2ter th. s. 181. *Id. Bert.* s. 386. *Id. Mohs,* b. iii. s. 239. *Id. Hab.* s. 107.—Cuivre pyriteux, *Lucas,* p. 125.—Kupferkies, *Leonhard,* Tabel. s. 57. —Cuivre pyriteux, *Brong.* t. ii. p. 213. *Id. Brard,* p. 283.—Kupferkies, *Karsten,* Tabel. s. 62. *Id. Haus.* s. 71.—Yellow Sulphuret of Copper, *Kid,* vol. ii. p. 109.—Cuivre pyriteux, *Haüy,* Tabl. p. 85.—Kupferkies, *Haus.* Handb. b. i. s. 161. *Id. Hoff.* b. iii. s. 113.—Yellow Copper, *Aikin,* p. 87.

External Characters.

On the fresh fracture, its colour is brass-yellow, of different shades: the varieties richest in copper have a deep yellow colour, approaching to gold-yellow; the poorer varieties incline to greyish brass-yellow, and steel-grey.

It is usually tarnished, either with variegated colours, as pavonine, columbine, and sometimes tempered steel coloured, or with simple colours, as blue and black.

The tarnished colours occur sometimes on the mineral in

* Throughout the work, where the name *Copper-Pyrites* occurs, it is to be understood as applicable only to the *Octahedral* species.

in the bosom of the earth, sometimes on exposure of the recent fracture to the action of the air.

It occurs massive, disseminated, and in membranes; also dendritic, reniform, botryoidal, stalactitic, specular, amorphous; and crystallized as follows:

1. Regular Octahedron.
   a. Perfect.
   b. Truncated on all the edges.
   c. Truncated on all the angles.
   d. Truncated on all the edges and angles.
   e. Elongated.
   f. Edges bevelled.

Frequently four of the alternate planes of the octahedron become larger than the others, and thus there is at length formed a

2. Tetrahedron.
   a. Truncated on all the angles.
   b. Perfect.
   c. Tabular segment.

Frequently two segments of this description are attached by their bases, and thus form a *Twin*-crystal.

The crystals are usually small and very small, and generally superimposed.

Externally it is intermediate between glistening and shining, and is often splendent.

Internally it is shining, which in some varieties passes into glimmering, and the lustre is metallic.

The cleavage is probably octahedral.

The fracture is most commonly coarse and small-grained uneven: the coarse-grained passes into imperfect and small conchoidal: the small-grained passes into fine-grained uneven, also into even, and large and flat conchoidal. The lustre varies with the fracture; the highest degree of lustre is in the small conchoidal: and the large conchoidal and even, have the least lustre, being only glimmering.

The fragments are indeterminate angular, and rather sharp-edged.

Some varieties are as hard as fluor-spar, others are not harder than calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, 4.1—4.2, *Mohs;* 4.160, *Gellert;* 4.080, *Kirwan.*

Chemical Characters.

Before the blowpipe, on charcoal, it decrepitates, emits a greenish-coloured sulphureous smoke, and melts into a black globule, which, by continuing the fire gradually, assumes the metallic lustre of copper. It imparts to borax a green tinge.

Constituent Parts.

	Cornwall.	St Bel.	Freyberg.
Copper,	30	30.0	32.0
Iron,	53	31.0	34.0
Sulphur,	12	36.5	33.0
	95	97.5	99.0
	Chenevix.	*Gueniveau.*	*Breithaupt.*

[illegible]times also contains small portions of gold or [illegible]

Geognostic Situation.

[illegible] of the most abundant metalliferous minerals: [illegible] in almost every kind of repository, and in all the [illegible] of rocks. Thus, it is met with in granite, gneiss,

gneiss, mica-slate, clay-slate, porphyry, syenite, trap, grey-wacke, in secondary limestones, in coal formations, and also in those of sandstone. In these rocks, it is associated with various metalliferous and earthy minerals, such as iron-pyrites, magnetic iron-ore, malachite, blue copper, tile-ore, red copper, variegated copper, copper-glance or vitreous copper, galena or lead-glance, blende, cobalt-ochre, arsenical pyrites, sparry iron, and sometimes native gold: the earthy minerals are calcareous-spar, fluor-spar, heavy-spar, brown-spar, quartz, garnet, actynolite, hornblende, tremolite, &c.

Geographic Situation.

Europe.—In veins that traverse a great bed of quartz in the Clifton mine, near Tyndrum in Perthshire; in these veins, it is associated with copper-green, red cobalt-ochre, galena or lead-glance, brown and yellow blende, quartz, and heavy-spar: in a vein in red sandstone in the Mainland, the largest of the Shetland Islands, where it is accompanied with grey copper, malachite, native copper, iron-pyrites, sparry iron, and brown iron-ore: at the mines of Ecton, on the borders of Derbyshire and Staffordshire, it is embedded in limestone, and is accompanied with galena or lead-glance, blende, calcareous-spar, fluor-spar, and heavy-spar: at Pary's Mountain in Anglesea, it occurs in a bed of great thickness, associated with native copper, malachite, blue copper, galena or lead-glance, and calamine: in several lead-mines in Derbyshire: abundantly in the copper-mines of Cornwall, along with copper-glance, grey copper and red copper. There are considerable copper-mines at Cronebane and Ballymurtagh, in the county of Wicklow in Ireland, and the principal ore

is

is copper-pyrites. This mineral is met with in considerable abundance on the Continent of Europe, but the localities are so numerous, that we cannot spare room but for a few of them. It occurs in the mines of Rörras and Arendal in Norway; in that of Fahlun in Sweden; in the Hartz; the Saxon Erzgebirge; Hessia, Bohemia, Franconia, Suabia, Bavaria, Silesia, Austria, Hungary, Spain, France and Russia.

Asia.—Siberia; and Japan.

America.—United States; Mexico; and Chili.

Africa.—Morocco; Abyssinia; country of the Namaquas, in Southern Africa.

Uses.

Nearly one-third of all the copper which is obtained by metallurgic operations, is extracted from this species: it is, however, a poor ore, seldom yielding above 36 pounds, more commonly only 20 pounds of copper in the hundred. Sulphur is frequently obtained from it by sublimation.

In Cornwall, the annual quantity of copper-ore raised, is sometimes 73.700 tons, of which the principal ore is yellow copper-pyrites. This quantity of ore affords 6.425 tons of pure copper, and sells for L. 410,936.

Observations.

1. It has been confounded with *Native Gold*, but it may be readily distinguished from that mineral by its fracture, which is uneven, imperfect conchoidal, or foliated; whereas that of gold is hackly; and also by its tenacity, it being brittle, whereas gold is malleable. It is distinguished from *Iron-pyrites* by its inferior hardness, it not exceeding fluor-spar hardness,

hardness, while iron-pyrites is harder than felspar; by colour, iron-pyrites being bronze-yellow, whereas it is brass-yellow; and the crystallizations are also very different from those of iron-pyrites; in particular, it occurs in tetrahedrons, a form never observed in iron-pyrites.

2. It passes into several other species of ore, particularly into White Copper, Grey Copper and Variegated Copper.

3. The softer varietics of copper-pyrites contain the greatest quantity of copper, and the harder the greatest proportion of iron. Among the softer varieties, those having a tarnished surface are said to contain the greatest quantity of copper.

4. Those varieties which contain the largest proportion of sulphur, are the least affected by exposure to the air.

2. Tetrahedral Copper-Pyrites.

Tetraedrischer, Kupferkies, *Mohs.*

This species is subdivided into two subspecies, viz. Grey Copper, and Black Copper.

First Subspecies.

Grey Copper.

Fahlerz, *Werner.*

Cuivre gris arsenifère, *Haüy.*

Minera Cupri grisea, *Wall.* t. ii. p. 281.—Mine d'Argent grise, et Mine de Cuivre grise, *Romé de Lisle*, t. iii. p. 315.—Fahlerz, *Wern.* Pabst. b. i. s. 83. *Id. Wid.* s. 751.—Grey Copper-ore,

ore, *Kirw.* vol. ii. p. 146.—Fahlerz, *Estner,* b. iii. s. 509. *Id. Emm.* b. iii. s. 238.—Argent gris, *Lam.* t. i. p. 138.—Mine d'une couleur fauve, ou le Cuivre gris, ou le Fahlerz, *Broch.* t. ii. p. 175.—Cuivre gris, *Haüy,* t. iii. p. 536,–556.—Fahlerz, *Reuss,* b. iv. s. 198. *Id Lud.* b. i. s. 224. *Id. Mohs,* b. iii. s. 231. *Id. Hab.* s. 108.—Cuivre gris, *Lucas,* p. 126.—Fahlerz, *Leonhard,* Tabel. s. 58.—Cuivre gris arsenié, *Brong.* t. ii. p. 215. *Id. Brard,* p. 286.—Fahlerz, *Karsten,* Tabel. s. 62. *Id. Haus.* s. 74.—Grey Copper-ore, *Kid,* vol. ii. p. 115.—Cuivre gris, *Haüy,* Tabl. p. 86.—Kupferfahlerz, *Haus.* Hand. b. i. s. 164.—Fahlerz, *Hoff.* b. iii. s. 119.—Grey Copper, *Aikin,* p. 86.

External Characters.

Its colour is steel-grey, which sometimes inclines to iron-black and lead-grey.

It occurs rarely with a tempered-steel coloured tarnish.

It occurs massive, disseminated, seldom in membranes, and often also crystallized: its crystallizations are the following:

1. Tetrahedron, or simple three-sided pyramid *, Pl. 11. fig. 213, which presents the following varieties:
   - *a.* Truncated on the angles †, fig. 214; or on the edges ‡, Pl. 11. fig. 215.
   - *b.* Bevelled on the edges ||, Pl. 11. fig. 216. When the bevelling edges increase so much as to cause the original planes of the tetrahedron to disappear, a tetrahedron is formed, in which each plane is divided into three, or there is formed on

* Cuivre gris primitif, Haüy.

† Cuivre gris epointé, Haüy.

‡ Cuivre gris cubo-tetraedre, Haüy.

|| Cuivre gris encadré, Haüy.

on each of the planes a very obtuse acumination *, Pl. 11. fig. 217.

c. Each of the angles of the tetrahedron very flatly acuminated with three planes, Pl. 11. fig. 218: sometimes the edges of the tetrahedron are bevelled at the same time †, and also the summits and edges of the acuminations ‡. When the acuminating planes increase so much that the original faces of the tetrahedron disappear, there is formed,

2. The rhomboidal or great dodecahedron, Pl. 11. fig. 219.

The crystals are small and seldom middle-sized; usually singly superimposed, or in druses.

Their surface is shining and splendent.

Internally it is usually glistening; sometimes, however, it passes into shining, and has a metallic lustre.

The fracture is coarse and small-grained uneven; sometimes it inclines to imperfect conchoidal, and such varieties have a blackish colour, the strongest lustre, and contain the greatest proportion of silver, and the least of copper.

The fragments are indeterminate angular, and rather blunt-edged.

Some varieties are harder than calcareous-spar, others harder than fluor-spar, but none so hard as apatite.

It generally remains unaltered in the streak; some afford a reddish-brown streak ‖.

It

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* Cuivre gris dodecaedre, Haüy.

† Cuivre gris apophane, Haüy; Cuivre gris progressif, Haüy.

‡ Cuivre gris identique, Haüy.

‖ According to Count de Bournon, those varieties that afford a reddish-brown streak, may be presumed to contain a mixture of silver and antimony, generally combined together in the state of red silver-ore.

It is brittle, and easily frangible.

Specific gravity, 4.4—4.9, *Mohs*. 4.594, *Wiedemann*. 4.8648, *Hauy*. 4.4460 to 4.560, *Bournon*.

Chemical Characters.

Before the blowpipe, it first decrepitates, and then melts into a greyish-coloured brittle metallic globule. During fusion it disengages a white aresenical vapour: to borax it communicates a yellowish colour inclining to red. Some varieties are difficult of fusion.

Constituent Parts.

	From Airthrie.
Copper,	19.2
Iron,	51.0
Sulphur,	14.1
Arsenic,	15.7
	160.00
Thomson, Ed. Tran.	

	Freyberg.	Freyberg.	Freyberg.
Copper,	41.00	48.00	42.50
Iron,	22.50	25.50	27.60
Sulphur,	10.00	10.00	10.00
Arsenic,	24.10	14.00	15.60
Silver,	0.40	0.50	0.90
Antimony,		-	1.50
	98.00	98.00	98.00
	Klaproth, Beit. b. iv. s. 47.	Ib. s. 49.	Ib. s. 52.

Some varieties contain Gold, as that of Hohenstein: others, as that of Guadalcanal in Spain, from 1 to 10 *per cent.* of Platina.

Geognostic Situation.

It occurs in beds and veins, in primitive, transition, and secondary rocks, in which it is usually accompanied with copper-pyrites, galena or lead-glance, ores of manganese, sparry iron, heavy-spar, calcareous-spar, fluor-spar, and quartz; seldomer with malachite, blue copper, and other cupreous minerals.

Geographic

Geographic Situation.

Europe.—It occurs along with copper-pyrites in red sandstone, near Sandlodge, in the Mainland of Shetland; in small veins at Fassney Burn in East Lothian; at Airthrie, in the Ochill Hills, north-east of Stirling, in veins along with heavy-spar, and calcareous-spar; also in Ayrshire; at Tavistock in Devonshire; in the copper-mines of Cornwall; at Kongsberg in Norway, along with variegated copper; at Freyberg in Saxony, in veins that traverse gneiss, along with copper-pyrites, sparry iron, quartz, calcareous-spar, heavy-spar, and fluor-spar; in the Hartz, also with copper-pyrites, and sparry iron, in veins that traverse greywacke, and transition clay-slate; in flœtz limestone at Falkenstein in the Tyrol; at Saint Marie-aux-Mines in France; at Baigorry, in Navarre, in Spain; in veins in gneiss, at Hochberg in the dukedom of Baden; in porphyry at Gablan in Silesia; in Thuringia, along with red and brown cobalt-ochre, and heavy-spar; at Saska and Oravicza, in the Bannat in Hungary; also at Kremnitz, and other parts in that kingdom; at Kapnic, Nagyag, and Offenbanya, in Transylvania; and in the government of Olonetz in Russia.

Asia.—Kolywan; Tobolsk, along with copper-green; and in several of the mines in the Uralian Mountains.

America.—In the mines of Guanaxuato in Mexico, in veins, along with copper-pyrites, brown-spar, calcareous-spar, amethyst, hornstone, and calcedony; and also in the mines of Zimapan, with quartz, calcareous-spar, and gypsum; and in the copper-mines of Chili.

Uses.

Uses.

It is valued as an ore of copper; and when it contains silver, it is worked as an ore of that metal.

Observations.

1. It passes into Copper-pyrites, and Copper-glance or Vitreous Copper.

2. Colour, tetrahedral form, hardness, brittleness, and specific gravity, are its essential characters. It is distinguished from *Octahedral Copper-pyrites*, by its colour, hardness, and brittleness; and this last character distinguishes it from *Brittle Silver*, and *White Silver*.

Second Subspecies.

Black Copper.

Schwarzerz, *Werner*.

Cuivre gris arsenifère, *Haüy*.

Minera Cupri grisea, (in part) *Waller*. Syst. Min. t. ii. p. 281. —Cuivre gris, (in part), *Haüy*, t. iii. p. 357.—Graugiltigerz, *Reuss*, b. ii. 3. s. 427.—Schwartzgiltigerz, *Lud.* b. i. s. 218. *Id. Suck.* 2ter th. s. 185. *Id. Bert.* s. 398. *Id. Mohs*, b. iii. s. 196.—Graugiltigerz, *Leonhard*, Tabel. s. 58.—Cuivre gris antimonié, *Brong.* t. ii. p. 216.—Graugiltigerz, *Karsten*, Tabel. s. 62.—Schwarzgiltigerz, *Haus.* s. 74.—Cuivre gris arsenifère, *Haüy*, Tabl. p. 87—Schwarzgiltigerz, *Haus.* Handb. b. i. s. 166.—Schwarzerz, *Hoff.* b. iii. s. 127.—Antimonial Grey Copper, *Aikin*, p. 86.

External

External Characters.

Its colour is iron-black, which sometimes inclines to steel-grey.

It occurs massive, disseminated; and crystallised in the following figures:

1. Tetrahedron.
   a. Perfect.
   b. Bevelled on the edges, and the angles flatly acuminated with three planes, which are set on the lateral planes.
   c. The preceding figure, in which the summits of the acuminations are truncated.
2. When the acuminations on the angles of the tetrahedron become so large that its original planes disappear, then a rhomboidal or garnet dodecahedron is formed.

The crystals are generally splendent, and are often invested with a thin crust of copper-pyrites.

Internally it is shining and splendent, and the lustre is metallic.

The fracture is small and imperfect conchoidal.

Same hardness as grey copper.

It is brittle, and very easily frangible.

Specific gravity 4.842, 4.893, *Ullmann.*

Chemical Characters.

Before the blowpipe, it decrepitates, and then melts into a black cupreous bead, giving out a white antimonial vapour.

Constituent

Constituent Parts.

Kapnik in Transylvania.		Poratsch in Hungary.	Annaberg in Saxony.	Zilla in Clausthal.	St Wenzel near Wolfach.	Peru.
Copper,	37.75	39.00	40.25	37.50	25.50	27.00
Antimony,	22.00	19.50	23.00	29.00	27.00	23.50
Sulphur,	28.00	26.00	18.50	21.50	25.50	27.75
Silver,	0.25		0.30	3.00	13.25	10.25
Iron,	3.25	7.50	13.50	6.50		
Lead,	-	-		-	-	1.75
Arsenic,	-		0.75			
Zinc,	5.00					
Mercury,	-	6.25				
Loss,	3.75	1.75	3.70	2.50	1.75	2.75
	100.00	100.00	100.00	100.00	100.00	100.00

Klaproth, Beit. b. iv. s. 56. 68. 73. & 80.

From these analyses, it appears, that the essential component parts of Black Copper are, Copper, Antimony, Iron, and Sulphur, and that the Silver, Lead, Zinc, and Mercury, are only accidentally mixed.

Geognostic and Geographic Situations.

Europe.—It occurs in veins that traverse transition rocks at Zilla, in the Clausthal in the Hartz *; Annaberg in Saxony; in the mine of St Wenzel, at Wolfach in the Schwarzwald; at Kapnik, in red manganese; at Nagyag, along with iron-pyrites, grey copper, and quartz; at Kremnitz and Poratsch in Hungary; and Allemont in Dauphiny.

America.—In Peru, in veins in alpine limestone.

Use.

It is worked, both as an ore of copper and as an ore of silver.

2 *Observations.*

* The crystals found at Zilla, are generally invested with a crust of copper-pyrites.

Observations.

1. It has been confounded with *Grey Copper*, but it may be distinguished from it by its iron-black colour, splendent lustre, and small conchoidal fracture.

2. It is intermediate between Brittle Silver-glance and Grey Copper.

3. It is the most compounded of all the ores of copper.

* White Copper.

Weiss Kupfererz, *Werner*.

Weisslich Kies-kupfererz, *Henkel's* Kieshistorie, s. 210.—Minera Cupri alba, *Wall.* t. ii. p. 280.—Weiss Kupfererz, *Werner*, Pabst. b. i. s. 83. *Id. Wid.* s. 750.—White Copper-ore, *Kirw.* vol. ii. p. 152.—Weiss Kupfererz, *Estner*, b. iii. s. 50?. *Id. Emm.* b. ii. s. 236.—Mine de Cuivre blanche arsenicale, *Lam.* t. i. p. 201.—La Mine de Cuivre blanche, *Broch.* t. ii. p. 173.—Weiss Kupfererz, *Reuss*, b. iii. s. 425. *Id. Lud.* b. i. s. 224. *Id. Suck.* 2ter th. s. 184. *Id. Bert.* s. 397. *Id. Leonhard*, Tabel. s. 58. *Id. Karsten*, Tabel. s. 62. *Id. Haus.* s. 74.—Weiss Kupfererz, *Haus.* Handb. b. i. s. 159. *Id. Hoff.* b. i. s. 131.—White Copper, *Aikin*, p. 87.

External Characters.

Its colour is intermediate between silver-white and brass-yellow. On the fresh fracture, it soon becomes tarnished with a greyish-yellow colour.

It occurs massive and disseminated.

Internally it is glistening, with a metallic lustre.

The fracture is small and fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It

It is semi-hard.

It is brittle, and easily frangible.

Specific gravity 4.500, *La Metherie.*

Chemical Characters.

Before the blowpipe, it yields a white arsenical vapour, and melts into a greyish-black slag.

Constituent Parts.

Henkel, who gave the first account of this ore, informs us, that it contains 40 parts of Copper, and the remainder consists of Iron, Arsenic, and Sulphur.

Geognostic Situation.

It occurs in veins and mineral beds in primitive and transition rocks. It is usually accompanied with copper-pyrites, and copper-glance or vitreous copper-ore, seldomer with grey copper, copper-green, red copper, blue copper, and native silver.

Geographic Situation.

Europe.—In the mine called Huel Gorland in Cornwall; in the mines Lorenz Gegentrum and Elias, near Freyberg in the kingdom of Saxony; Rudelstadt, Altenberg, and Kupferberg in Silesia; Lauterberg in the Hartz; Frankenberg in Hessia; Christophsthal, near Freüdenstadt in Wurtemberg; Strazena, behind the Creutzberg in Upper Hungary.

Asia.—Catharinenburg in Siberia.

America.—Chili.

Observations.

Observations.

1. It has been frequently confounded with Copper-pyrites, Copper-glance, Grey Copper, and Arsenical-pyrites. It is, however, easily distinguished from *Copper-pyrites*, *Copper-glance*, and *Grey Copper*, by its colour; and from *Arsenical-pyrites* by its inferior specific gravity.

2. It is an intermediate species between copper-pyrites and arsenical-pyrites.

Genus VI.—TIN-PYRITES *.

This genus contains one species, viz. Common Tin-Pyrites.

1. Common Tin-Pyrites.

Zinnkies, *Werner*.

Id. Wid. s. 875.—Tin-pyrites, *Kirw.* vol. ii. p. 200.—Zinnkies, *Emm.* b. ii. s. 418.—Etain sulphuré, *Lam.* t. i. p. 279. *Id. Haüy,* t. iv. p. 154.—La Pyrite d'Etain, ou l'Etain pyriteux, *Broch.* t. ii. p. 332.—Zinnkies, *Reuss,* b. iv. s. 286. *Id. Lud.* b. i. s. 267. *Id. Suck.* 2ter th. s. 354. *Id. Bert.* s. 440. *Id. Mohs,* b. iii. s. 591.—Etain sulphuré, *Lucas,* p. 151.—Zinnkies, *Leonhard,* Tabel. s. 75.—Etain pyriteux, *Brong.* t. ii. p. 191.—Etain sulphuré, or Mussif natif, *Brard,* p. 337.—Zinnkies, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 74.—Etain sulphuré,

* Although this mineral is placed here for the present as a distinct species, we should not be surprised to find that it is a mixture of Sulphurets of Copper and Iron, with mechanically diffused Tin.

sulphuré, *Haüy*, Tabl. p. 102.—Sulphuret of Tin, *Kid*, vol. ii. p. 154.—Zinnkies, *Haus.* Handb. b. i. s. 161. *Id. Hoff.* b. iv. s. 51.—Tin-Pyrites, *Aikin*, p. 117.

External Characters.

Its colour is intermediate between steel-grey and brass-yellow, but usually more inclined to the first.

It occurs massive and disseminated.

Internally it is glistening, sometimes shining, and the lustre is metallic.

The fracture is small and coarse-grained uneven; sometimes inclining to small and imperfect conchoidal.

The fragments are indeterminate angular and blunt-edged.

It yields easily to the knife.

It is brittle and easily frangible.

Specific gravity, 4.350, *Klaproth.*

It is not magnetic.

Chemical Characters.

Before the blowpipe it exhales a sulphureous odour, and melts easily, without being reduced, into a black scoria.

It communicates a yellow or green colour to borax.

Constituent Parts.

Tin, -	34	26.50
Copper, -	36	30.00
Iron, -	3	12.00
Sulphur,	25	30.50
Earthy Matter,	2	
	100	99
	Klaproth, Beit. b. ii. s. 257.—264.	*Klaproth*, Beit. b. v. s. 230.

Geognostic

Geognostic and Geographic Situations.

It has been hitherto found only in Cornwall, as at St Agnes, Stenna Gwynn, Huel Rock, and Huel Scorier, associated with ores of copper and blende, and in small veins in granite at St Michael's Mount.

Observations.

Its colour and greater hardness distinguish it from *Copper-Pyrites:* inferior hardness, and different colour and weight, from *Iron-Pyrites;* and inferior specific gravity and colour distinguish it from *Grey Copper.*

Order IV. GLANCE.

Genus I.—COPPER-GLANCE, or VITREOUS COPPER.

Kupfer-Glanz, *Mohs.*

This genus contains one species, viz. Rhomboidal Copper-Glance. * Variegated Copper.

1. Rhomboidal Copper-Glance, or Vitreous Copper-Ore.

Kupferglas, *Werner.*

This species is divided into two subspecies, viz. Compact Copper-Glance, and Foliated Copper-Glance.

First Subspecies.

Compact Copper-Glance, or Compact Vitreous Copper-Ore.

Dichtes Kupferglas, *Werner.*

Cuprum vitreum, *Wall.* Syst. Min. vol. ii. p. 277.—Dichtes Kupferglas, *Wern.* Pabst. b. i. s. 71.—Compact Vitreous Copper-ore, *Kirw.* vol. ii. p. 144.—Dichtes Kupferglanzerz, *Estner,* b. iii. s. 476.—Kupferglas, *Emm.* b. ii. s. 223.—Cuivre sulphuré, *Haüy,* t. iii. p. 551.–555.—Le Cuivre vitreux compacte, *Broch.* t. ii. p. 162.—Dichter Kupferglanz, *Reuss,* b. iii. s. 401. *Id. Lud.* b. i. s. 220. *Id. Suck.* 2ter th. s. 173. *Id. Bert.* s. 383. *Id. Mohs,* b. iii. s. 253. *Id. Leonhard,* Tabel. s. 57.—Cuivre sulphuré, *Brong.* t. ii. p. 212. *Id. Brard,* p. 289.—Gemeiner Kupferglanz, *Karsten,* Tabel. s. 62.

s. 62. *Id. Haus.* s. 71.—Grey Sulphuret of Copper, *Kid,* vol. ii. p. 106.—Cuivre sulphuré, *Haüy,* Tabl. p. 87.—Dichter Kupferglanz, *Haus.* Handb. b. i. s. 142. *Id. Hoff.* b. iii. s. 104.—Glance Copper, *Aikin,* p. 84.

External Characters.

Its colour is blackish lead-grey, which sometimes inclines to steel-grey, and to iron-black; and has often a tempered-steel coloured tarnish.

It occurs massive, disseminated, in plates, membranes; and sometimes crystallised.

Its primitive form is a rhomboid, whose dimensions are unknown. The following are some of its secondary figures:

1. Low equiangular six-sided prism, which is sometimes so short as to form a six-sided table.
2. Preceding figure, in which the alternate angles are truncated.
3. Prism in which the terminal edges are truncated, and the truncating planes are inclined to the lateral planes under an angle of 151° 52′.
4. Prism truncated as in the preceding, but in which the truncating planes are inclined to the lateral planes, under an angle of 121° 37′.
5. Double six-sided pyramid; two varieties; one formed from the truncations of fig. 3. and another from the truncation of fig. 4.

The crystals are small and very small, seldom middle-sized.

Externally it is shining.

Internally it is intermediate between shining and glistening, and sometimes even passes into glimmering: it is most commonly glistening, and the lustre is metallic.

The

The fracture is small and fine-grained uneven, which passes into small conchoidal; also into large and flat conchoidal, and sometimes into even.

The fragments are indeterminate angular, and more or less sharp-edged.

It retains its colour, and is shining in the streak.

It is harder than gypsum, and sometimes as hard as calcareous-spar.

It is perfectly sectile.

It is rather easily frangible.

Specific gravity 5.5,—5.8, *Mohs*.

Constituent Parts.

	Siberia.	Rothenburg.
Copper, -	78.05	76.50
Iron, - -	2.25	0.50
Sulphur, -	18.50	22.00
Silica, -	0.75	Loss, 1.00
	100.00	100.00
	Klaproth, Beit. b. ii. s. 279.	Ibid. b. iv. s. 39.

Second Subspecies.

Foliated Copper-Glance, or Foliated Vitreous Copper-Ore.

Blättriches Kupferglanz, *Werner*.

Id. Werner, Pabst. b. i. s. 73.—Foliated Vitreous Copper-ore, *Kirw.* vol. ii. p. 146.—Blättriges Kupferglanzerz, *Estner*, b. iii. s. 477.—Blättriges Kupferglas, *Emm.* b. ii. s. 225.—Le Cuivre

Cuivre vitreux lamelleux, *Broch.* t. ii. p. 164.—Blättriches Kupferglanz, *Reuss,* b. iii. s. 403. *Id. Lud.* b. i. s. 222. *Id. Suck.* 2ter th. s. 178. *Id. Bert.* s. 385. *Id. Mohs,* b. ii. s. 260. *Id. Leonhard,* Tabel. s. 57.—Schuppiger Kupferglanz, *Karsten,* Tabel. s. 62.—Cuivre sulphuré feuilleté, *Haüy.* *Id. Haus.* s. 72.—Blättricher Kupferglanz, *Haus.* Handb. b. i. s. 142.—Blattriges, Kupferglas, *Hoff.* b. iii. s. 109.

External Characters.

Its colour is the same as that of the preceding subspecies.

It occurs massive, disseminated, in granular concretions, and very rarely crystallised, in the same figure as the compact subspecies.

Internally it is shining, which sometimes passes to splendent, sometimes to glistening, and the lustre is metallic.

The cleavage is not very distinct; one cleavage is parallel with the terminal planes, and other three with the truncations on the alternate angles of the prism.

The fragments are indeterminate angular, and blunt-edged.

In the remaining characters, it agrees with the preceding subspecies.

Chemical Characters of the Species.

Before the blowpipe, on charcoal, it melts very easily, and yields a globule of copper, covered with a blackish-coloured scoria. When melted with borax, it communicates to it a green colour; and when digested with ammonia, it tinges it blue.

Constituent

Constituent Parts.

Copper, - -	79.50
Sulphur, - -	19.00
Iron, - -	0.75
Quartz, - -	1.00
	100.25

Ullmann.

Geognostic Situation.

It occurs in veins and beds in primitive rocks; also in beds in bituminous marl-slate, and in flœtz amygdaloid. The accompanying minerals in the primitive and transition rocks, are copper-pyrites, grey copper, blue copper, malachite, copper-green, and red and brown iron ores, with calcareous-spar, and quartz; in the flœtz rocks, it is associated with copper-pyrites, and variegated copper.

Geographic Situation.

Europe.—It occurs in small veins, along with heavy-spar, in transition rocks, at Fassney Burn in East Lothian; also in Ayrshire; and in the Fair Isle, situated between Orkney and Shetland; at Middleton Tyas in Yorkshire; Llandidno in Caernarvonshire; Cook's Kitchen, Carvath, Tincroft, Camborne, Huel-Muttrel, and Bullen Garden, in Cornwall: in the mines of Friedrichsminde and Glittersberg in Norway, along with quartz, malachite, variegated copper, &c.; also in the mines of Kongsberg; at Atwod and Sunnerskog in Sweden; in Hessia, along with grey copper, white copper, malachite, brown iron-ore, tile-ore, variegated copper, copper-pyrites, sparry iron, white cobalt, quartz, and calcareous-spar;

spar; in Thuringia, in bituminous marl-slate, associated with copper-pyrites, and variegated copper; in different mines in the Saxon Erzgebirge, where it is accompanied with various ores of copper, iron, and silver; thus, at Berggieshübel, it occurs along with copper-pyrites, iron-pyrites, compact and ochry red iron-ore, native silver, and lamellar heavy-spar; and at Deutschneudorf, with quartz, lithomarge, ochry red iron-ore, and copper-green; at Graupen in Bohemia, with grey copper and copper-green: in talc-slate in Moravia: in amygdaloid in Deux-Ponts: at Schwaz in the Tyrol, along with fibrous malachite, slaggy ironshot copper-green, and blue copper; in the Leogang, and Limberg in Bavaria: in Silesia; in the Kinzegthal in Suabia, along with copper-green, malachite, and quartz, in veins that traverse gneiss: Catalonia in Spain: in primitive limestone at Saska, in the Bannat of Temeswar; and in Hungary.

Asia.—In great abundance in different mines in the Uralian Mountains.

America.—In small quantities, along with copper-green and quartz, in West Greenland.

Observations.

1. Compact and Foliated Copper-glance are sometimes confounded with *Grey Copper*, but may be readily distinguished from it, by their being sectile, whereas grey copper is brittle. The red colour and red-coloured streak of *Red Copper*, distinguish it at once from copper-glance; and *Silver-glance* or *Sulphureted Silver*, although somewhat resembling the two subspecies of copper-glance in external aspect, yet may be readily distinguished from them by an obvious character, viz. Its cutting readily into

to slices with a knife, whereas these minerals separate into small grains when we attempt to cut them.

2. The tarnished varieties of Compact aud Foliated Copper-glance incline to Variegated Copper.

3. The Frankenberg or Hessian corn-ears mentioned by authors, are sometimes aggregations of small crystals of copper-glance; sometimes, according to M. Monch, true petrifactions of a phalaris, (Phalaris pulposa ?), composed of copper-glance, white copper and grey copper. They are sometimes invested with a thin cover of native silver.

4. It is rather a rare mineral, and the only country in which it has been met with in great quantity, is Siberia.

* Variegated Copper.

Buntkupfererz, *Werner*.

Cuprum lazureum, *Wall.* t. ii. p. 278.—Bunt Kupfererz, *Werner*, Pabst. b. i. s. 73. *Id. Wid.* s. 744.—Cuivre sulphuré violet, *De Born*, t. ii. p. 311.—Purple Copper-ore, *Kirw.* vol. ii. p. 142.—Bunt Kupfererz, *Estner*, b. iii. s. 489. *Id. Emm.* b. ii. s. 228.—La Mine de Cuivre panachée ou violette, *Brock.* t. ii. p. 166.—Cuivre pyriteux hepatique, *Haüy*, t. iii. p. 536. —Buntkupfererz, *Reuss*, b. iii. s. 410. *Id. Lud.* b. i. s. 222. *Id. Suck.* 2ter th. s. 179. *Id. Bert.* s. 385. *Id. Mohs*, b. iii. s. 248. *Id. Leonhard*, Tabel. s. 57.—Le Cuivre pyriteux panaché, *Brong.* t. ii. p. 215.—Bunt Kupfererz, *Karsten*, Tabel. s. 62. *Id. Haus.* s. 74.—Variegated or Iridescent Sulphuret of Copper, *Kid*, vol. ii. p. 108.—Cuivre pyriteux hepatique, *Haüy*, Tabl. p. 86.—Bunt Kupfererz, *Haus.* Handb., b. i. s. 163. *Id. Hoff.* b. iii. s. 110.—Purple Copper, *Aikin*, p. 85.

External Characters.

Its fresh colour is intermediate between copper-red and pinchbeck-brown; it, however, soon acquires a tarnish, which

which is first reddish, then the red passes successively into violet-blue, azure-blue, and sky-blue, and lastly into green; yet several of these colours are to be observed on the same mass, so that it has a variegated aspect, and of these colours the blue is usually the predominant, and the green occurs only in spots.

It occurs massive, disseminated, in plates, in membranes; and crystallised in six-sided prisms.

Internally it is shining or glistening, and the lustre is metallic.

The fracture is small and rather imperfect conchoidal, which sometimes approaches to fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

Neither colour nor lustre are changed in the streak.

It is soft.

It is sectile in a slight degree.

It is easy frangible.

Specific gravity, from the Bannat, 4,956, *Kirwan.* From Lorraine, 4.983, *Kirwan.* 5.051, *Breithaupt.* 5.467, *Wiedenman.* 5.033, *Bournon.*

Chemical Characters.

It is fusible, but not so easily as copper-glance, and with less ebullition, into a globule, which acts powerfully on the magnetic needle.

Constituent Parts.

	From Hitterdahl in Norway.	From Rudelstadt in Silesia.
Copper, -	69.50	58
Sulphur, -	19.00	19
Iron, - -	7.50	18
Oxygen, -	4.00	5
	100.0	100
	Klaproth, Beit. b. ii. s. 283.	Ibid. s. 286.

Geognostic

Geognostic Situation.

It occurs in veins in primitive and transition rocks, particularly in gneiss, mica-slate, talc-slate, and grey-wacke. It is also met with in flœtz rocks, as in beds in bituminous marl-slate. In these repositories, it is associated with grey copper, copper-pyrites, copper-glance or vitreous copper-ore, copper-green, malachite, iron-pyrites, blende, brown iron-ore, quartz, common garnet, heavy-spar, calcareous-spar, tremolite, and actynolite.

Geographic Situation.

Europe.—It is found in Cook's Kitchen and Tincroft mines in Cornwall, along with grey copper, copper-pyrites, &c.; in the mines of Arendal in Norway, where it is associated with copper-glance or vitreous copper, copper-pyrites, and common garnets; in beds in gneiss at Kongsberg, also in Norway, along with native silver; at Lauterberg in the Hartz, in veins that traverse grey-wacke, along with copper-pyrites, and tile-ore; and in the Fluss Mine, in the same country, along with fluor-spar, lamellar heavy-spar, calcareous-spar, and blue copper; in the Saxon Erzgebirge, along with grey-copper, copper-glance, copper-pyrites, and different ores of silver; in bituminous marl-slate in Mansfield and Thuringia; at Kupferberg in Silesia, in a metalliferous bed, along with copper-pyrites, blue copper, malachite, tile-ore, copper-glance or vitreous copper-ore, arsenical-pyrites, iron-pyrites, lamellar heavy-spar, brown-spar, calcareous-spar, and heavy-spar; at Olonez in Russian Finland, with iron-pyrites, copper-pyrites, copper-green, and quartz; at Swappawari in Lapland, in quartz and mica-slate; in Transylvania, along with amethyst; at Dognatska, with common garnet, blende, copper-

copper-pyrites, copper-green, and malachite, in calcareous-spar or quartz; and at Oravicza, along with calcareous-spar and asbestous tremolite.

Asia.—At Schlangenberg, along with quartz, brown-spar, and hornstone; and in the Pochadjaschinche mines, associated with malachite, blue copper, and quartz.

America.—At Coquimbo in Chili, along with copper-green and malachite.

Uses.

Copper is extracted from it, but is not so easily reduced as copper-glance. It yields from 50 to 70 *per cent.* of copper.

Observations.

1. Its external characters and chemical composition, shew that it is intimately connected with copper-glance.

2. It occurs equally abundant with copper-glance, but not in such great quantity as copper-pyrites.

3. This variety differs from copper-glance or vitreous copper-ore, with respect to its component parts, in containing a smaller proportion of copper, and a greater proportion of Iron. The variegated colour is supposed by Klaproth to be owing to the slightly oxidated state of the metal: so in steel, and other metallic substances, the beginning of their oxidation is indicated by a similar diversity of colours. In the last-mentioned substances, indeed, the change of colour is only superficial, for the oxygen of the atmosphere can only act upon the surface of the metal: in the variegated copper-ore, the diversity of colour penetrates the whole mass, in consequence of the general distribution of the oxygen throughout the substance of the ore. As, however, the oxidation is slight, the

the metal is disposed to absorb a farther portion of oxygen; and the uniform brown colour is gradually produced in consequence, as often as a fresh surface is exposed to the action of the air *.

4. It was formerly confounded with Copper-glance, Copper-pyrites, and Red Copper; but Werner ascertained it to be a distinct species, and gave it its present name from its tarnish, which is one of the most striking features in its external aspect.

GENUS II.—SILVER-GLANCE, OR VITREOUS SILVER.

Silber-Glanz, *Mohs*.

This genus contains two species, viz. Hexahedral Silver-Glance, and Rhomboidal Silver-Glance. * White Silver. ** Grey Silver.

1. Hexahedral Silver-Glance.

Hexaedrischer Silber-Glanz, *Mohs*.

This species is subdivided into two subspecies, viz. Compact Hexahedral Silver-Glance, and Earthy Hexahedral Silver-Glance.

* Kid's Min. vol. ii. p. 108, 109.

First Subspecies.

Compact Hexahedral Silver-Glance, or Compact Vitreous Silver.

Dichtes Glanzerz, *Hausmann.*

Minera Argenti vitrea, *Wall.* t. ii. p. 329.—Mine d'Argent vitreuse, *Romé de Lisle,* t. iii. p. 440.—Argent vitreuse, *De Born,* t. ii. p. 424.—Glaserz, *Werner,* Pabst. b. i. s. 33. *Id. Wid.* s. 696.—Sulphurated Silver-ore, *Kirw.* vol. ii. p. 115.—Geschmeidiges Silberglanzerz, *Estner,* b. iii. s. 370.—Glaserz, *Emm.* b. ii. s. 175.—Argent vitreuse, *Lam.* t. i. p. 120. *Id. Broch.* t. ii. p. 134.—Argent sulphuré, *Haüy,* t. iii. p. 398.-402.—Glanzerz, *Reuss,* b. iii. s. 342. *Id. Lud.* b. i. s. 214. *Id. Suck.* 2ter th. s. 142. *Id. Bert.* s. 366. *Id. Mohs,* b. iii. s. 144.—Geschmeidiges Silber-glanzerz, *Hab.* s. 103.—Argent sulphuré, *Lucas,* p. 105.—Glanzerz, *Leonhard,* Tabel. s. 54.—Argent sulphuré, *Brong.* t. ii. p. 251. *Id. Brard,* p. 245.—Glanzerz, *Karsten,* Tabel. s. 60.—Dichtes Glanzerz, *Haus.* s. 71.—Sulphuret of Silver, *Kid,* vol. ii. p. 87.—Argent sulphuré, *Haüy,* Tabl. p. 74.—Dichtes Glanzerz, *Haus.* Handb. b. i. s. 137.—Glaserz, *Hoff.* b. iii. s. 57.—Sulphureted Silver, *Aikin,* p. 77.

External Characters.

The colour is dark blackish lead-grey. On exposure, its surface acquires a pavonine or tempered-steel coloured tarnish.

It generally occurs massive, sometimes disseminated, and in membranes, but seldom in plates; also in several particular external shapes, as dentiform, filiform, capillary, reticulated, irregular dendritic, stalactitic, with globular

bular and pyramidal impressions, corroded and amorphous; also crystallised. Its crystallisations are the following:

1. Cube, which is either perfect or truncated on its edges or angles, or on both at the same time *.
2. Octahedron †. It is either perfect or truncated on its angles or edges. When the edges of the common basis are very deeply truncated, it passes into the rectangular four-sided prism, acuminated on both extremities by four planes, which are set on the lateral planes.
3. Rhomboidal dodecahedron, which is formed from the cube or the octahedron, by the truncation of their edges ‡. Its edges are sometimes truncated.
4. Double eight-sided pyramid, flatly acuminated on both extremities by four planes, which are set on the alternate lateral edges.

The last mentioned crystallisation is rare.

The crystals are seldom middle-sized; usually small and very small; superimposed, or aggregated in rows. The octahedron is generally aggregated in rows, the other crystallisations usually superimposed. The cubes are sometimes hollow.

The surface of the crystals is sometimes smooth, sometimes drusy. The particular external shapes, which frequently terminate in crystals, have a streaked surface.

Externally it is shining and glistening, and when drusy, faintly glimmering.

Internally

* Argent sulphuré cubique; Argent sulphuré cubo-octaedre, Haüy.

† Argent sulphuré octaedre, Haüy.

‡ Argent sulphuré dodecaedre, Haüy.

Internally it alternates from shining to glistening, and the lustre is metallic.

The cleavage is rhomboidal.

The fracture is commonly small-grained uneven; sometimes it inclines to imperfect small and flat conchoidal.

The fragments are indeterminate angular, and blunt-edged.

Its lustre is increased in the streak.

It is harder than gypsum, but not so hard as calcareous-spar.

It is completely malleable.

It is flexible, but not elastic.

It is difficultly frangible.

Specific gravity 5.7,—6.1, *Mohs.*

Chemical Characters.

Before the blowpipe it loses its sulphur, and a bead of pure silver remains. If heated gently in a furnace, the sulphur dissipates, and the silver appears in its metallic state, in dendritic and capillary forms, resembling some varieties of native silver.

Constituent Parts.

	From Himmelsfürst.	From Joachimsthal.		
Silver, -	85	84.81	84	75
Sulphur, -	15	14.19	16	25
	100	99.00	100	100
	Klaproth.	*Klaproth.*	*Sage,*	*Bergman.*

Geognostic Situation.

It is one of the most frequent of the ores of silver, and there are few formations of that metal which do not contain

tain it. It occurs principally in veins that traverse primitive and transition rocks, such as gneiss, mica-slate, clay-slate, and grey-wacke; less frequently in porphyry; and still seldomer in granite. In these veins, it is associated with various ores of silver, copper, and lead, and also of iron, zinc, cobalt, arsenic, and more rarely with native gold. Of the accompanying earthy minerals, the following may be enumerated, viz. quartz, calcareous-spar, brown-spar, heavy-spar, fluor-spar, and hornstone.

Geographic Situation.

Europe.—This ore was formerly met with in the workings for silver at Alva in Stirlingshire; it has also been found massive and in cubes at Herland in Cornwall, and in the same county, at Huel Duchy, with red and native silver; at Huel Basset with galena, and in a copper mine at Dolcoath: at Kongsberg, it occurs in veins, along with native silver, and various ores of that and other metals; in the Hartz, in veins that traverse grey-wacke; in Saxony, in veins in gneiss; in veins in the granite of Altwolfach in Suabia; at Annaberg in Lower Austria, in veins that traverse compact grey-coloured limestone; at Joachimsthal in Bohemia, in mica-slate and clay-slate; in porphyritic-syenite at Schemnitz in Hungary; and in Sardinia, along with corneous silver, and native silver.

Asia.—At Schlangenberg in Siberia.

America.—This ore is very common in the mines of Guanaxuato and Zacatecas, as well as in the *Veta Biscaina* of Real del Monte in Mexico; but in Peru, where it also occurs, it is much less abundant.

Uses.

It is highly valued as an ore of silver.

Observations.

Observations.

1. Compact Silver-Glance is distinguished from native silver, whether fresh or tarnished, by its colour, streak, and inferior specific gravity.

2. This mineral has received the name *Silver-Glance* from its shining appearance: it is also named *Vitreous Silver-ore*, from the German name *Glaserz*, which, however, is but a corruption of glanz-erz.

Second Subspecies.

Earthy Hexahedral Silver-Glance, or Earthy Vitreous Silver.

Silberschwärze, *Werner.*

Silberschwärze, *Wid.* s. 694.—Sooty Silver-ore, *Kirw.* vol. ii. p. 117.—Silberschwärze, *Estner*, b. iii. s. 365. *Id. Emm.* b. ii. s. 173.—L'Argent noir, *Broch.* t. ii. p. 132.—Silberschwärze, *Reuss*, b. iii. s. 338. *Id. Lud.* b. i. s. 213. *Id. Suck.* 2ter th. s. 141. *Id. Bert.* s. 363. *Id. Mohs*, b. iii. s. 141. *Id. Leonhard*, Tabel. s. 54. *Id. Karsten*, Tabel. s. 60.—Erdiges Glanzerz, *Haus.* s. 71.—Erdiges Glanzerz, *Haus.* Handb. b. i. s. 138.—Silberschwärze, *Hoff.* b. iii. s. 55.—Black sulphureted Silver, *Aikin*, p. 77.

External Characters.

Its colour is bluish-black, which sometimes inclines to blackish lead-grey.

It seldom occurs massive, sometimes disseminated, but generally as a coating or crust

It varies from friable to solid.

Internally it is dull, passing into feeble metallic glimmering.

When friable, it occurs in feeble glimmering dusty particles, but when solid, its fracture is fine earthy, inclining to uneven.

The fragments are blunt-edged.

It is feebly translucent.

It is very soft, sometimes passing into friable.

It affords a metallic shining streak.

It soils a little.

It is easily frangible.

It is sectile.

Chemical Characters.

It is easily fusible; is converted into a slaggy mass, containing globules of impure silver.

Constituent Parts.

It appears to be a Sulphuret of Silver.

Geognostic Situation.

It occurs in veins in primitive mountains, in which it is generally associated with compact silver-glance, corneous silver, brittle silver-glance, native silver, native gold, ochry brown iron-ore, quartz, and straight lamellar heavy-spar.

Geographic Situation.

Europe.—It occurs principally in the Saxon Erzgebirge, in veins, along with other ores of silver; at Kremnitz, along with native gold, silver-glance, and amethyst; near Schemnitz, in ironshot quartz, with white lead-spar, and malachite; in Chalanches, near Allemont in Dauphiny, with native silver, earthy black cobalt, red cobalt, ochre

ochre of nickel, and calcareous-spar; and in the mines of Kongsberg.

Asia.—At Schlangenberg in Siberia, along with iron-pyrites, blende, auriferous native silver, and hornstone.

2. Rhomboidal Silver-Glance, or Brittle Silver-Glance.

Sprödglaserz, *Werner.*

Argent fragile, *De Born,* t. ii. p. 429.—Sprödglaserz, *Wid.* s. 669. *Id. Werner,* Pabst. b. i. s. 41.—Sprödes Silber-glanzerz, *Estner,* b. iii. s. 398.—Sprödglaserz, *Emm.* b. ii. s. 180.—L'Argent vitreux aigre, *Broch.* t. ii. p. 138.—Argent noire, *Haüy,* t. iii. p. 416.—Sprödglanzerz, *Reuss,* b. iii. s. 351. *Id. Lud.* b. i. s. 215. *Id. Suck.* 2ter th. s. 148. *Id. Bert.* s. 370. *Id. Mohs,* b. iii. s. 160. *Id. Leonhard,* Tabel. s. 54.—Argent rouge aigre, *Brong.* t. ii. p. 254.—Sprödglanzerz, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 71.—Argent antimonié sulphuré noir, *Haüy,* Tabl. p. 76.—Brittle sulphureted Silver, *Aikin,* p. 78.

External Characters.

Its colour is intermediate between iron-black and blackish lead-grey, and has sometimes a tempered-steel tarnish.

It seldom occurs massive, more frequently disseminated, and very often crystallised.

Its primitive form is a rhomboid, whose magnitude is unknown; the following are its secondary figures:

1. Equiangular six-sided prism, with straight or convex terminal faces.
2. The preceding figure, rather acutely acuminated by six planes, which are set on the lateral planes, and

and the extremities of the acuminations sometimes very deeply truncated.

3. Equiangular six-sided table. In this figure the lateral edges are sometimes truncated.

4. Double six-sided pyramid.

The tabular crystals often intersect one another, and thus form the cellular external shape; sometimes they are superimposed. The crystals are seldom middle-sized, usually small, and very small, and even microscopic.

The lateral planes, particularly of the prism, are longitudinally streaked; in the other figures the planes are sometimes smooth, sometimes drusy.

Externally it is highly splendent.

Internally it is shining, inclining to glistening, and the lustre is metallic.

The cleavage not discernible.

The fracture alternates from small conchoidal to fine-grained uneven.

The fragments are indeterminate angular, and rather blunt-edged.

The lustre is not increased in the streak.

It is soft.

It is sectile.

It is easily frangible.

Specific gravity 5.7,—6.1, *Mohs.*

Chemical Characters.

Heated on charcoal before the blowpipe, it melts with difficulty, and the sulphur, arsenic and antimony, are in part volatilised. A globule of imperfectly malleable silver, accompanied with a brown scoria, remains behind.

Constituent

Constituent Parts.

According to Klaproth, the brittle silver-glance from the mine Hoffnung Gottes in Gross-Voightsberg near Freyberg, affords

Silver, -	66.50
Sulphur, -	12.00
Antimony, -	10.00
Iron, - -	5.00
Copper and Arsenic,	0.50
Earthy substances, -	1.00
	95.00

Klaproth, Beit. b. i. s. 166.

Geognostic Situation.

It occurs in veins that traverse gneiss, clay-slate, and porphyry, and in these it is accompanied with other ores of silver; also ores of lead, zinc, copper, cobalt, iron, and more rarely gold, and also with quartz, calcareous-spar, and brown-spar.

Geographic Situation.

Europe.—This mineral occurs in the district of Freyberg in Saxony, in veins, along with native silver, hexahedral silver-glance, dark red silver, white silver, galena or lead-glance, black blende, &c. with brown-spar, calcareous-spar, and quartz, seldomer with heavy-spar and fluor-spar: in the Upper Erzgebirge, both on the Saxon and Bohemian sides, it is associated with light red silver, white cobalt, native arsenic, hexahedral silver-glance; also native silver, iron-pyrites, copper-pyrites, brown-spar, and calcareous-spar, and these veins occur in gneiss and clay-slate. In

In Hungary, it occurs at Chemnitz and Kremnitz; at Chemnitz, it is associated with hexahedral silver-glance, rhomboidal copper-glance, galena or lead-glance, iron-pyrites, brown and black blende, dark red silver, and very rarely light red cinnabar, and native gold, calcareous-spar, brown-spar, and calcedony; in the mines at Kremnitz, it is usually accompanied with quartz, brown-spar, amethyst, iron and copper pyrites, dark red silver, and seldomer with native gold: at Joachimsthal in Bohemia, the ores and earthy minerals with which it is accompanied are dark red silver, hepatic pyrites, calcareous-spar, and brown-spar.

Asia.—In Siberia it is accompanied with granular heavy-spar, copper-pyrites, blue copper, and brown blende.

America.—In the mine of Ecateras in Mexico; and also in the silver mines of Peru.

Observations.

1. It is characterised by colour, form, fracture, sectility, easy frangibility, and specific gravity. It is distinguished from *Hexahedral Silver-glance* by its higher lustre, crystallizations, fracture, and want of malleability; from *Iron-glance* by its inferior hardness, and its retaining its colour in the streak.

2. It has been described under the names *Röscherz*, *Roschgewächs*, *Roschgewir*, and some of the varieties of Schwarzgiltigerz belong to it.

* White

* White Silver.

Weiss-Giltigerz, *Werner*.

Id. Werner, Pabst. b. i. s. 58. *Id. Wid.* s. 711.—Light Grey Silver-ore, *Kirw.* vol. ii. p. 119.—Weiss-Giltigerz, *Estner.* b. iii. s. 443. *Id. Emm.* b. ii. s. 195.—La Mine blanche riche, *Broch.* t. ii. p. 150.—Weiss-Gultigerz, *Reuss,* b. iv. s. 193. *Id. Lud.* b. i. s. 217. *Id. Mohs,* b. iii. s. 193. *Id. Leonhard,* Tabel. s. 55.—Argent blanc, *Brong.* t. ii. p. 255.—Weiss-Gultigerz, *Karsten,* Tabel. s. 68. *Id. Haus.* s. 74.—Plomb sulphuré antimonifere et argentifere, *Haüy,* Tabl. p. 89.—Weissgiltigerz, *Hoff.* b. iii. s. 78. *Id. Haus.* Handb. b. i. s. 177.—White Silver, *Aikin,* p. 78.

External Characters.

Its colour is very light lead-grey; but when it approaches to brittle silver-glance, it inclines somewhat to black.

It occurs massive and disseminated, and always associated with lead-glance.

Internally it alternates from glimmering to glistening, and the lustre is metallic. The varieties that verge on silver-glance have the greatest lustre; those that pass into plumose antimony the least.

The fracture is even, and fine-grained uneven. When fine-grained uneven, it is passing into brittle silver-glance; when intermixed with delicate fibres, it is passing to indurated plumose antimony: Therefore the characteristic fracture of the true white silver is even.

The fragments are indeterminate angular and blunt-edged.

Its lustre is rather increased in the streak, and the colour is not changed.

It

It is soft, approaching to very soft.

It is sectile.

It is easily frangible.

Specific gravity, 5.322, *Gellert*; 5.622, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it melts, and partly evaporates, leaving a bead of impure silver, surrounded by a yellow powder.

Constituent Parts.

	Dark White Silver from Himmelsfürst near Freyberg.	Light White Silver from Himmelsfürst.
Lead, -	41.00	48.06
Silver, -	9.25	20.40
Antimony, -	21.50	7.88
Iron, -	1.75	2.25
Sulphur, -	22.0	12.25
Alumina, -	1.00	7.00
Silica, -	0.75	0.25
	97.25	99.09
	Klaproth, Beit. b. i. s. 175.	Ibid. s. 172.

Geognostic and Geographic Situations.

It occurs in veins that traverse gneiss, along with galena or lead-glance, dark red silver, brittle silver-glance, plumose antimony, arsenical and iron pyrites, black blende, brown-spar, calcareous-spar, and quartz.

It is found in considerable quantity in the mines of Himmelsfürst and Beschert Glück, near Freyberg, but rarely in other countries.

It is said to have been found in small quantity in the Hartz, and also in Bohemia.

Observations.

Observations.

1. This ore is more nearly allied to galena than to silver-glance, and it is probable that it will be removed from its present place, as soon as all its characters shall have been fully ascertained.

2. It is characterised by its colour, fracture, sectility, and weight; it is distinguished from *Brittle Silver-glance*, by its colour, want of crystallization, inferior lustre, and inferior specific gravity; from *Hexahedral Silver-glance*, by colour and want of sectility.

3. It is nearly allied to grey antimony and compact lead-glance, and also to brittle silver-glance.

** Grey Silver, or Carbonate of Silver.

Grausilber, *Hausmann:*

Luftsaures Silber, *Wid.* Min. s. 689.—L'Argent carbonaté, *Broch.* t. ii. p. 155.—Kohlensaures Silber, *Reuss,* Min. b. ii. 3. s. 376.—Argent carbonaté, *Lucas,* t. ii. p. 293.—Kohlensaures Silber, *Leonhard,* Tabel. s. 55.—Argent carbonaté, *Haüy,* Tabl. p. 76.—Grausilber, *Haus.* Handb. b. iii. s. 1008.—Carbonated Silver, *Aikin,* p. 80.

External Characters.

Its colour is ash-grey, which passes into greyish-black, and iron-black.

It occurs massive and disseminated.

Its lustre is glistening.

The fracture is uneven, inclining to earthy.

It is soft.

It

It becomes more shining in the streak.

It is brittle, passing into sectile.

It is heavy.

Chemical Characters.

It is easily reduced before the blowpipe. It effervesces with nitrous acid.

Constituent Parts.

Silver, -	72.5	
Carbonic Acid, -	12.0	
Oxide of Antimony, and a trace of Copper,	15.5	
	100.0	*Selb.*

Geognostic and Geographic Situations.

It occurs in veins that traverse granite, in the mine of Wenzeslaus, at Altwolfach in the Black Forest. In these veins, it is associated with native silver, silver-glance, and heavy-spar.

Observations.

The characters of this mineral are still but imperfectly known, so that it is of no great importance where it is placed. Its present situation is therefore to be considered as temporary.

GENUS III.

GENUS III.—GALENA OR LEAD-GLANCE.

This genus contains but one species, viz. Hexahedral Galena.

1. Hexahedral Galena, or Lead-Glance.

Hexaedrischer Bleiglanz, *Mohs*.

This species is divided into three subspecies, viz. Common Galena, Compact Galena, and Friable Galena. * Blue Lead. ** Cobaltic Galena.

First Subspecies.

Common Galena or Lead-Glance.

Gemeiner Bleiglanz, *Werner*.

Id. Werner, Pabst. b. i. s. 97. *Id. Wid.* s. 841.—Common Galena, *Kirw.* vol. ii. p. 216.—Gemeiner Bleiglanz, *Emm.* b. ii. s. 369.—Plomb sulphuré, Galene, *Lam.* t. i. p. 289.–292.—Plomb sulphuré, *Haüy*, t. iii. p. 456.—La Galene commune, *Broch.* t. ii. p. 295.—Gemeiner Bleiglanz, *Reuss*, b. iv. s. 174. *Id. Lud.* b. i. s. 258. *Id. Suck.* 2ter th. s. 306. *Id. Bert.* s. 445. *Id. Mohs*, b. iii. s. 469.—Blættriges Bleiglanz, *Hab.* s. 126.—Plomb sulphuré, *Lucas*, p. 114.—Gemciner Bleiglanz, *Leonhard*, Tabel. s. 70.—Plomb sulphuré laminaire, *Brong.* t. ii. p. 195. *Id. Brard*, p. 265.—Bleiglanz, *Karsten*, Tabel. s. 68. *Id. Haus.* s. 74.—Sulphuret of Lead, *Kid*, vol. ii. p. 130.—Plomb sulphuré forme determ., &c. *Haüy*, Tabl. p. 79.—Gemeiner Bleiglanz, *Hoff.* b. iv. s. 4.—Galena, *Aikin*, p. 107.

External

The crystals are usually middle-sized, small, and very small; seldom large. They are generally superimposed, or in druses, but seldom imbedded.

The planes of the crystals are smooth, drusy, or rough.

Externally it alternates from specular splendent to glimmering, according as the surface is smooth, drusy or rough.

Internally it alternates from specular splendent to glistening, and the lustre is metallic.

The cleavage is rectangular, threefold, and parallel with the sides of the cube,—or we say it is hexahedral. The folia of the cleavage are more or less perfect, generally straight, sometimes floriform, and scaly.

The fragments are cubical.

The streak is shining.

It is harder than gypsum, but not so hard as calcareous-spar.

It is perfectly sectile.

It is uncommonly easily frangible.

Specific gravity, 7.0,—7.6, *Mohs;* 7.220, *Muschenbröck;* 7.290, *Gellert.* The crystallized, 7.5873, *Brisson;* 7.786, *Watson.* From the Hartz, 7.447, *Kirwan.* From Kampfstein, 7.100, *Vanquelin.* From Eckelsberg, from 7.300 to 7.600, *Vauquelin.*

Chemical Characters.

Before the blowpipe it flies into pieces, then melts, emitting a sulphureous odour, and a globule of metallic lead remains. When it is alternately heated and cooled, it at length disappears entirely; and if it be argentiferous, a minute globule of silver remains behind.

 Constituent

Constituent Parts.

According to Vauquelin, galena or lead-glance contains the following ingredients:

	From Kirschwald in Deux Ponts.	Kampf-stein.	Eckles-berg.	Kanten-bach.
Lead, - -	54	69	68.69	64
Sulphur, -	8	16	16.18	18
Calcareous-earth and silica,	38	15	16.13	18

All those specimens appear impure, so that the analyses are not of so much value as those that follow:

	Klausthal.			Durham.
Lead,	83.0	77	Lead,	85.13
Sulphur,	16.41	20	Sulphur,	13.02
Silver,	0.08	1	Iron,	0.50
Westrumb.	99.49	*Kirwan.* 98	*Thomson.*	98.65

Probably every variety of galena contains silver. The quantity varies from a very small portion to 4½ ounces in the hundred weight. Those varieties that afford less than one ounce of silver in the hundred weight, are considered as poor in silver, while those which afford from 2 ounces to 4½ ounces, are considered as rich. It is said that 11½ ounces of silver to the ton, is the general average of the lead in the North of England. That of Huel Pol in Cornwall yielded 60 ounces: that of Guarneck, near Truro, 70 ounces, and one ton of the ore of the South Hoo mine, near Beeralstone in Devonshire, yielded 135 ounces of silver. Some varieties of galena yield gold, as that of Kremnitz in Hungary, and others a small proportion of antimony, as that of Dufton, in the North of England.

The whole of the lead-mines in Great Britain produce annually from 45,000 to 48,000 tons of lead, which is principally obtained from galena.

Geognostic Situation.

It occurs in veins, beds, and imbedded masses, and is not confined to any particular class of rocks, for it occurs in primitive, transition, and secondary mountains. In primitive rocks it is met with in beds, subordinate to gneiss, mica-slate and clay-slate, and associated with blende and iron-pyrites; and in veins in primitive limestone. It occurs in beds in grey-wacke, and in veins traversing that rock and clay-slate. It forms beds along with calamine in the older flœtz or secondary limestones; occurs in veins and imbedded portions, and disseminated in shell limestone and conglomerate; and in veins, and disseminated in limestone and sandstone, belonging to the coal formation.

Geographic Situation.

Europe.—At Leadhills, in Lanarkshire, it occurs in veins that traverse transition rocks along with white lead-spar, green lead-spar, earthy lead-spar, sulphate of lead, calamine, ochry brown iron-ore, brown hematite, iron-pyrites, sparry iron, blue copper, manganese-ore, brown spar, calcareous-spar, heavy-spar, and mountain-cork. The same formation extends into the upper part of Dumfries-shire, where it forms the mines of Wanlockhead. It occurs along with fluor-spar, in veins that traverse granite at Monaltrie, in Aberdeenshire; in the old lead-mines of Clifton at Tyndrum, already described; in veins that traverse

traverse gneiss, along with heavy-spar and calcareous-spar, at Strontian in Argyleshire; in veins that traverse sandstone, along with heavy-spar and calcareous-spar, at Cumberhead in Lanarkshire; in small veins or disseminated in the grey sandstone of the coal formation in the Lothians and Fifeshire; in veins traversing limestone, in the island of Isla; veins traversing gneiss, in the isle of Coll; and in conglomerate rocks near Stromness in Orkney. It forms large veins in limestone, in Northumberland, Durham, Derbyshire, Flintshire, Somersetshire, and in slate in Shropshire, and most of the counties of Wales *. In the mines of Derbyshire, the galena or lead-glance is associated with white lead-spar, or green lead-spar, heavy-spar, calcareous-spar, and fluor-spar, and some ores of zinc and iron. Fluor-spar is one of the most common vein-stones in that country; and there are some places in which the veins are entirely filled up with fluor-spar. It is also met with in clay-slate, in Devonshire and Cornwall. It occurs in veins in primitive limestone at Sala, and in beds, along with copper-pyrites, iron-pyrites, and blende, also at Fahlun, in Sweden. In veins that traverse transition rocks, or in beds subordinate to these, in the Hartz, and in veins in gneiss, in the Saxon Erzgebirge. Disseminated, and in nests, in shell limestone, as at Kulf, near Brugen, in the *ci-devant* kingdom of Westphalia, and in the vicinity of Göttingen. At Mus in Bohemia, in veins that traverse clay-slate, associated with white, black, and green lead-spar, blende. copper-pyrites, malachite, iron-pyrites, quartz, and heavy-spar. At Prizbram, also in Bohemia, where it occurs in veins that traverse clay-slate, it is accompanied with black

* Aikin's Manual, 2d edit. p. 108.

and green lead-spar, blende, white silver, native silver, sparry iron, grey and white antimony, iron-pyrites, heavy-spar, calcareous-spar and quartz. At Bleyberg, in Carinthia, it is accompanied with white, yellow, and black lead-spars, calamine, yellow and brown blende, and mountain-cork. At Offenbanya in Transylvania, it is associated with grey copper, grey antimony, iron-pyrites, and brown blende, in a bed of granular limestone; at Nagyag, with red antimony, and amethyst, in clay-porphyry. At Querbach in Silesia it is accompanied with black blende, cobalt-glance, magnetic iron-ore, iron-pyrites, copper-pyrites, arsenical pyrites, garnet, and calcareous-spar; and at Altenberg in the same country, along with iron-pyrites, copper-pyrites, arsenical-pyrites, copper-glance or vitreous copper-ore, calcareous-spar and quartz. Besides the countries above enumerated, the following may be added, as affording galena or lead-glance: Swabia, Bavaria, the Tyrol, Salzburg, Upper Austria, the Bannat, France, (in which the most considerable mines are those of Pompean, Poullaouen, and Huelgoët), Italy and Spain.

Asia.—This ore does not occur so abundantly in Asia as in Europe; it is met with at Irkutzk, Kolywan, and in the Uralian districts. Lead-ore, (I presume galena or lead-glance), is found at Dessouly in Higher Hindostan, about fifty coss east of Sirinagur; and we are informed by Captain Turner, that at a place situated nearly two days journey from Tessoolumboo in Thibet, there is a mine of this mineral. In Lower India, it has been met with in small quantities at Jangumrauzpillay, in the Cumtum district. The greater part, however, of the lead met with in the Peninsula of India comes from Siam *, and

* Milburne's Guide to the Indian Trade, p. 309.

Araccan, and occasionally from the Burmah dominions *; it is also found at Omon in Arabia †.

America.—It occurs in Upper Louisiana, Virginia, Maryland, Pennsylvania, New-York, Connecticut, Vermont, Massachusets, and Maine ‡. It is met with as far north as Greenland, where it is associated with cryolite, brown-spar, sparry iron, and iron-pyrites.

It abounds in a flœtz limestone in the north-eastern parts of New Spain, particularly in the district of Zimapan; in the kingdom of New Leon; and in the province of New Santander. In these districts the galena contains a small portion of silver, and is generally worked more for its silver than its lead. Mines of this ore also occur in Chili in South America.

Uses.

Nearly all the lead of commerce is obtained from galena. In order to obtain the lead the ore is first roasted, in order to drive off the sulphur, and then mixed with the necessary quantity of coke, charcoal, or peat, and reduced in a common furnace. The lead which remains after the operation of roasting, is in an oxydated state; the inflammable matter, with which it is mixed in the furnace, decomposes the metallic oxide; and combining with its oxygen, flies off in the form of carbonic acid gas, while the lead is reduced to the metallic state, and sinks to the bottom of the furnace. Almost all the varieties of galena or lead-glance, contain a greater or less portion of silver. The

* Oriental Repertory, vol. i, p. 117.

† Ainslie's Materia Medica of Hindostan, p. 56.

‡ Cleaveland's Mineralogy, p. 513, 514.

The silver, after the reduction of the lead, may be separated by the process of cupellation; but in the greater number of instances, the quantity of silver is so inconsiderable, as not to repay the expence of labour; and hence the lead of commerce almost always contains a minute portion of silver. Galena is also used for glazing pottery.

Observations.

1. Some dark-coloured varieties of galena might, with a superficial observer, be confounded with *blende*, or sulphuret of zinc; but the lustre of the zinc-ore is destroyed by scratching the surface with a knife, which is not the case with the galena or lead-glance. If both are breathed upon, the galena recovers its lustre in a moment; the blende very slowly. Galena is distinguished from *graphite* by its colour, greater specific gravity, and by the comparatively faint trace it leaves on paper. The same marks will serve to distinguish it from *molybdena*, which possesses, besides a foliated fracture, a considerable degree of flexibility.

2. Galena, which occurs in beds, is said to contain less silver than that found in veins.

3. The galena in veins appears frequently to have experienced considerable alterations since its formation,—the fused-like and corroded form may be considered as changed galena, and the numerous empty spaces in lead veins are owing to the gradual abstraction of galena, which may have furnished materials for the formation of various lead-spars. In my Elements of Geology, it is intended to give an account of the various changes that are taking place in metalliferous and other minerals in the bowels of the earth.

Second

Second Subspecies.

Compact Galena, or Lead-Glance.

Bleischweif, *Werner.*

?Plumbum Plumbago, *Wall.* t. ii. p. 305.—Bleischweif, *Werner,* Pabst. b. i. s. 114. *Id. Wid.* s. 845.—Galene compacte, *De Born,* t. ii. p. 355.—Compact Galena, *Kirw.* vol. ii. p. 218.—Bleischweif, *Emm.* b. ii. s. 377.—Plomb sulphuré compacte, *Haüy,* t. iii. p. 461.—La Galene compacte, *Broch.* t. ii. p. 301.—Bleischweif, *Reuss,* b. iv. s. 188. *Id. Lud.* b. i. s. 259.—Dichter Bleiglanz, *Suck.* 2ter th. s. 312.—Bleischweif, *Bert.* s. 447. *Id. Mohs,* b. iii. s. 486. *Id. Hab.* s. 127.—Dichtes Bleiglanz, *Leonhard,* Tabel. s. 71.—Plomb sulphuré compacte, *Brong.* t. ii. p. 195.—Bleischweif, *Karsten,* Tabel. s. 68. *Id. Haus.* s. 74.—Plomb sulphuré compacte, *Haüy,* Tabl. p. 80.—Bleischweif, *Haus.* Handb. b. i. s. 178. *Id. Hoff.* b. iv. s. 11.—Compact Galena, *Aikin,* p. 108.

External Characters.

Its colour is fresh lead-grey, which is in general darker than in common galena.

It occurs massive, disseminated, and specular; and rarely in the curved lamellar concretions.

The specular variety is smooth, splendent, shining, or glimmering and streaked.

Internally it is strongly glimmering, and the lustre is metallic.

The fracture is even, which in some varieties passes into flat conchoidal.

The fragments are indeterminate angular, and not particularly sharp edged.

It acquires a stronger lustre in the streak.

It

It agrees with the preceding subspecies in its other characters.

Constituent Parts.

It is a compound of Sulphuret of Lead and Sulphuret of Antimony, and a small portion of Silver.

Geognostic Situation.

It occurs in veins, and is usually accompanied with common galena or lead-glance. It is worthy of remark, that when the two subspecies occur together, the compact always forms the sides of the vein, and this probably owing to its having been in a less perfect state of solution. It is also accompanied with black blende, common iron-pyrites, copper-pyrites, quartz, and heavy-spar.

Geographic Situation.

Europe.—It is found at Leadhills in Lanarkshire; in Derbyshire; Sahlberg in Westermannland; in the Hartz; Freyberg and Gersfdorf in Saxony; Rauschenberg in Upper Bavaria; Weiding in the Upper Palatinate; Leogang in Salzburg; Servoz, in the valley of Chamouni in Switzerland.

Asia.—Siberia.

Observations.

1. It seldom occurs pure, being generally intermixed with common galena or lead-glance. A mixture of this kind is described under the name *Galena striata*, by some of the older mineralogists; *Plumbum stibiatum*, Lin.; *Galena plumbi antimonialis*, Waller. Syst. Min. t. ii. p. 305.; *Plomb sulphuré strié*, Haüy; *Stripmalm* of the Swedes.

2. The

2. The specular variety is known in Derbyshire under the name *Slikensides*, a term somewhat expressive of its smooth form. It occurs lining the walls of very narrow rents. It has a most remarkable property, that when the rock in which it is contained is struck with a hammer, a crackling noise is heard, which is generally followed by an explosion of the rock, in the direction and neighbourhood of the vein. The cause of this singular effect has not been satisfactorily explanied.

Third Subspecies.

Friable Galena or Lead-Glance.

Mulmiger Bleiglanz, *Werner*.

External Characters.

Its colour is dark fresh lead-grey.

It occurs massive and in thick flakes. It is composed of metallic glimmering scaly parts, which are more or less coherent, and which do not soil.

It passes from friable into very soft.

It is sectile.

Geognostic and Geographic Situations.

It has been hitherto found only in the lead and silver-mines around Freyberg in Saxony.

Observations.

1. It appears to be formed by the decomposition of common lead-glance, and bears the same relation to common lead-glance that copper-black does to copper-glance, and silver-black to silver-glance.

2. Weiss

2. Weiss describes a mineral under the name Quartzy Compact Galena, (Quarziger Bleischweif,) which appears to be a mere mixture of quartz, galena, and iron and copper pyrites.—Vid. Berlin, Naturforschender Freünde, ii. s. 79.

3. A friable variety of lead-glance, found in the Dufton lead-mines, which probably belongs to this subspecies, is so highly inflammable as to take fire and burn, on being held in the flame of a candle.

* Blue-Lead.

Blau Bleierz, *Werner*.

Plumbi nigri crystallis regularibus, *Waller*. t. ii. p. 309.?—Blau Bleierz, *Werner*, Pabst. b. i. s. 115. *Id. Wid.* s. 847.—Blue Lead-ore, *Kirw.* vol. ii. p. 220.—Blau Bleierde, *Emm.* b. ii. s. 380.—Plomb noire, *Haüy*, t. iii. p. 497.—La Mine de Plomb bleue, *Broch.* t. ii. p. 303.—Blaubleierz, *Reuss*, b. i. s. 209. *Id. Lud.* b. i. s. 260. *Id. Suck.* 2ter th. s. 322. *Id. Bert.* s. 453. *Id. Mohs*, b. iii. s. 487. *Id. Leonhard*, Tabel. s. 71.—Plomb noir, *Brong.* t. ii. p. 199.—Blaubleierz, *Karsten*, Tabel. s. 68.—Plomb sulphuré epigene prismatique, *Haüy*, Tabl. p. 83.—Blaubleierz, *Haus.* Handb. b. iii. s. 1092. *Id. Hoff.* b. iv. s. 13.—Blue Lead, *Aikin*, p. 109.

External Characters.

Its colour is intermediate between very dark indigo-blue and dark lead-grey, and which externally sometimes inclines to black.

It occurs massive, and crystallized in regular six-sided prisms, which are usually small, low, sometimes bulging, and with a rough and dull surface.

Internally

Internally it is feebly glimmering, and the lustre is metallic.

The fracture is even; sometimes it approaches to small and flat conchoidal.

The fragments are indeterminate angular.

It is opaque.

The streak is shining and metallic.

It is soft, inclining to very soft.

It is sectile.

It is easily frangible.

Specific gravity 5.461, *Gellert*.

Chemical Characters.

It melts easily before the blowpipe, emitting a pungent sulphureous vapour, and is reduced to the metallic state.

Constituent Parts.

It is conjectured to be sulphuret of lead intermixed with phosphat of lead.

Geognostic and Geographic Situations.

It occurs in veins, accompanied with black lead-spar, brown lead-spar, white lead-spar, malachite, radiated blue copper, quartz, fluor-spar, and heavy-spar.

It is a rare fossil, having hitherto been found only at Zschoppau in Saxony, and Huelgöet in France.

Observations.

It is distinguished from *Galena* or *Lead-glance* by its colour, form, its crystals appearing to belong to the rhomboidal series, inferior lustre, and lower specific gravity.

** Cobaltic

** Cobaltic Galena or Lead-glance.

Kobaltbleierz, *Hausmann.*

Kobaltbleierz, *Haus.* s. 75. *Id. Haus.* Handb. b. i. s. 138.—Kobalt-Bleiglanz, Nordeutch. Beitr. z. Berg und Hüttenk. iii. s. 120.

External Characters.

Its colour is fresh lead-grey.

It occurs fine and minutely disseminated, and in extremely minute crystals, which are aggregated in a moss-like form.

Its lustre is shining and metallic.

It is small and fine scaly foliated.

It occurs in fine granular distinct concretions.

It is opaque.

It is soft.

It is sectile.

It soils feebly.

Chemical Character.

Before the blowpipe it splits into small pieces; and communicates a smalt-blue colour to glass of borax.

Geognostic and Geographic Situations.

It occurs in small quantity in a vein in transition rocks, in the mine of Lorenz near Clausthal in the Hartz.

Observations.

This ore was first discovered by M. Bauersach of Zellerfeld. An ore of this kind is mentioned by Proust as occurring in Catalonia *.

Genus IV.

* Proust, Journ. de Phys. lxiii. Nov. 1806.

GENUS IV.—BLACK TELLURIUM.

Blätter-glanz, *Mohs.*

This genus contains but one species, viz. Prismatic Black Tellurium.

1. Prismatic Black Tellurium.

Prismatischer Blätter-glanz, *Mohs.*

Nagyagerz, *Werner.*

Id. Wid. s. 671.—Or gris lamelleux, *De Born,* t. ii. p. 463.—Blättererz, *Karst.* Tabel. 56.—Nagyagerz, *Emm.* b. ii. s. 121.—Mine d'Or de Nagyag, *Lam.* t. i. p. 110.—Tellure natif aurifere et plombifere, *Haüy,* t. iv. p. 327.—La Mine de Nagyag, ou le Silvane lamelleux, *Broch.* t. ii. p. 486.—Blättererz, *Reuss,* b. iv. s. 615.—Nagyagerz, *Lud.* b. i. s. 311.—Blätter Tellurerz, *Suck.* 2ter th. s. 497.—Blättererz, *Bert.* s. 522. *Id. Mohs,* b. iii. s. 70. *Id. Leonhard,* Tabel. s. 80.—Tellur natif plombifere, var. feuilleté, *Brong.* t. ii. p. 124.—Blättererz, *Karsten,* Tabel. s. 70.—Blätter Tellur, *Haus.* s. 71.—Tellur natif auro-plombifere, laminaire et lamelliforme, *Haüy,* Tabl. p. 119.—Blätter Tellur, *Haus.* Handb. b. i. s. 132.—Nagyager-erz, *Hoff.* b. iv. s. 134.—Black Tellurium, *Aikin,* p. 141.

External Characters.

Its colour is intermediate between blackish lead-grey, and iron-black.

It

It occurs massive, disseminated, in leaves, and crystallised.

Its primitive figure is an oblique four-sided prism, the dimensions of which are unknown. The following are the secondary figures which have been observed:

1. Oblique four-sided table.
2. Six-sided table.
3. Eight-sided table.
4. Acute double four-sided pyramid, truncated on the summits.

Externally it is splendent, and the lustre is metallic.

Internally it is shining.

The cleavage is either prismatoidal or axifrangible, and the folia are often curved.

The fragments are tabular.

It is harder than talc, but not so hard as gypsum.

It is sectile; it is the most sectile of the ores of tellurium.

It soils slightly.

The thin leaves and tables are flexible.

Specific gravity 7.0,—7.2, *Mohs*.

Chemical Characters.

It melts very easily before the blowpipe; the sulphur and tellurium are soon volatilised, and a blackish-brown coloured globule remains, which, on being melted with borax, affords an argentiferous gold globule; the slag which remains, tinges borax violet-blue. It dissolves with effervescence in acids; the nitrico-muriatic acid extracts the gold from it.

Constituent Parts.

Tellurium,	-	32.2
Lead,	-	54.0
Gold,	-	9.0
Sulphur,	-	3.0
Copper,	-	1.3
Silver,	- -	0.5
		100

Klaproth, Beit. b. iii. s. 32.

Geognostic and Geographic Situations.

It is generally associated with yellow tellurium, in veins that traverse porphyry, and has been hitherto found only at Nagyag in Transylvania.

Use.

It is worked for the gold it contains.

Observations.

Its principal characters are colour, lustre, fracture, crystallization, soiling, flexibility, and specific gravity. It is distinguished from *Galena* by its colour, cleavage and flexibility; from *Brittle Silver-glance* and *Copper-glance* by cleavage and flexibility; from *Iron-glance* by softness, sectility, and weight; and from *Graphite* by its slight soiling, and inferior specific gravity.

2. Dr Clarke the celebrated traveller gives a description of the tellurium mines in the fourth volume of his Travels.

3. This mineral was formerly described under the names Graugold (*Or gris*).

GENUS V.

Genus V. MOLYBDENA.

Molydän Glanz, *Mohs*.

This genus contains but one species, viz. Rhomboidal Molybdena.

1. Rhomboidal Molybdena.

Rhomboedrischer Molybdän, *Mohs*.

Wasserblei, *Werner*.

Ferrum Molybdæna pura membranacea nitens, (in part), *Wall.* t. ii. p. 249.—Wasserblei Molybdæna, *Scheele*, i. d. Abhand. d. Schwed. Acad. 1778, s. 238.—Wasserblei, *Werner*, Pabst. b. i. s. 221. *Id. Wid.* s. 962.—Molybdena, *Kirw.* vol. ii. p. 322.—Sulphure de Molybdene, *De Born*, t. ii. p. 119.—Wasserbley, *Emm.* b. ii. s. 541.—Molybene sulphuré, *Lam.* t. i. p. 397. *Id. Haüy*, t. iv. p. 289.—Le Molybdene sulphuré, *Broch.* t. ii. p. 482.—Wasserblei, *Reuss*, b. iv. s. 478. *Id. Lud.* b. i. s. 295.—Molybdänkies, *Suck.* 2ter th. s. 437.—Wasserblei, *Bert.* s. 499. *Id. Mohs*, b. iii. s. 588.—Molybdene sulphuré, *Lucas*, p. 179.—Wasserblei, *Leonhard*, Tabel. s. 80.—Molybdene sulphuré, *Brong.* t. ii. p. 92. *Id. Brard*, p. 381.—Molybdän, *Karsten*, Tabel. s. 70.—Molybdänkies, *Haus.* s. 76.—Molybdena, *Kid*, vol. ii. p. 216.—Molybdene sulphuré, *Haüy*, Tabl. p. 114.—Molybdänkies, *Haus.* Handb. b. i. s. 197.—Wasserblei, *Hoff.* b. iv. s. 231.—Molybdena, *Aikin*, p. 133.

External Characters.

Its colour is fresh lead-grey.

It occurs usually massive, disseminated, in plates, also in distinct concretions, which are large, coarse and small granular, and sometimes crystallised.

Its primitive figure is a rhomboid, whose dimensions are unknown. The following are the secondary figures:

1. Regular six-sided table, Pl. 12. fig. 231 *.
2. Very short six-sided prism flatly acuminated on both extremities, with six planes, which are set on the lateral planes, Pl. 12. fig. 232 †.

The crystals are small and middle-sized, and always imbedded, or in druses.

Internally it is splendent, sometimes passing into shining, and the lustre is metallic.

It has a single cleavage, parallel with the lateral planes of the table. The folia of the cleavage are generally curved, and sometimes floriform.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It writes with a bluish-grey streak on paper, but with a greenish-grey streak on porcelain.

It retains its lustre in the streak.

It soils slightly.

It is harder than talc, but not so hard as gypsum.

It is easily frangible.

It splits easily.

In thin leaves it is flexible, but not elastic.

It is sectile, approaching to malleable.

It feels greasy.

Specific gravity 4.4, 4.6, *Mohs*; 4.569, *Karsten*; 4.667, *Schumacher*.

* Molybdene sulphuré prismatique, Haüy.

† Molybdene sulphuré trihexaedre, Haüy.

Chemical Characters.

It gives out a sulphureous odour before the blowpipe; and when urged by the utmost force of the heat, it gives out white vapour, and a pale blue flame; it is soluble, with violent effervescence, in carbonate of soda.

Constituent Parts.

Molybdena,	-	60
Sulphur,	-	40
		100

Bucholz in Gehlen's Journ. de Chem. u. Phys. b. iv. s. 603.

Geognostic Situation.

It occurs disseminated in granite, gneiss, mica-slate, and chlorite-slate, or in veins traversing these rocks, in which it is associated with wolfram, tungsten, tinstone, magnetic iron-ore, arsenical pyrites, fluor-spar, topaz, quartz and heavy-spar.

Geographic Situation.

Europe.—It occurs imbedded in chlorite-slate along with actynolite in Glenelg in Inverness-shire; in granite at Peterhead; in six-sided tables, in quartz in granite, on the mountain of Corybuy, at the head of Loch Creran; in tin and copper veins in Drakewalls mine near Calstock in Cornwall; near Menbilly and in Huel Unity, and Huel Gorland, in veins traversing clay-slate and mica-slate; in granite near the source of the Caldew, about four miles south-west from Hesket Newmarket, Caldbeck Cumberland,

Cumberland, accompanied by apatite and iron, and arsenical pyrites; in granite at Shap in Cumberland. In Norway and Sweden, it is found imbedded in granite and gneiss; in Bohemia and Saxony in veins accompanied with tinstone; in the *Snow-pits* in the Riesengebirge in Silesia, disseminated in granite; in the country of Glatz, imbedded in gneiss and mica-slate; in porphyritic syenite near the copper-mines of Chessy in the department of the Rhone in France; and in granitic rocks in the Alps and the Vosges.

Asia.—Siberia.

America.—In South Carolina; in Virginia; near Baltimore in Maryland, in granite; in Pennsylvania; New York; Connecticut; at Brunswick disseminated in granite, and in gneiss*.

Observations.

1. This mineral has frequently been confounded with *Graphite;* but the following characters sufficiently distinguish them from one another: The colour of graphite is steel-grey, inclining more or less to iron-black; whereas that of molybdena is lead-grey: if both minerals are rubbed on a piece of white porcelain, it will be seen that the streak made by the graphite is of the same colour with the substance by which it was made, while that made by the molybdena is greenish-grey: and graphite soils strongly, but molybdena only slightly.

2. It was formerly considered as a variety of graphite, until Cronstedt and Wallerius described it as a distinct species.

* Cleaveland's Mineralogy.

* Molybdena-Ochre.

Molybdänocher, *Karsten.*

Molybdänocher, *Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 336.

External Characters.

Its colour is sulphur-yellow, which passes on the one side into straw-yellow and orange-yellow, and on the other into siskin-green.

It occurs disseminated, and incrusting molybdena.

It is friable.

It is dull.

Geographic Situation.

It is found investing and intermixed with molybdena, in the granite of Corybuy at Loch Creran; and also at Nummedalen in Norway.

Genus VI. GOLD-GLANCE.

This genus contains one species, viz. Prismatic Gold-Glance.

1. Prismatic

1. Prismatic Gold-Glance.

Prismatischer Gold-Glanz, *Mohs.*

This Species is divided into two subspecies, viz. Graphic Gold-Glance, and Yellow Gold-Glance.

First Subspecies.

Graphic Gold-Glance, or Graphic Tellurium.

Schrifterz, *Werner.*

Weiss Golderz, *Wid.* s. 673.—Schrifterz, *Esmark,* N. Bergm. Journ. t. ii. p. 10.—Or blanc d'Offenbanya, ou graphique, Aurum graphicum, *De Born,* t. ii. p. 470.—Schrifterz, *Emm.* b. iii. s. 405.—Tellure natif graphique, *Haüy,* t. iv. p. 327.—Le Silvane graphique, *Broch.* t. ii. p. 482.—Schrifterz, *Reuss,* b. iv. s. 608. *Id. Lud.* b. i. s. 310. *Id. Suck* 2ter th. s. 493. *Id. Mohs,* b. iii. s. 65.—Tellure natif aurifere et argentifere, *Lucas,* p. 186.—Schrifterz, *Leonhard,* Tabel. s. 80.—Tellur natif graphique, *Brong.* t. ii. p. 123.—Schrifterz, *Karsten,* Tabel. s. 70.—Schrift Tellur, *Haus.* s. 70.—Tellur natif auro-argentifere, *Haüy,* Tabl. p. 119.—Schrifterz, *Haus.* Handb. b. i. s. 130. *Id. Hoff.* b. iv. s. 129.—Graphic Tellurium, *Aikin,* p. 140.

External Characters.

Its colour is steel-grey, which sometimes becomes white, yellow, or lead-grey, or variously tarnished by exposure to the air.

It occurs massive, disseminated, in leaves; and crystallised.

Its

Its primitive form is an oblique four-sided prism, whose dimensions are unknown.

Several varieties of this prism are enumerated by authors.

The crystals are small, and very small, and are generally arranged in rows on the surface of quartz.

Frequently there are attached to the extremities of the prisms, others at right angles, giving to the whole row the appearance of a line of Persepolitan characters.

The planes of the crystals are smooth.

Externally it is splendent, and the lustre is metallic.

Internally it is glistening, and the lustre is metallic.

Its cleavage is prismatic, and not axifrangible.

The fracture is fine-grained uneven.

It is sometimes as hard as gypsum, and is therefore harder than black tellurium.

It is rather brittle, and easily frangible.

It soils slightly.

Specific gravity 5.7, 5.8, *Mohs.* 5.723, *Müller.*

Chemical Characters.

Before the blowpipe it burns with a green flame, and is volatilized.

Constituent Parts.

Tellurium, -	60
Gold, -	30
Silver, - -	10
	100

Klaproth, Beit. b. iii. s. 20.

Geognostic

Geognostic Situation.

It occurs in veins in porphyry, along with quartz, calcareous-spar, iron-pyrites, blende, and brass-yellow native gold.

Geographic Situation.

It has been hitherto only found at Offenbanya in Transylvania.

Use.

It is worked as an ore of gold, and as an ore of silver.

Observation.

Its name is derived from the particular appearance formed by the aggregation of the crystals.

Second Subspecies.

Yellow Gold-Glance, or Yellow Tellurium.

Weiss Sylvanerz, *Werner*.

Var. de Nagyagerz, *Wid.* s. 671.—Or gris jaunâtre, *De Born*, t. ii. p. 464.—Var. de Nagyagerz, *Emm.* b. i. s. 121.—Mine jaune de Nagyag, *Journ. des Min.* N° 38. p. 150.—Gelberz, *Karst.* Tabel. s. 56.—Tellure natif aurifere et plombifere, *Haüy*, t. iv. p. 327.—Le Silvane blanc, *Broch.* t. ii. p. 484.—Gelberz, *Reuss*, b. iv. s. 612.—Gelbtellurerz, *Lud.* b. i. s. 311. *Id. Suck.* 2ter th. s. 495.—Weiss-sylvanerz, *Bert.* s. 521. *Id. Mohs*, b. iii. s. 59.—Tellure aurifere et plombifere, *Lucas*, p. 186.—Weiss Tellurerz, *Leonhard*, Tabel. s. 80.—Tellure natif

natif plombifere, *Brong.* t. ii. p. 124. *Id. Brard*, p. 392.—Gelberz, *Karsten*, Tabel. s. 70.—Weiss Tellur, *Haus.* s. 71.—Tellure natif auro-plombifere, *Haüy*. Tabl. p. 119.—Weiss Tellur, *Haus.* Handb. b. . s. 131.—Weiss Sylvan, *Hoff.* b. iv. s. 131.—Yellow Tellurium, *Aikin*, p. 140.

External Characters.

Its colour is silver-white, which inclines very much to brass-yellow. It occasionally exhibits a yellow and green play of colour, which, however, is not of long duration, as the whole surface soon becomes of one tint of colour.

It occurs disseminated, less frequently massive, very rarely imperfectly reticulated; and seldom crystallised, in broad four-sided prisms, which are generally acicular.

Externally it is splendent and shining.

Internally it alternates from splendent to glistening, and the lustre is metallic.

The cleavage is prismatic.

The fracture is small-grained uneven.

Specific gravity 5.7, 5.8, *Mohs.*

In other characters agrees with the preceding.

Constituent Parts.

Tellurium, -	44.75
Gold, -	26.75
Lead, - -	19.50
Silver, - -	8.50
Sulphur, -	0.50
	100

Klaproth, Beit. b. iii. s. 25.

Geognostic

Geognostic and Geographic Situations.

This mineral occurs in small and very irregular veins in porphyry. The most frequent vein-stones are brown-spar and quartz; sometimes it is also associated with read manganese, sulphuret of manganese, native arsenic, plumose antimony, and brass-yellow native gold. It has been hitherto found only at Nagyag in Transylvania.

Use.

As it contains a considerable portion of gold and silver, it is worked on account of both these metals.

GENUS VII.—BISMUTH-GLANCE.

This genus contains two species, viz. Acicular Bismuth-Glance, and Prismatic Bismuth-Glance. * Cupreous Bismuth. ** Bismuth-Ochre.

1. Acicular Bismuth-Glance.

Nadelförmiger Wismuth-Glanz, *Mohs.*

Nadelerz, *Werner.*

Nadelerz, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 75.—Bismuth sulphuré plumbo-cuprifere, *Haüy,* Tabl. p. 108.—Nadelerz, *Haus.* Handb. b. i. s. 186. *Id. Hoff.* b. iv. s. 282.—Plumbo-cupriferous Sulphureted Bismuth, *Aikin,* p. 122.

External Characters.

Its colour is dark lead-grey.

It

It acquires a bright copper-red tarnish.

It occurs disseminated and crystallised in oblique four or six sided prisms, in which the lateral planes are deeply longitudinally streaked. The crystals are long, often acicular, frequently curved, and sometimes divided by cross rents.

Internally it is splendent in the cleavage; but only shining on the uneven fracture; and the lustre is metallic.

It has an imperfect cleavage.

The fracture is small-grained uneven.

It is opaque.

It is brittle.

It is as hard as gypsum, sometimes even harder; but never so hard as calcareous-spar.

Specific gravity, 6.1, 6.2, *Mohs*; 6.125, *John*.

Chemical Characters.

It is fusible before the blowpipe into a steel-grey globule; by continuance of the heat, it partly volatilises, and deposits on the charcoal a yellow powder, after which there remains a red globule, inclosing a grain of cupriferous metallic lead, which, when treated with glass of borax, communicates a bluish-green colour to it.

Constituent Parts.

Bismuth,	-	-	43.20
Lead,	-	-	24.32
Copper,	-	-	12.10
Sulphur,	-	-	11.58
Nickel,	-	-	1.58
Tellurium,	-	-	1.32
Gold,	-	-	0.79
			94.89

John, n. Chem. Untersuchungen, s. 216.

Or

Or we may estimate its ingredients in the following manner:

Sulphuret of Bismuth,	Bismuth,	43.20	50.76
	Sulphur,	7.56	
Sulphuret of Lead,	Lead,	24.32	28.07
	Sulphur,	3.75	
Sulphuret of Copper,	Copper,	12.10	15.13
	Sulphur,	3.03	
Nickel,	-	-	1.58
Tellurium,	-	-	1.32
Gold,	-	-	0.79

Geognostic Situation.

It occurs imbedded in quartz, and is associated with galena or lead-glance, and native gold. The crystals are sometimes invested with a greenish crust, which appears to be copper-green, and sometimes with a yellow crust of bismuth-ochre.

Geographic Situation.

It occurs in the mines of Pyschminskoi and of Klintzefskoi near Beresof, in the district of Catharinenburg in Siberia.

Observations.

In the former edition of this work, Needle-ore, on the authority of Werner, was arranged as an ore of Chrome; but the late investigations of John have proved, that it belongs to the genus Bismuth-glance. It was at one time considered as an auriferous ore of nickel; and Patrin, so early as the year 1786, approached very near to its true nature, for he describes it as a sulphuret of bismuth.

2. Prismatic

2. Prismatic Bismuth-Glance.

Prismatischer Wismuth-Glanz, *Mohs.*

Wismuth-Glanz, *Werner.*

Galena Wismuthi, *Wall.* t. ii. p. 206.—Minera Wismuthi cinerea-versicolor-martialis, *Id.* p. 207. and 208.—Wismuthglanz, *Wern.* Pabst. b. i. s. 187. *Id. Wid.* s. 890.—Sulphurated Bismuth, *Kirw.* vol. ii. p. 266.—Bismuth sulphuré, *De Born,* t. ii. p. 217.—Wismuth-glanz, *Emm.* b. ii. s. 438.—Bismuth sulphuré, *Lam.* t. ii. p. 333. *Id. Haüy,* t. iv. p. 190. —La Galena de Bismuth, ou le Bismuth sulphuré, *Brock.* t. ii. p. 346.—Wismuth-glanz, *Reuss,* b. iv. s. 314. *Id. Lud.* b. i. s. 271. *Id. Suck.* 2ter th. s. 363. *Id. Bert.* s. 473. *Id. Mohs,* b. iii. s. 631.—Bismuth sulphuré, *Lucas,* p. 157.—Wismuth-glanz, *Leonhard,* Tabel. s. 77.—Bismuth sulphuré, *Brong.* t. ii. p. 133. *Id. Brard,* p. 350.—Wismuth-glanz, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 75.—Bismuth sulphuré, *Haüy,* Tabl. p. 105.—Wismuthglanz, *Haus.* Handb. b. i. s. 190. *Id. Hoff.* b. iv. s. 68.—Sulphureted Bismuth, *Aikin,* p. 121.

External Characters.

Its colour is pale lead-grey.

Externally it is tarnished yellow, or with variegated colours.

It occurs massive, disseminated, in large and coarse granular and narrow radiated concretions, and crystallised.

Its primitive figure is an oblique four-sided prism, the dimensions of which are unknown. The crystals generally met with, are acicular and capillary oblique four and six sided prisms.

Internally

Internally it is splendent and metallic.

The cleavages are parallel to the sides and to the short diagonal of the oblique four-sided prism.

The fragments are indeterminate angular.

It is sometimes harder than gypsum, but never so hard as calcareous-spar.

It soils.

It is brittle, inclining to sectile.

It is easily frangible.

Specific gravity, 6.1, 6.4, *Mohs*; 6.4672, *Brisson*; 6.131, *Kirwan*.

Chemical Characters.

It melts in the flame of a candle. It is volatilised before the blowpipe, and deposits on the charcoal a yellow crust, which becomes white on cooling.

Constituent Parts.

Bismuth, -	60
Sulphur, - -	40
	100

Sage in Mem de l'Acad. d. Sc. 1782, p. 307.

Geognostic Situation.

It occurs in veins, and is usually accompanied with native bismuth, grey cobalt, cerite, sparry iron, arsenical-pyrites, copper-pyrites, tinstone, quartz, and fluor-spar.

Geographic Situation.

It is found in Herland-mine, also at Huel Sparnor, near Redruth, and at Botallack, in Cornwall; at Joachimsthall and

and Schlackenwald in Bohemia; Johanngeorgenstadt and Altenberg in the kingdom of Saxony; and Bastnäs near Riddarhytta in Sweden.

Observations.

1. It is distinguished from *Grey Antimony* by its lighter lead-grey colour, and its greater specific gravity; from *Grey Copper* and *Iron-glance*, by colour, and from *Native Bismuth*, by colour.

2. It is a rare mineral.

* Cupreous Bismuth, or Cupriferous sulphureted Bismuth.

Kupferwismutherz, *Karsten.*

Kupferwismuth, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 75. *Id. Klaproth,* Beit. b. iv. s. 91. *Id. Selb,* in d. Annal. der Wetterauischen Gesellch. b. i. s. 40. *Id. Haus.* Handb. b. i. s. 189. —Cupriferous Sulphureted Bismuth, *Aikin,* p. 222.

External Characters.

Its colour is light lead-grey, which passes on the one side into steel-grey, and on the other into tin-white; and its tarnish is yellowish or reddish.

It occurs massive, disseminated, seldom in small scopiformly aggregated prisms.

Internally it is shining and metallic.

The fracture is fine-grained uneven, and sometimes inclines to radiated.

It is sectile.

Constituent Parts.

Bismuth, - -	47.24
Copper, - -	34.66
Sulphur, - -	12.58
	94.48

Klaproth, Beit. b. iv. s. 96.

Or probably more correctly, according to estimation,

Sulphuret of Bismuth,	Bismuth,	47.240	55.507
	Sulphur,	8.267	
Sulphuret of Copper,	Copper,	34.660	43.325
	Sulphur,	8.665	
			98.832

Hausmann, Handb. b. i. s. 188.

Geognostic and Geographic Situations.

It occurs in veins in granite, along with native bismuth, copper-pyrites, and heavy-spar, in the mines named Neuglück, and Daniel at Gallenbach, near Wittichen, in Furstemberg.

Observation.

This rare ore was first discovered by Mr Selb.

** Bismuth-Ochre.

Wismuthocker, *Werner*.

Ochra Wismuthi, *Wall.* t. ii. p. 209.—Wismuthocker, *Werner*, Pabst. b. i. s. 188. *Id. Wid.* s. 891.—Bismuth-Ochre, *Kirw.* vol. ii. p. 265.—Ocre de Bismuth, *De Born*, t. ii. p. 194.—Wismuth-ocre, *Emm.* b. ii. s. 440.—Oxide de Bismuth, *Lam.* t. i. p. 332.—Bismuth oxidé, *Haüy*, t. iv. p. 194, 195.—L'Ocre

L'Ocre de Bismuth, *Broch.* t. ii. p. 348.—Wismuth-Ochre, *Reuss*, b. iv. s. 318. *Id. Lud.* b. i. s. 272. *Id. Suck.* 2ter th. s. 364. *Id. Bert.* s. 474. *Id. Mohs*, b. iii. s. 662. *Id. Leonhard*, Tabel. s. 77.—Bismuth oxidé, *Brong.* t. ii. p. 134.—Wismuth-Ochre, *Karsten*, Tabel. s. 70.—Bismuth oxidé, *Haüy*, Tabl. p. 106.—Wismuth-Ocker, *Haus.* Handb. b. i. s. 337.—Native Oxide of Bismuth, *Kid*, vol. ii. p. 212.—Wismuth-ocker, *Hoff.* b. iv. s. 71.—Bismuth Ochre, *Aikin*, p. 122.

External Characters.

Its colour is straw-yellow, which sometimes passes into light yellowish-grey and ash-grey; sometimes even verges on siskin and apple-green *.

It occurs massive and disseminated.

Internally it is glimmering and glistening, and the lustre inclines to adamantine.

The fracture is fine and small-grained uneven, and earthy.

The fragments are indeterminate angular, and rather blunt-edged.

It is opaque.

It is soft and very soft, verging on friable.

It is rather brittle.

It is easily frangible.

Specific gravity 4.3711, *Brisson*.

Chemical Characters.

Before the blowpipe, on charcoal, it is easily reduced, but it is also volatilised if the heat be continued. It dissolves

* The apple-green varieties contain nickel.

solves with effervescence in acids, and the solution is decomposed by means of water, when a white precipitate is formed.

Constituent Parts.

Oxide of Bismuth,	-	86.3
Oxide of Iron,	- -	5.2
Carbonic Acid,	- -	4.1
Water,	- - -	3.4
		99.0

Lampadius, Handb. z. Chem. Annal. s. 286.

Geognostic and Geographic Situations.

It occurs along with red cobalt, copper-nickel, grey copper, copper-glance or vitreous copper-ore, blue copper, sparry iron, quartz, and calcareous-spar.

It is found at St Agnes in Cornwall; Schneeberg and Johanngeorgenstadt in Saxony; and Joachimsthal in Bohemia; but is a rare mineral.

Observation.

It has been confounded with green iron-earth, from which it is well distinguished not only by its external aspect, but by its accompanying minerals.

Genus VIII.—ANTIMONY-GLANCE.

Spiesglas-Glanz, *Mohs*.

This genus contains three species, viz. Prismatoidal Antimony-Glance, Axifrangible Antimony-Glance, and Prismatic Antimony-Glance. * Antimony-Ochre. ** Nickeliferous Grey Antimony.

1. Prismatoidal Antimony-Glance, or Grey Antimony.

Grau Spiesglaserz, *Werner*.

Prismatoidescher Spiesglas Glanz, *Mohs*.

This species is divided into two subspecies, viz. Common Grey Antimony, and Plumose Antimony.

First Subspecies.

Common Grey Antimony.

Gemeines Grau Spiesglaserz, *Werner*.

This subspecies is divided into three kinds, viz. Common, Foliated, and Radiated.

First Kind.

Compact Grey Antimony.

Dichtes Grauspiesglaserz, *Werner*.

Minera Antimonii solida, *Wall.* t. ii. p. 198.—Dichter Grauspiesglaserz, *Werner*, Pabst. b. i. s. 197. *Id. Wid.* s. 912.—Compact

pact sulphurated Antimony, *Kirw.* vol. ii. p. 247.—Dichter Grauspiesglaserz, *Emm.* b. ii. s. 468.—L'Antimoine gris compacte, *Broch.* t. ii. p. 372.—Dichter Grauspiesglanzerz, *Reuss,* b. iv. s. 367. *Id. Lud.* b. i. s. 278. *Id. Suck.* 2ter th. s. 384. *Id. Bert.* s. 475. *Id. Mohs,* b. iii. s. 687. *Id. Leonhard,* Tabel. s. 79.—Antimoine sulphuré pure compacte, *Brong.* t. ii. p. 127.—Dichtes Grauspiesglanzerz, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 75.—Sulphuret of Antimony, *Kid,* vol. ii. p. 201. —Antimoine sulphuré compacte, *Haüy,* Tabl. p. 113.—Dichtes Grauspiesglazerz, *Haus.* Handb. b. i. s. 194. *Id. Hoff.* b. iv. s. 109.—Antimoine sulphuré compacte, *Haüy,* Tabl. p. 113.—Grey Antimony, *Aikin,* p. 123.

External Characters.

Its colour is light lead-grey, and it has sometimes a pavonine or steel-coloured tarnish.

It occurs massive, disseminated, and seldom in membranes.

Internally, it is shining and glistening, and the lustre is metallic.

The fracture is small and fine-grained uneven, which latter sometimes passes into even.

The fragments are indeterminate angular, and blunt-edged.

It is soft.

It is easily frangible.

It soils.

The lustre is increased in the streak.

Specific gravity, 4.0,—4.6, *Mohs;* 4.368, *Kirwan.*

Geographic Situation.

Europe.—It is found in Huel Boys mine in Cornwall; at Sahlberg in Sweden; Braunsdorf near Freyberg in Saxony;

ony; Hungary; Baireuth; Salzburg; and Auvergne in France.

Asia.—Siberia.

America.—Chili.

Observations.

1. It is distinguished from *White Silver*, *Compact Galena*, and *Copper-Glance*, by colour and specific gravity.

2. It is the rarest subspecies of grey antimony.

Second Kind.

Foliated Grey Antimony.

Blättriges Grauspiesglaserz, *Werner.*

Id. Wern. Pabst. b. i. s. 197.—Foliated sulphurated Antimony, *Kirw.* vol. ii. p. 248.—Blättriches Grauspiesglaserz, *Emm.* b. ii. s. 470.—L'Antimoine gris lamelleux, *Broch.* t. ii. p. 373. —Blättriches Grauspiesglanserz, *Reuss,* b. iv. s. 368. *Id. Lud.* b. i. s. 278. *Id. Suck.* 2ter th. s. 385. *Id. Bert.* s. 475. *Id. Mohs,* b. iii. s. 687. *Id. Leonhard,* Tabel. s. 79.—Antimoine sulphuré pure lamelleux, *Brong.* t. ii. p. 127.—Blättriches Grauspiesglaserz, *Karsten,* Tabel. s. 72. *Id. Haus.* Handb. b. i. s. 194. *Id. Hoff.* b. iv. s. 107.

External Characters.

The colour is the same as that of the preceding kind.

It occurs massive and disseminated; also in coarse, small and fine, generally longish, granular concretions.

Internally it is shining or glistening, and the lustre is metallic.

The cleavage is prismatic.

The

The fragments are indeterminate angular, and not particularly sharp-edged.

It is as hard as gypsum.

It is not particularly brittle.

It is easily frangible.

Specific gravity, 4.0,—4.6, *Mohs*; 4.368, *Kirwan*; 4.300 to 4.382, *Breithaupt*.

Third Kind.

Radiated Grey Antimony.

Strahliches Grauspiesglaserz, *Werner*.

Id. Werner, Pabst. b. i. s. 198. *Id. Wid.* s. 914.—Striated sulphurated Antimony, *Kirw.* vol. ii. p. 249.—Strahliches Grauspiesglaserz, *Emm*. b. ii. s. 374.—L'Antimoine gris rayonné, *Broch.* t. ii. p. 374.—Strahliches Grauspiesglaserz, *Reuss*, b. iv. s. 370. *Id. Lud.* b. ii. s. 279. *Id. Mohs*, b. iii. s. 690. *Id. Leonhard*, Tabel. s. 79.—Antimoine sulphuré pure rayonné, *Brong.* t. ii. p. 127.—Strahliges Grauspiesglanzerz, *Karsten*, Tabel. s. 72. *Id. Haus.* s. 75. *Id. Hoff.* b. iv. s. 103.

External Characters.

The colour is common lead-grey, and it is sometimes tarnished with an azure-blue colour, or it exhibits the colours of tempered steel, or it is pavonine.

It occurs massive, disseminated, in distinct concretions, which are scopiform or stellular, or promiscuous radiated, sometimes passing into fibrous, or collected into others of a wedge-shape. It is frequently crystallised, and the primitive

tive figure is an oblique four-sided prism, the dimensions of which are unknown. The following are the secondary figures:

1. Oblique four-sided prism, rather acutely acuminated with four planes, which are set on the lateral planes, Pl. 12. fig. 233. Sometimes the obtuse lateral edges of the prism are truncated, sometimes bevelled, or even rounded off, so that the prism appears reed-shaped.
2. Oblique four-sided prism, flatly acuminated with four planes, which are set on the lateral planes, Pl. 12. fig. 234.
3. Oblique four-sided prism, rather acutely acuminated with four planes, which are set on the lateral planes; and this acumination flatly acuminated with four planes, which are set on the planes of the first acumination, Pl. 12. fig. 235.
4. Oblique four-sided prism, rather acutely acuminated with four planes, which are set on the lateral planes; and the angles formed by the meeting of the acuminating and lateral planes bevelled, Pl. 12. fig. 236.
5. Broad six-sided prism, rather acutely acuminated on the extremities with four planes, which are set on the narrow lateral planes, Pl. 12. fig. 237.
6. Broad six-sided prism, flatly acuminated on both extremities with four planes, which are set on the narrow lateral planes, Pl. 12. fig. 238.
7. In acicular, and sometimes in capillary crystals.

The crystals usually intersect one another, or are scopiformly aggregated. Their surface is strongly longitudinally streaked, and usually shining.

Internally

Internally, it alternates from splendent to glistening, and the lustre is metallic.

The fragments are usually indeterminate angular, and not particularly sharp-edged; sometimes also splintery.

It is as hard as gypsum.

It is rather brittle.

It is easily frangible.

Specific gravity, 4.0—4.6, *Mohs*; 4.200, *Bergman*; 4.229, *Gellert*; 4.1327 to 4.5165, *Brisson*; 4.440, *Kirwan*.

Chemical Characters.

It melts by the mere flame of a candle; it is almost entirely dissipated before the blowpipe, in the form of a white vapour, with a sulphureous odour.

Constituent Parts.

Antimony,	74	75
Sulphur,	26	25
	100	100
	Bergman, Chem. Opusc. t. ii. p. 167.	*Proust.*

Geognostic Situations of the Foliated and Radiated Kinds.

These minerals occur in veins, and it is said sometimes also in beds, in primitive and transition mountains. The veins sometimes contain no other minerals besides antimony and quartz; in other instances they are associated with gold, or ores of silver, and more frequently with galena or lead-glance, grey copper, iron-pyrites, arsenical-pyrites, blende, heavy-spar and brown-spar.

Geographic

Geographic Situation.

Europe.—It occurs at Glendinning in Dumfriesshire, in veins that traverse transition rocks, accompanied with fine granular brown blende, iron-pyrites, quartz, and calcareous-spar *; it has been lately discovered in Banffshire; in Cornwall at St Stephens, Padstow, and Huel Boys in Endellion, in veins traversing those of copper and tin-ore, but not in the east and west veins of that county; at Narverud and Hillebeck near Eger in Norway, along with common garnet; in veins in transition rocks in the Hartz; in veins that traverse gneiss in Massiac and Langle in Auvergne: at Braunsdorf in Saxony; in Bohemia, Silesia, Swabia, Salzburg, Tuscany, Sardinia, Corsica, Sicily, and Spain; also at Offenbanya in Hungary, in veins with galena, grey copper, iron-pyrites, and brown blende, in foliated granular limestone; at Felsobania in Transylvania, associated with grey copper, plumose antimony, red orpiment, red antimony, rose-red brown-spar, calcareous-spar and quartz.

America.—It is found at Catorce and Los Pozuelos, near Guencamé in Mexico; also in Louisiana †, Connecticut, Massachusets and Maine ‡.

Second Subspecies.

Plumose Grey Antimony.

Federerz, *Werner.*

Minera Antimonii plumosa, *Wall.* t. ii. p. 197.—Federerz, *Wern.* Pabst. b. i. s. 201. *Id. Wid.* s. 916.—Plumose Antimonial ore,

* Jameson's Mineralogy of Dumfriesshire, p. 74.

† Bruce's American Mineralogical Journal, p. 125.

‡ Cleaveland's Mineralogy, p. 563.

ore, *Kirw.* vol. ii. p. 250.—Federerz, *Emm.* b. ii. s. 474.—L'Antimoine en plumes, *Broch.* t. ii. p. 377.—Haarförmiges, Grauspiesglanzerz, *Reuss*, b. iv. s. 375.—Federerz, *Lud.* b. i. s. 280. *Id. Suck.* 2ter th. s. 389. *Id. Bert.* s. 478. *Id. Mohs*, b. iii. s. 702.—Haarförmiges Grauspiesglanzerz, *Leonhard*, Tabel. s. 79.—Antimoine sulphuré capillaire, *Brong.* t. ii. p. 127.—Haarförmiges Grauspiesglanzerz, *Karsten*, Tabel. s. 72.—Federerz, *Haus.* s. 75.—Antimoine sulphuré capillaire, *Haüy*, Tabl. p. 113.—Federerz, *Hoff.* b. iv. s. 110. *Id. Haus.* Handb., b. i. s. 196.—Plumose Grey Antimony, *Aikin*, p. 124.

External Characters.

Its colour is intermediate between dark lead-grey and smoke-grey. The lighter coloured varieties have sometimes a tempered steel coloured tarnish.

It occurs sometimes massive; most commonly, however, in thin capillary crystals, which are almost always promiscuously or scopiformly aggregated, and sometimes so interwoven as to appear like wool.

Externally the crystals are glistening.

Internally it is glimmering, and the lustre is semi-metallic or metallic.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It is very soft, passing into friable.

It is rather brittle, and easily frangible.

Chemical Characters.

Before the blowpipe, it melts into a black slag, after giving out a vapour, which, when condensed, appears in form of a white and yellow powder.

Constituent

Constituent Parts.

According to Bergman, it is a compound of Antimony, Sulphur, Arsenic, Iron and Silver. Some mineralogists, as Cronstadt, from its containing silver, refer it to the ores of silver.

Geognostic Situation.

It occurs most frequently in veins in primitive rocks, that contain ores of silver, particularly white silver; also in antimony veins. It is usually accompanied with argentiferous arsenical-pyrites, native tellurium, and the ores already mentioned as accompanying the other ores of this metal. A newer formation is met with in transition rocks, where it is associated with galena or lead-glance, grey copper, sparry iron, and fluor-spar.

Geographic Situation.

Europe.—It occurs at Andreasberg and Clausthal in the Hartz; Freyberg and Braunsdorf in the kingdom of Saxony; Rathhausberg in Gastein, and Schwarzleogang in Salzburg; Schemnitz in Hungary; Nagyag and Felsobanya in Transylvania.

America.—Mexico.

Observations.

1. It is distinguished from *Amianthus* and *Tremolite* by its colour, kind of lustre, and easier fusibility.

2. It has been described under the name *Silberfederez.*

2. Axifrangible

2. Axifrangible Antimony Glance, or Bournonite.

Axentheilender Spiesglas, *Mohs*.

Schwarzspies Glanzerz, *Werner*.

Spiessglanzbleierz, *Karsten*.

Hatchett and *Bournon*, in Phil. Trans. for 1804.—Spiessglanzblei, *Karsten*, Tabel. s. 68.—Plomb sulphuré antimonifere, *Haüy*, Tabl. p. 80.—Triple sulphuré d'Antimoine, Plomb et Cuivre, Endellione, *Bournon*, Catalogue Mineralogique, p. 409.—Spiessglanzbleierz, *Haus*. Handb. b. i. s. 173.—Schwarz Spiesglanzerz, *Hoff*. b. iv. s. 111.—Triple Sulphuret of Lead, *Aikin*, p. 109.

External Characters.

Its colour is blackish lead-grey, falling into steel-grey.

It generally occurs massive, disseminated, and crystallised.

Its primitive form is an oblique four-sided prism, the angles of which are unknown. This prism occurs variously modified by truncation, and bevelment on the edges and terminal planes, and by acuminations on the terminal planes.

Externally it is shining and metallic.

Internally the lustre is intermediate between glistening and glimmering, and is metallic.

It cleavage is axifrangible.

The fracture is small, and rather perfect conchoidal, and rarely coarse-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It is harder than gypsum, but not so hard as calcareous-spar.

It

It becomes more shining in the streak.

It is brittle, and easily frangible.

Specific gravity, 5.5,—5.8, *Mohs*; 5.700, *Hatchett.*

Chemical Characters.

Before the blowpipe, it generally splits and decrepitates, then melts, emitting a white and sulphureous vapour; after which, there remains a crust of sulphureted lead, inclosing a globule of copper.

Constituent Parts.

	Huel Boys, near Endellion, Cornwall.	Cornwall.	Clausthal.
Lead,	42.62	39.00	42.50
Antimony,	24.23	28.50	19.75
Copper,	12.80	13.50	11.75
Iron,	1.20	1.00	5.00
Sulphur,	17.00	16.00	18.00
	Hatchett, Phil. Trans. 1804, i. 63.	*Klaproth*, Beit. b. iv. s. 90.	Id. s. 86.

According to an estimate of Mr Smithson, this ore contains in 100 parts the following compounds:

Sulphuret of Lead or Galena,	Lead,	41.08	47.41
	Sulphur,	6.33	
Sulphuret of Antimony,	Antimony,	25.67	34.23
	Sulphur,	8.56	
Sulphuret of Copper,	Copper,	12.80	16.00
	Sulphur,	3.20	
Sulphuret of Iron,	Iron,	1.20	2.60
	Sulphur,	1.40	
			100.24

Smithson, Phil. Trans. for 1808, P. i. p. 55. &c.

Geognostic

Geognostic and Geographic Situations.

Europe.—It is found near Endellion in Cornwall, along with grey antimony, and brown-blende, in veins in clay-slate. On the Continent, it is met with at Ratisbon, associated with brown blende, grey copper, galena or lead-glance, and common iron-pyrites; also in Saxony; in the Hartz, accompanied with galena or lead-glance, sparry iron, and heavy-spar, in veins that traverse grey-wacke and grey-wacke-slate; at Bleyberg in Carinthia, and at Kapnic, in Transylvania.

Asia.—In Siberia, along with quartz, malachite, galena or lead-glance, and calcareous-spar.

America.—In Peru, associated with copper and iron pyrites.

Observations.

In a former edition of this work, I named this mineral *Bournonite*, in honour of Bournon, who first described it: Count Bournon names it *Endellione*, from the parish in which it was first found.

3. Prismatic Antimony-Glance.

Prismatischer Spiesglas Glanz, *Mohs.*

External Characters.

Its colour is blackish lead-grey.

Its primitive figure is an oblique four-sided prism, the dimensions of which are unknown.

The lustre is shining and metallic.

Its

Its cleavage is in the direction of the smaller diagonal of the prism.

It is harder than gypsum, and sometimes as hard as calcareous-spar.

Specific gravity 5.7, 5.8, *Mohs*.

Observations.

The above description is that of Mohs, and contains all the information I possess in regard to this species.

* Antimony-Ochre.

Spiesglanzocker, *Werner*.

Spiessglanzocher, *Reuss*, b. ii. s. 388. *Id. Lud.* b. i. s. 282. *Id. Suck.* 2ter th. s. 394. *Id. Bert.* s. 478. *Id. Mohs*, b. iii. s. 713. *Id. Leonhard*, Tabel. s. 79. *Id. Karsten*, Tabel. s. 72.—Antimoine oxydé terreux, *Haüy*, Tabl. p. 113.—Spiessglanzocher, *Haus.* Handb. b. i. s. 339. *Id. Hoff.* b. iv. s. 124.—Antimonial Ochre, *Aikin*, p. 125.

External Characters.

Its colour is straw-yellow, of different degrees of intensity, which inclines on the one side into yellowish-grey, on the other into yellowish-brown.

It sometimes occurs massive, and disseminated, but generally incrusting crystals of grey antimony.

It is dull or glimmering.

The fracture is small-grained uneven or earthy.

It is soft, passing into very soft.

It is rather brittle, and easily frangible.

Chemical Characters.

Before the blowpipe, on charcoal, it becomes white, and evaporates without melting. With borax, it intumesces, and is partly reduced to the metallic state.

Geognostic and Geographic Situations.

It occurs always in veins, and accompanied with grey antimony, and sometimes with red antimony.

It is found at Dublowitz, near Saltschaw in Bohemia; Telkebanya in Hungary; Toplitz in Transylvania; Braunsdorf, in the kingdom of Saxony; on the Sonnenberg, near Mittersill in Salzburg; and in Siberia.

Observations.

It nearly resembles bismuth-glance in external characters, but is readily distinguished from it by its accompanying minerals.

** Nickeliferous Grey Antimony.

Antimoine sulphuré nickelifere, *Haüy.*

Id. Lucas, t. ii. p. 471. *Id. Vauquelin,* Annal. du Mus. t. xix. p. 52.—Spiessglanzkies, *Haus.* Handb. b. i. s. 192.—Nickel Antimonerz, *John,* in Scwheigger's Journal for 1814.

External Characters.

Its colour is steel-grey, which passes on the one side into lead-grey, on the other into tin-white, and is tarnished with tempered-steel colours.

It

It occurs massive and disseminated.
It is shining and glistening.
It has a double rectangular cleavage.
The fragments are cubical.
It is harder than grey antimony.
It is brittle.
It is easily frangible.
Specific gravity, 5.65—6.546, *Strohmeyer;* 6.020—6.833, *Ullman.*

Chemical Characters.

On exposure to the blowpipe, it melts, emits a white vapour, having the smell of arsenic, part of which remains attached to the charcoal, to which it communicates a yellow colour. In proportion as the vapours are exhaled, the fusibility is diminished, until the remaining portion becomes infusible: the infusible portion appears as a small white easily frangible button, which proves that at least two metals enter into the composition of this ore.

It is partly soluble in nitric acid, to which it communicates a green colour, and deposites a white powder. It is almost entirely dissolved in muriatic acid.—*Vauquelin.*

Constituent Parts.

It is composed of Antimony, Nickel, Arsenic, Iron, Lead, and Sulphur: of these, the antimony is the most abundant, forming about half of the ore; the next in quantity is the nickel; arsenic the third; sulphur the fourth; iron the fifth; and lead but in very small quantity. It is probable that the antimony and sulphur form a particular combination, the arsenic and nickel another, which is me-

 chanically

chanically mixed with the first, and that the lead and iron are combined with the sulphur.—*Vauquelin.*

According to John, it contains Antimony with Arsenic, 61.68; Nickel, 23.33; Sulphur, 14.16; Silica with Silver and lead, 0.83; Trace of Iron. According to Strohmeyer, 43.80 Antimony; 36.60 Nickel; 17.71 Sulphur; 1.89 Iron and Manganese. According to Ullman, 47.75 Antimony; 25.25 Nickel; 11.75 Arsenic; 15.25 Sulphur.

Geognostic and Geographic Situations.

It occurs in veins near Freussberg, in the county of Sayn-Altenkirchen, in the principality of Nassau, along with sparry iron, galena or lead-glance, and copper-pyrites.

ORDER V. *BLENDE.*

GENUS I. MANGANESE-BLENDE.

Glanz-Blende, *Mohs.*

Mangan-Blende, *Werner.*

This genus contains but one species, viz. Prismatic Manganese Blende. * Phosphate of Manganese.

1. Prismatic Manganese Blende.

Prismatischer Glanz-Blende, *Mohs.*

Schwarzerz, *Müller v. Reichenstein,* Phys. arb. d. eintr. Fr. i. Wien. 1. Jahrg. 2. Quart. s. 86. *Id. Reuss,* b. ii. 4. s. 446. —Braunsteinkies, *Leonhard,* Tabel. s. 70.—Manganglanz, *Karsten,* Tabel. s. 72.—Manganese sulphuré, *Haüy,* Tabl. p. 111.—Schwarzerz, *Haus.* Handb. b. i. s. 199.—Manganblende, *Hoff.* b. iv. s. 197.—Sulphuret of Manganese, *Aikin,* p. 132.

External Characters.

Its colour on the fresh fracture is iron-black, which approaches to dark steel-grey; but on exposure it becomes tarnished of a brownish-black colour.

It occurs massive, disseminated: in distinct concretions, which are coarse and small granular, and in which the surfaces are marked with interrupted fortification-like streaks. It is sometimes crystallised: its primitive form is an oblique four-sided prism, the dimensions of which are unknown. The prism occurs variously modified by truncation on the lateral edges.

Its

Its lustre is splendent or shining, and semi-metallic.

Its cleavage is prismatic, but is very imperfect.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

Its streak is of a greenish colour.

It is harder than calcareous-spar, and sometimes as hard as fluor-spar.

It is intermediate between sectile and imperfectly brittle, and is easily frangible.

Specific gravity, 3.9, 4.0, *Mohs*; 3.95, *Klaproth*.

Chemical Characters.

Before the blowpipe, it gives out sulphur, and tinges borax violet-blue.

Constituent Parts.

Oxide of Manganese,	82.00	85
Sulphur, -	11.50	15
Carbonic Acid, -	5.00	-
	98	100
	Klaproth, Beit. b. iii. s. 42.	*Vauquelin*, Annal. d. Mus. vi. s. 405.

Geognostic and Geographic Situations.

It is found in Cornwall; and at Nagyag in Transylvania, along with ores of tellurium, blende, copper-pyrites, compact red manganese, and brown-spar.

Observations.

1. It is easily distinguished from all metalliferous minerals, having the same colour, by its greenish-grey streak.

 It

It is most nearly allied to *Black Blende*, but is readily distinguished by its streak, and the form of its crystals.

2. It has been described under the following names, Schwarzerz, Braunsteinkies, Magnesiumkies, Braunsteinblende, and Manganglanz.

* Phosphate of Manganese.

Eisenpecherz, *Werner*.

Fer phosphaté, *Broch.* t. ii. p. 533.—Manganese phosphaté, *Brong.* t. ii. p. 112.—Phosphormangan, *Karsten,* Tabel. s. 72. —Manganese phosphaté ferrifere, *Haüy,* Tabl. p. 111.—Triplit, *Haus.* Handb. b. iii. s. 1079.—Eisenpecherz, *Hoff.* b. iii. s. 300.—Phosphate of Manganese, *Aikin,* p. 133.

External Characters.

Its colour is brownish-black, sometimes inclining to clove-brown.

It occurs massive and disseminated.

Internally it is shining, glistening, or glimmering, and the lustre is resinous, inclining to adamantine.

Its cleavage is imperfect, and appears to be in the direction of the lateral planes of a prism.

The fracture is imperfect, and flat conchoidal.

It is opaque in the mass, but semi-transparent in splinters.

It scratches glass.

Its streak is yellowish-grey.

It is brittle and easily frangible.

Specific gravity, 3.4390, *Vauquelin.* 3.767, 3.775, *Ullmann,* 3.731, *Karsten.* 3.562, *Breithaupt.*

Chemical

Chemical Characters.

It is readily fusible before the blowpipe into a black enamel.

Constituent Parts.

Oxide of Manganese,	-	42
Oxide of Iron,	-	31
Phosphoric Acid,	-	27
		100

Vauquelin, Journ. d. Min. N. 64. p. 299.

Geognostic and Geographic Situations.

It occurs in a coarse granular granite at Limoges in France; and it is said also in Pennsylvania.

GENUS II.—ZINC-BLENDE OR GARNET-BLENDE *.

Granat-Blende, *Mohs.*

This genus contains one species, viz. Dodecahedral Zinc-Blende.

1. Dodecahedral

* This genus is by Mohs named *Garnet-Blende*, on account of its resemblance to garnet: throughout the present system, it is in general simply named Blende.

1. Dodecahedral Zinc-Blende.

Dodecaedrischer Granat-Blende, *Mohs.*

Blende, *Werner.*

This species is divided into three subspecies, viz. Yellow Zinc-Blende, Brown Zinc-Blende, and Black Zinc-Blende.

First Subspecies.

Yellow Zinc-Blende.

Gelbe Blende, *Werner.*

Id. Wern. Pabst. b. i. s. 188. *Id. Wid.* s. 898.—Yellow Blende, *Kirw.* vol. ii. p. 238.—Gelb Blende, *Emm.* b. ii. s. 443.—La Blende jaune, *Broch.* t. ii. p. 350.—Gelbe Blende, *Reuss,* b. iv. s. 326. *Id. Lud.* b. i. s. 273. *Id. Suck.* 2ter th. s. 367. *Id. Bert.* s. 464. *Id. Mohs,* b. iii. s. 557. *Id. Leonhard,* Tabel. s. 74.—Zinc sulphuré jaune, *Brong.* t. ii. p. 141.—Gelbe Blende, *Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 232. *Id. Hoff.* b. iv. s. 74.—Phosphorescent Blende, *Aikin,* p. 118.

External Characters.

It exhibits the following series of colours: asparagus and oil green, seldom sulphur-yellow, most frequently wax-yellow, which sometimes passes into yellowish-grey, then into lemon, honey, and orange yellow, aurora and hyacinth red, into pale reddish brown, which forms the transition into brown blende. All these colours incline more or less to green.

It occurs usually massive, disseminated, in granular concretions,

concretions, and crystallised in octahedrons, rhomboidal dodecahedrons, and in twin crystals.

The crystals are middle-sized and small, seldom single, generally in druses, but usually so much grown together, that it is difficult to determine their figure.

The crystals have a smooth surface.

Externally and internally it is shining and splendent, and the lustre is adamantine, inclining to resinous.

The cleavage is dodecahedral, that is, it is sixfold, and the folia are parallel with the sides of the dodecahedron.

The fragments are dodecahedral, but on account of the distinct concretions can seldom be obtained perfect, and are therefore most commonly indeterminate angular, and sharp-edged.

It is usually only translucent, but the lighter coloured varieties are semitransparent, inclining to transparent.

It refracts single.

It yields a yellowish-grey or yellowish-white streak.

It is harder than calcareous-spar, and even as hard as fluor-spar.

It is brittle, and easily frangible.

Specific gravity, 4.0, 4.2, *Mohs*; 4.044 to 4.048, *Gellert*; 4.067, *Kirwan*; 4.103, *Karsten*.

Physical Character.

It becomes phosphorescent by friction; and, according to Bergmann, as powerfully under water as in the air.

Chemical Characters.

It decrepitates before the blowpipe, becomes grey, but is infusible either alone or with borax.

Constituent

Constituent Parts.

Yellow Blende from Scharfenberg.		
Zinc, -	64	62.0
Sulphur, -	20	34.0
Iron, -	5	1.5
Fluoric Acid, -	4	
Silica, -	1	
Water, -	6	
	100	97.5
	Bergmann, Opuscul. t. ii. p. 345.	*Gueniveau*, Journ. des Mines, N. 126.

Geognostic Situation.

It occurs in veins in primitive, transition, and flœtz rocks, where it is generally associated with galena or lead-glance.

Geographic Situation.

It occurs along with galena or lead-glance, copper-pyrites, copper-green, red cobalt, and heavy-spar, in veins that traverse quartz-rock, at Clifton Mine, near Tyndrum in Perthshire; also in Flintshire. Very beautiful specimens are met with at Ratieborziz in Bohemia, where it is associated with galena or lead-glance, grey copper, iron-pyrites, brown-spar, and quartz; and sometimes also with native silver, silver-glance or red silver. It is also found at Scharfenberg in Saxony; Rammelsberg in the Hartz, in veins in transition rocks. The green varieties are found at Gumerud in Norway, associated with galena or lead-glance, smalt-blue apatite, in transition rocks; and it is accompanied with manganese-blende and red manganese, at Nagyag in Transylvania.

Observations.

Observations.

It is characterised by its colour, strong adamantine lustre, and high degree of transparency; the reddish varieties are distinguished from *Red Silver* and from *Cinnabar*, by their distinct cleavage, superior hardness, and inferior weight.

Second Subspecies.

Brown Zinc-Blende.

Braun Blende, *Werner.*

This subspecies is divided into two kinds, viz. Foliated Brown Zinc-Blende, and Fibrous Brown Zinc-Blende.

First Kind.

Foliated Brown Zinc-Blende.

Blättrige Braune Blende, *Werner.*

Id. Werner, Pabst. b. i. s. 191. *Id. Wid.* s. 896.—Brown Blende, *Kirw.* vol. ii. p. 239.—Braune Blende, *Emm.* b. ii. s. 447.—La Blende brune, *Broch.* t. ii. p. 353.—Braune Blende, *Reuss,* b. iv. s. 330. *Id. Lud.* b. i. s. 274. *Id. Suck.* 2ter th. s. 369. *Id. Bert.* s. 466. *Id. Mohs,* b. iii. s. 564. *Id. Leonhard,* Tabel. s. 74.—Zinc sulphuré brun, *Brong.* t. ii. p. 141.—Braune Blende, *Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 231.—Blättrige Braune Blende, *Hoff.* b. iv. s. 78.

External Characters.

Its principal colour is reddish-brown, which passes on the one side into hyacinth-red and yellowish-brown, and on the other into blackish-brown, and rarely into clove-brown.

It

It is sometimes tarnished with variegated colours.

It occurs usually massive, and disseminated, also in granular distinct concretions, varying in magnitude from large to extremely fine granular; often crystallised:

1. Rhomboidal dodecahedron, which may be viewed as the fundamental or primitive figure. It is either perfect or truncated on the alternate lateral edges and angles, with triangular planes.
2. Octahedron, which is sometimes elongated, and is either perfect, truncated on the edges or angles, or on both at once; and sometimes bevelled on the edges.
3. Tetrahedron, which is either perfect or truncated on the angles.
4. Acicular crystals.

The crystals are small, very small, and middle-sized. Their lateral planes are generally convex.

Externally it is drusy and shining.

Internally it alternates from specular splendent to feebly glimmering, and the lustre is intermediate between pearly and adamantine.

The cleavage is sixfold or tessular.

It is more or less translucent, commonly strongly translucent on the edges. The extremely fine granular variety is opaque. The large and coarse granular varieties are translucent, sometimes bordering on perfect transparent.

It yields a yellowish-brown streak.

In other characters, agrees with the preceding.

Specific gravity 4.048, *Gellert.*

Constituent Parts.

From Sahlberg.		Allonheads, Northumberland.	
Zinc, -	44	Zinc, -	58.8
Iron, -	5	Sulphur, -	23.5
Sulphur, -	17	Iron, -	8.4
Silica, -	24	Silica, -	7.0
Alumina, -	5		
Water, -	5		97.7
	100		*Dr Thomson.*

Bergmann, Opusc. t. ii. p. 332.

Blende, like all other ores, often contains what, chemically considered, may be viewed as accidental ingredients; thus the blende of Prizbram frequently contains silver; and that from Nagyag, manganese, lead, arsenic, and auriferous silver.

Geognostic Situation.

It occurs principally in veins and beds, in primitive and transition rocks; seldomer in secondary or flœtz rocks. It is associated with ores of different kinds, such as galena or lead-glance, copper-pyrites, iron-pyrites, grey copper, and black silver-ore.

Geographic Situation.

It occurs in the Clifton lead-mine near Tyndrum in Perthshire; in small veins along with galena, in the coal-fields around Edinburgh; at Cumberhead in Lanarkshire, along with galena or lead-glance; at Leadhills it is associated with galena, white lead-spar, sulphate of lead, sparry ry iron, iron-pyrites, brown hematite, blue copper, electric calamine, and wad; the vein-stones are quartz, lamellar heavy-spar, calcareous-spar, brown-spar, and mountain-cork. It is met with in all the lead-mines in England and Wales. On the Continent of Europe it forms a constant attendant of galena or lead-glance, whether it occurs in veins or beds; and it maintains the same relation in the lead-mines of Asia, Africa and America.

Second Kind.

Fibrous Brown Zinc-Blende.

Fasrige Braune Blende, *Werner.*

Hepatisches Zinkerz, *Widemann,* Min. s. 906.—Zink sulphuré compacte, *Broch.* t. ii. p. 359.—Schaalenblende, *Reuss,* b. iv. s. 342. *Id. Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 233.—Fasrige & Strahlige Braune Blende, *Hoff.* b. iv. s. 83, 84.—Fibrous Blende, *Aikin,* p. 119.

External Characters.

Its colour is dark reddish-brown, which passes sometimes into yellowish, seldom into clove brown.

It occurs massive and reniform; also in distinct concretions, which are scopiform and stellular fibrous or radiated, and collected into others, which are granular, and these again traversed by curved lamellar concretions, bent in the direction of the external surface.

It is glistening, passing into strongly glimmering, and the lustre is resinous, inclining to pearly.

It

It is opaque, or very feebly translucent on the edges.

In other characters it agrees with foliated brown blende.

Constituent Parts.

	From the Breisgau.
Zinc, - - - -	62
Iron, - - - -	3
Lead, - - - -	5
Arsenic, - - - -	1
Sulphur, - - - -	21
Alumina, - - - -	2
Water, - - - -	4
	98

Hecht, in Journ. d. Min. t. xlix. N. 13.

Geognostic and Geographic Situations.

It occurs in Huel Unity copper-mine in Cornwall, in small masses, incrusting copper-pyrites, and is sometimes itself covered with sparry-iron; and along with galena and iron pyrites at Geroldsbeck in the Breisgau, and Raibel in Carinthia.

Observations.

1. It bears a considerable resemblance to fibrous brown iron-ore, from which it is principally distinguished by its resinous lustre, and its accompanying minerals.

2. The lamellar variety is described under the name *Schaalenblende.*

Third

Third Subspecies.

Black Zinc-Blende.

Schwarze Blende, *Werner*.

Id. Werner, Pabst. b. i. s. 193. *Id. Wid.* s. 893.—Black Blende, *Kirw.* vol. ii. p. 241.—Schwarze Blende, *Emm.* b. ii. s. 451.—La Blende noire, *Broch.* t. ii. p. 357.—Schwarze Blende, *Reuss*, b. iv. s. 337. *Id. Lud.* b. i. s. 275. *Id. Suck.* 2ter th. s. 371. *Id. Bert.* s. 467. *Id. Mohs*, b. iii. s. 575. *Id. Leonhard*, Tabel. s. 74.—Zinc sulphuré noir, *Brong.* t. ii. p. 141. —Schwarze Blende, *Karsten*, Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 230. *Id. Hoff.* b. iv. s. 86.

External Characters.

Its colour is intermediate between greyish and velvet black; it is rarely of a blood-red colour. It is sometimes tarnished with variegated colours.

It occurs massive, disseminated, in granular distinct concretions, and crystallised in the same figures as brown blende.

The crystals are small; and so much grown together, that it is very difficult to ascertain their figure.

Internally it is shining, sometimes splendent, and the lustre is adamantine, inclining to metallic.

The cleavage is the same as in the other subspecies, but much less distinct.

The fragments are indeterminate angular, and rather sharp-edged.

It is almost always opaque, excepting the blood-red variety, which is translucent on the edges and angles.

The streak is dark yellowish-brown.

Its other characters agree with the preceding.

Specific gravity, 4.1665, *Brisson*; auriferous from Nagyag, according to *Von Müller*; 4.085,—4.108, *Breithaupt*.

Constituent Parts.

	From Danemora.	Bowallon.
Zinc, -	45	52
Iron, -	9	8
Lead, -	6	–
Arsenic, -	1	–
Copper, -	–	4
Sulphur, -	29	26
Silica, -	4	6
Water, -	6	4
	100	100

Bergman, Opuscul. t. iv. p. 329.

Oxide of Zinc,	53
Iron, -	12
Arsenic, -	5
Sulphur, -	26
Water, -	4
	100

Lampadius, Handb. z. Chem. Annal. d. Min. s. 282.

The black blende from Nagyag, besides zinc, iron, and manganese, contains a portion of auriferous silver. The lead and copper obtained from blende by Bergman, were probably derived from very minutely mixed galena or lead-glance and copper-pyrites, and the silica from the vein-stone. In the Freyberg mining district, some varieties of blende, named *Verglaste Blende*, contain a small portion of silver.

Geognostic Situation.

It occurs in veins in gneiss, seldomer in grey wacke. It is generally accompanied with copper-pyrites, arsenical-pyrites,

pyrites, iron-pyrites, magnetic iron-ore, red silver, white silver, and galena. It is rarely associated with brown blende. Its accompanying vein-stones are calcareous-spar, brown-spar, and rarely asbestous actynolite, and garnet.

Geographic Situation.

It occurs in Sweden, Saxony, Silesia, Hungary, Transylvania, and in Mexico.

Uses of the Species.

This ore is valued on account of the zinc which it affords. In order to obtain that metal from it, it is first roasted, to drive off the sulphur, and then ground with charcoal, and exposed to heat in a crucible, when the metal is reduced, and sublimes into a lute, so placed as to convey it into water, when it condenses in small drops.

Observations on the Species.

1. It is distinguished from *Tinstone*, by its inferior hardness: from *Galena* or *Lead-Glance*, by its grey-coloured dull streak; and it is distinguished from most other substances which it resembles, by exhaling a sulphureous odour, when either triturated in a mortar, or thrown into an acid.

2. Of all the subspecies, the brown is the most frequent and abundant.

3. Blende is named *Black Jack* by the miners in England; and is also known under the name *Pseudo-galena*.

Genus III.

Genus III.—ANTIMONY-BLENDE.

Nadel-Blende, *Mohs.*

This genus contains one species, viz. Prismatic Antimony-Blende.

1. Prismatic Antimony-Blende, or Red Antimony.

Prismatische Nadel-Blende, *Mohs.*

Rothspiesglaserz, *Werner.*

This species is subdivided into two subspecies, viz. Common Antimony-Blende, and Tinder Antimony-Blende.

First Subspecies.

Common Antimony-Blende, or Common Red Antimony.

Gemeines Rothspiesglaserz, *Werner.*

Minera Antimonii colorata, *Wall.* t. ii. p. 199.—Roth-spiesglaserz, *Werner,* Pabst. b. i. s. 202. *Id. Wid.* s. 918.—Red Antimonial ore, *Kirw.* vol. ii. p. 250.—Rothspiesglaserz, *Emm.* b. ii. s. 477.—Antimoine rougeâtre, mineralisé par le Soufre, *Lam.* t. i. p. 343.—Antimoine hydro-sulphuré, *Haüy,* t. iv. p. 276.—L'Antimoine rouge, *Broch.* t. ii. p. 379.—Rothspiesglanzerz, *Reuss,* b. iv. s. 379. *Id. Lud.* b. i. s. 281. *Id. Such.* 2ter th. s. 390. *Id. Bert.* s. 480. *Id. Mohs,* b. iii. s. 706.—Antimoine hydro-sulphuré, *Lucas,* p. 174.—Rothspiesglanzerz, *Leonhard,* Tabel. s. 79.—Antimoine hydro-sulphuré capillaire, *Brong.* t. ii. p. 129.—Rothspiesglanzerz, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 77.—Hydro-sulphuret of Antimony, *Kid*, vol. ii. p. 202.—Antimoine hydro-sulphuré, *Haüy*, Tabl. p. 113.—Rothspiesglanzerz, *Haus.* Handb. b. i. s. 225. —Gemeines Rothspiesglanzerz, *Hoff.* b. iv. s. 115.—Red Antimony, *Aikin*, p. 124.

External Characters.

Its colour is distinct cherry-red, and the surface has sometimes a tempered steel or columbine tarnish.

It occurs massive, disseminated, in flakes; in granular distinct concretions; and also crystallised.

The primitive form is an oblique four-sided prism, the dimensions of which are unknown.

The crystals are generally delicate capillary, and are variously aggregated, as scopiformly, stellularly, and promiscuous.

Externally and internally it is shining, and the lustre is nearly adamantine.

The cleavage is prismatic.

The fragments are wedge-shaped and splintery.

It is opaque, or translucent on the edges.

The colour is not changed in the streak.

It is harder than talc, but not so hard as gypsum.

It is rather brittle, and very easily frangible.

Specific gravity 4.5, 4.6, *Mohs.*

Chemical Characters.

It melts and evaporates before the blowpipe, giving out a sulphureous odour.

Constituent

Constituent Parts.

From the mine called Neue Hoffnung Gottes at Braünsdorf:

Antimony,	-	67.50
Oxygen,	-	10.80
Sulphur,	-	19.70
		98.00

Klaproth, Beit. b. iii. s. 182.

Geognostic Situation.

This rare mineral occurs in veins, in primitive rocks, generally along with native antimony, grey antimony, and ores of arsenic, and these are associated with quartz, iron-pyrites, and calcareous-spar.

Geographic Situation.

It occurs at Braunsdorf in Saxony; Allemont in France; in Tuscany; at Malaczka in Hungary; and Felsobanya in Transylvania.

Observations.

1. The cherry-red colour, acicular, variously aggregated crystals, and lustre, are the principal characters of this mineral; it is distinguished from *Red Silver* and *Red Copper-ore* by its colour, fracture, and inferior specific gravity.

2. It has been described under the name *Natürlicher Mineral Kermes.*

Second Subspecies.

Tinder Antimony-Blende.

Zundererz, *Werner.*

Zundererz, *Reuss*, b. iii. s. 382. *Id. Leonhard*, Tabel. s. 79. *Id. Karsten*, Tabel. s. 72. *Id. Haus.* Handb. b. i. s. 226. *Id. Hoff.* b. iv. s. 117.

External Characters.

Its colour is muddy cherry-red.

It occurs in very delicate flexible tinder-like leaves, which have sometimes a promiscuous fibrous texture.

Its lustre is feebly glimmering.

It is opaque.

It becomes shining in the streak.

It is friable.

It is sectile and flexible.

It is easily frangible.

Chemical Characters.

Before the blowpipe, the antimony, lead and sulphur, evaporate, and colour the charcoal white and yellow; the residuum melts into a black magnetic slag.

Constituent Parts.

According to an analysis by Link, this ore appears to contain in 100 parts, 33 of Oxide of Antimony, 40 of Oxide of Iron, 16 of Lead, and 4 of Sulphur. It also contains a portion of Silver.—Vid. N. Journ. de Chem. v. s. 461.

Geognostic

Geognostic and Geographic Situations.

It occurs principally in the mines named Carolina and Dorothea at Clausthal, where it is associated with crystals of quartz, calcareous-spar, and lead-glance.

Use.

It is considered as an ore of silver in the districts where it occurs.

Observations.

It is named Tinder Antimony-Blende, from the leaves, which resemble in form and general aspect the substance named Tinder.

GENUS IV.—RUBY-BLENDE.

Rubin-Blende, *Mohs.*

This genus contains two species, viz. Rhomboidal Ruby-Blende, and Prismato-rhomboidal Ruby-Blende.

1. Rhomboidal Ruby-Blende, or Red Silver.

Rhomboedrische Rubin-Blende, *Mohs.*

This species is divided into two subspecies, viz. Dark Red Silver and Light Red Silver. * Red Zinc.

First

First Subspecies.

Dark Red Silver.

Dunkles Rothgiltigerz, *Werner.*

Id. Werner, Pabst. b. i. s. 45. *Id. Wid.* s. 703.—Dark red Silver-ore, *Kirw.* vol. ii. p. 123.—Dunkles Rothgiltigerz, *Estner,* b. iii. s. 410. *Id. Emm.* b. ii. s. 185.—L'Argent rouge foncé, *Broch.* t. ii. p. 143.—Argent antimonié sulphuré, *Haüy,* t. iii. p. 402,–416.—Dunkles Rothgiltigerz, *Reuss,* b. iii. s. 358. *Id. Lud.* b. i. s. 215. *Id. Suck.* 2ter th. s. 153. *Id. Bert.* s. 372. *Id. Mohs,* b. iii. s. 168. *Id. Leonhard,* Tabel. s. 55. —Argent rouge sombre, *Brong.* t. i. p. 254.—Dunkles Rothgiltigerz, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 77.—Antimoniated Sulphuret of Silver, *Kid,* vol. ii. p. 89.—Argent antimonié sulphuré rouge obscur, *Haüy,* Tabl. p. 76.—Dunkles Rothgiltigerz, *Haus.* Handb. b. i. s. 221. *Id. Hoff.* b. iii. s. 68.—Red or ruby Silver, *Aikin,* p. 79.

External Characters.

Its colour is intermediate between cochineal-red and dark lead-grey, which sometimes passes into blackish lead-grey, and even inclines to iron-black.

It occurs massive, disseminated, in membranes; and crystallized.

Its primitive figure is a rhomboid of 109° 28′; and the following are the secondary figures:

1. Equiangular six-sided prism, which is either perfect, or truncated on the terminal edges and angles, or on the alternate lateral edges.
2. Equiangular six-sided prism, flatly acuminated with three

three planes, which are set on the alternate lateral planes. Sometimes the summit and the edges of the acumination are truncated.

3. Equiangular six-sided prism, very flatly acuminated with six planes, which are set on the lateral planes. The summits of the acuminations are sometimes so deeply truncated, that the acuminating planes become truncations on the terminal edges.
4. The preceding figure, in which the six planed acumination is again acuminated with three planes, which are set on the alternate lateral edges of the first acumination.
5. Equiangular double six-sided pyramid, flatly acuminated with six planes, which are set on the lateral planes.

The crystals are sometimes acicular and capillary, and are middle-sized, small, and very small.

The surface of the crystals is generally smooth, and rarely transversely streaked.

Externally it alternates from shining to splendent, and the lustre is semi-metallic or adamantine.

Internally it alternates from shining to glimmering, and has sometimes an adamantine, sometimes a semi-metallic lustre.

The cleavage is rhomboidal.

The fracture of the massive and other similar varieties is usually coarse and fine-grained uneven; that of the crystallised varieties imperfect and small conchoidal.

The fragments are indeterminate angular, and blunt-edged.

The massive varieties are opaque; those which are crystallised tallized semi-transparent, passing into transparent, and sometimes only translucent.

The streak is cochineal-red, and the lustre unchanged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is sectile, but not in so high a degree as brittle silver-glance.

It is easily frangible; more easily frangible than brittle silver-glance.

Specific gravity, 5.2, 5.7, *Mohs.* 5.608, 5.684, *Gellert.* 5.5637, *Brisson.*

Chemical Characters.

Before the blowpipe, it first decrepitates, then melts with a slight effervescence, and the disengagement of sulphureous and antimonial yellow and white vapours, leaving behind a globule of silver.

Constituent Parts.

Silver, - - -	60.0
Antimony, - -	20.3
Sulphur, - -	14.7
Oxygen, - -	5.0
	100.0

Klaproth, Beit. b. v. s. 200.

Or, according to Thenard, 58.4 Oxide of Silver; 23.5 Oxide of Antimony; and 16 of Sulphur.

Geognostic Situation.

It occurs in veins in gneiss, mica-slate, porphyry, and grey-wacke, along with brittle silver-glance, white silver, galena

galena or lead-glance, iron-pyrites, sparry iron, blende, copper-pyrites, zeolite, cross-stone, calcareous-spar, and brown-spar.

Geographic Situation.

Europe.—It was at one time met with in a cross vein in Huel Duchy mine in Cornwall, associated with native silver and black silver. On the Continent of Europe, it is met with in the silver-mines of Kongsberg, already so often mentioned; also in those of the Hartz, where it is sometimes associated with galena or lead-glance, iron-pyrites, quartz, and calcareous-spar; sometimes with galena or lead-glance, native arsenic, hepatic pyrites, quartz, and calcareous-spar: at Schemnitz, it is generally accompanied with brittle silver-glance: at Kremnitz, its accompanying minerals are brittle silver-glance, iron and copper pyrites, brown-spar, quartz, and amethyst, and sometimes silver-glance and galena or lead-glance: at Boitza in Transylvania, it occurs along with iron-pyrites, yellow blende, galena or lead-glance, brittle silver-glance, brown-spar, common quartz, and amethyst: at Joachimsthal in Bohemia, it is found imbedded in quartz, calcareous-spar, or hepatic pyrites, and is accompanied with brittle silver-glance, and several other ores.

America.—This ore forms a principal part of the wealth of Sombrerete, Cosala, and Zolaga, near Villalta, in the province of Oaxaca in Mexico. From this ore more than 700,000 marcs of silver have been extracted, in the famous mine of *La Veta Negra*, near Sombrerete, in the space of from five to six months. It is affirmed, that the mine which produced this enormous quantity of metal, the greatest

est which was ever yielded by any vein on the same point of its mass, was not ninety-eight feet in length *.

Observations.

Colour, form, lustre, red streak, and inferior specific gravity, distinguish it from *Brittle Silver-glance;* and its form, fracture, want of distinct concretions, and streak, distinguish it from *Dark Red Cinnabar.*

Second Subspecies.

Light Red Silver.

Lichtes Rothgiltigerz, *Werner.*

Id. Werner, Pabst. b. i. s. 52. *Id. Wid.* s. 706.—Light Red Silver-ore, *Kirw.* vol. ii. p. 122.—Lichtes Rothgiltigerz, *Estner,* b. iii. s. 426. *Id. Emm.* b. ii. s. 190.—L'Argent rouge clair, *Brock.* t. ii. p. 147.—Argent antimonié sulphuré rouge vif, *Haüy,* t. iii. p. 410.—Lichtes Rothgiltigerz, *Reuss,* b. iii. s. 305. *Id. Lud.* b. i. s. 217. *Id. Suck.* 2ter th. s. 102. *Id. Bert.* s. 375. *Id. Mohs,* b. iii. s. 193. *Id. Leonhard,* Tabel. s. 55. *Id. Karsten,* Tabel. s. 60. *Id. Haus.* s. 76.—Argent antimonié sulphuré rouge vif, *Haüy,* Tabl. p. 75.—Lichtes Rothgiltigerz, *Haus.* Handb. b. i. s. 221. *Id. Hoff.* b. iii. s. 74.

External Characters.

Its colour is cochineal-red, which passes on the one side into a colour intermediate between cochineal-red and lead-grey,

* Humboldt's New Spain, vol. iii. p. 155. Black's translation.

grey, and on the other it approaches to carmine-red. It has rarely a columbine tarnish.

It occurs massive, disseminated, in membranes, small botryoidal, and crystallised.

Its crystallizations are nearly the same with those of the preceding subspecies; but of all the forms, the most frequent is the double six-sided pyramid.

The crystals are seldom middle-sized, usually small, and very small, and occur in druses.

The surface of the crystals is usually smooth, sometimes streaked; the streaks being longitudinal in the prisms, but oblique in the pyramids, and sometimes drusy.

Externally the lustre is splendent, passing into shining.

Internally it alternates from shining to glistening, and has usually an adamantine lustre; the varieties that incline to the foregoing subspecies have a semi-metallic lustre.

The fracture is usually imperfect and small conchoidal, which sometimes passes into coarse and small-grained uneven.

The fragments are rather sharp-edged.

The massive varieties are generally translucent on the edges; the crystallised usually transparent.

The streak is aurora-red, passing into cochineal-red.

Specific gravity, 5.443, *Gellert*; 5.5886, *Brisson*; 5.592, *Vauquelin*.

Chemical Characters.

On Charcoal, before the blowpipe, it melts, blackens, and burns with a blue flame like sulphur, diffusing a white smoke, and a feeble garlic smell, and leaves a globule of nearly pure slver.—*Vauquelin*.

Constituent

Constituent Parts.

From the mine called Catharina Neufang, at Andreasberg.		Mine called Churprinz Friedrich August, near Freyberg.	1st Analysis.	2d Analysis.
Silver,	60.0	62.00	56.6748	54.2713
Antimony,	20.3	18.50	16.13	16.3
Sulphur,	14.7	14.45	15.0666	17.75
Oxygen,	5.0	5.05	12.1286	11.8487
	100.00	100.0	100	100
	Klaproth.	*Klaproth.*	*Vauquelin.*	*Vauquelin.*

			From Johanngeorgenstadt.
Oxide of Silver, -	58.4	Silver, -	61.0
Oxide of Antimony,	23.5	Antimony, -	19.0
Sulphur, - -	16.0	Sulphur, -	11.1
		Sulphuric Acid,	7.0
	97.9	Arsenic, -	2.9
	Thenard.		101
			Lampadius.

Geognostic Situation.

It occurs in veins, in the same species of rocks as the dark red subspecies, but is distinguished from it by its accompanying minerals, which are, native arsenic, red orpiment, nickel-pyrites, white cobalt, straight lamellar heavy-spar, calcareous-spar, and fluor-spar, and occasionally native silver, silver-glance, copper-pyrites, and small quantities of galena or lead-glance, iron-pyrites, and sparry iron.

Geographic Situation.

Europe.—This mineral occurs at Andreasberg in the Hartz, where it is accompanied with native arsenic, quartz, and calcareous-spar; in many of the mines in the kingdom

dom of Saxony, as at Kurprinz Friedrich-August at Gross-scherma, along with native arsenic, and lamellar heavy-spar; at Himelsfürt, along with native arsenic, copper-pyrites, heavy-spar, brown-spar, and quartz; at Johanngeorgenstadt, with white cobalt, nickel-ochre, silver-glance, and iron-pyrites; at Marienberg, with white cobalt, naitve arsenic, galena or lead-glance, dark-red silver, iron-pyrites, heavy-spar, calcareous-spar, fluor-spar, sparry-iron, and brown-spar; at Schneeberg, with white cobalt, dark-red silver, copper-nickel, or nickel-pyrites, iron-pyrites, sparry iron, calcareous-spar, and quartz; at Joachimsthal in Bohemia, it is accompanied with common silver-glance, brittle silver-glance, white cobalt, orpiment, copper-pyrites, sparry iron, brown-spar, calcareous-spar, heavy-spar, and hornstone; at Markirchen in Alsace, along with native arsenic, silver-glance, galena or lead-glance, copper-pyrites, brown-spar, calcareous-spar, and quartz; in the Sierra Morena in Spain, along with arsenical silver, and calcareous-spar; and at Schemnitz and Kremnitz in Hungary.

America.—It is found in the mines of Guanaxuato, in some veins, associated with native gold, common silver-glance, brittle silver-glance, copper green, blue copper, iron-pyrites, quartz, and calcareous-spar; in others with native gold, galena or lead-glance, zinc-blende, copper-pyrites, iron-pyrites, and sparry iron. In the mining district of Porco, in Potosi in Peru, it is accompanied with dark-red silver, native silver, blende, iron-pyrites, and calcareous-spar.

Uses.

Both subspecies are smelted, on account of the silver they contain. The dark-red is considerably more productive than the light red.

Observations.

Observations.

1. Red Silver, Cinnabar, and Red Copper-ore, have several characters in common: the following, however, sufficiently distinguish them from one another.

Cinnabar has a specific gravity of 7.0, and is almost always accompanied with native mercury and iron-ochre; whereas the specific gravity of Red Silver does not exceed 5.7; and its accompanying fossils, as already mentioned, are very different from those of cinnabar.

Red Copper-ore has a specific gravity of 5.6, 6.0, and is usually accompanied with native copper, malachite, and brown iron-ochre,—characters that distinguish it sufficiently from Red Silver.

2. Red Silver has a slight resemblance to *Copper-glance* and *Red Orpiment*. Copper-glance gives a blackish streak; red orpiment an orange-yellow streak, and its specific gravity is only 3.2,—characters that distinguish them at once from Red Silver.

3. The colour of the streak distinguishes the two subspecies from one another: the dark-red affords a cochineal or brick-red coloured streak; but the light-red an aurora-coloured streak.

4. The Light Red Silver, as already mentioned, occurs usually with native arsenic, and white cobalt, also with orpiment and heavy-spar; but the dark, on the contrary, with galena or lead-glance, white silver, brittle silver, quartz, calcareous-spar, and iron-pyrites. They are thus, by these geognostic characters, well distinguished from one another.

5. In the Hartz and Hungary, dark red silver occurs frequently, the light red rarely.

2. Prismato-rhomboidal Ruby-Blende or Cinnabar.

Prismato-Rhomboedrische Rubin-Blende, *Mohs.*

This species is divided into three subspecies, viz. Dark Red Cinnabar, Bright Red Cinnabar, and Hepatic Cinnabar.

First Subspecies.

Dark Red Cinnabar.

Dunkel-rother Zinnober, *Werner.*

Minium, *Plin.* Hist. Nat. xxxiii. s. 38. (ed. Bip. 5. v. 204.)—Dunkel-rother Zinnober, *Werner*, Pabst. b. i. s. 8. *Id. Wid.* s. 728.—Dark Red Cinnabar, *Kirw.* vol. iii. p. 228.—Dunkel-rother Zinnober, *Estner*, b. iii. s. 290. *Id. Emm.* b. ii. s. 144. —Le Cinnabre d'un rouge foncé, ou le Cinnabre commun, *Broch.* t. ii. p. 107.—Mercure sulphuré, *Haüy*, t. iii. p. 437. —Dunkel-rother Zinnober, *Reuss*, b. iii. s. 287. *Id. Lud.* b. i. s. 207. *Id. Suck.* 2ter th. s. 118. *Id. Bert.* s. 436. *Id. Mohs*, b. iii. s. 76. *Id. Leonhard*, Tabel. s. 52.—Mercure sulphuré compacte, *Brong.* t. ii. p. 243.—Gemeiner Zinnober, *Karsten*, Tabel. s. 60.—Blättriger Zinnober, & Dichter Zinnober, *Haus.* s. 76.—Sulphuret of Quicksilver, *Kid*, vol. ii. p. 94.—Mercure sulphuré couleur rouge foncé, *Haüy*, Tabl. p. 78.—Dunkel-rother Zinnober, *Haus.* Handb. b. i. s. 214. *Id. Hoff.* b. iii. s. 27.—Cinnabar, *Aikin*, p. 82.

External Characters.

Its principal colour is perfect cochineal-red, which in some varieties inclines very much to lead-grey; in others passes into carmine-red.

Besides

Besides massive, disseminated, in blunt-cornered pieces, in flakes, dendritic, and in granular distinct concretions: it also occurs crystallized. Its primitive form appears to be a rhomboid, the dimensions of which are still unknown. The following are some of the secondary forms:

1. Regular six-sided prism, sometimes flatly acuminated with three planes, which are set on the alternate lateral planes.
2. Rather acute rhomboid, truncated on the apices. When these truncating planes become so large as to assume the size of lateral planes, a figure is formed, having an octahedral form. When the truncating planes become still larger, there is formed a
3. Six-sided table, in which the terminal planes are set on obliquely.

The crystals are small and very small; occur in druses, on one another, side by side, and promiscuous.

Externally the crystals are splendent.

Internally it alternates from shining to glimmering, and the lustre is adamantine, verging on semi-metallic.

The cleavage is in the direction of the sides of the six-sided prism.

The fracture is sometimes fine-grained uneven, sometimes even and conchoidal.

The fragments are indeterminate angular, and blunt-edged.

The massive varieties are opaque, or translucent on the edges; the crystals are translucent, sometimes semi-transparent, and even verging on transparent.

It yields a scarlet-red shining streak.

It is harder than gypsum, but not so hard as calcareous-spar.

It is sectile, and easily frangible.

Specific gravity, 6.7, 8.2, *Mohs*; Japan Cinnabar, 7.710, *Klaproth*; Almaden Cinnabar, 7.786, *Kirwan*.

Chemical Characters.

Before the blowpipe, it melts, and is volatilised with a blue flame, and sulphureous odour.

Constituent Parts.

	Japan.	Neumarktel in Carniola.
Mercury,	84.50	85.00
Sulphur,	14.75	14.25
	99.25	99.25

Klaproth, Beit. b. iv. s. 17. & 19.

For Geognostic and Geographic Situations, see the following subspecies.

Second Subspecies.

Bright Red Cinnabar *.

Hochrother Zinnober.

Id. Wern. Pabst. b. i. s. 11. *Id. Wid.* s. 727. *Id. Estner*, b. iii. s. 297. *Id. Emm.* b. ii. s. 146.—Le Cinnabre d'un rouge vif, ou le Cinnabre fibreux, *Broch.* t. ii. p. 111.—Mercure sulphuré rouge vif, *Haüy*, t. iii. p. 440.—Lichtrother Zinnober, *Reuss*, b. iii. s. 293.—Hochrother Zinnober, *Lud.* b. i. s. 208. *Id. Mohs*, b. iii. s. 86. *Id. Leonhard*, Tabel. s. 52.—Mercure sulphuré fibreux, *Brong.* t. ii. p. 243.—Zerreblicher Zinnober,

* It is also named *Native Vermilion.*

Zinnober, *Karsten*, Tabel. s. 60.—Erdiger Zinnober, *Haus.* s. 76.—Mercure sulphuré couleur rouge vif, *Haüy*, Tabl. p. 78.—Lichtrother Zinnober, *Haus.* Handb. b. i. s. 215. —Hochrother Zinnober, *Hoff.* b. iii. s. 31.

External Characters.

Its colour is bright scarlet-red, which sometimes inclines to carmine-red.

It occurs massive, disseminated, in flakes, and sometimes in very delicate fibrous concretions.

Internally it is glimmering and pearly.

The fracture is earthy.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

The streak is shining.

It soils.

It is very soft, passing into friable.

It is imperfectly sectile, and very easily frangible.

Geognostic Situation.

This mineral occurs in small quantities in beds and veins, in rocks of clay-slate, talc-slate, and chlorite-slate, and is associated with quartz, calcareous-spar, sparry iron, and with minuter portions of iron-pyrites, copper-pyrites, iron-glance or specular iron-ore, and micaceous iron-ore; also in veins that traverse trap-porphyry, pitchstone and hornstone porphyries, and alpine limestone, but most abundantly along with sandstone, slate-clay, &c. in the coal formation.

Geographic

Geographic Situation.

Europe.—It occurs in veins at Horzowitz in Bohemia, where it is associated with red iron-ore, sparry iron, galena or lead-glance, yellow blende, and straight lamellar heavy-spar; at Idria in the Friaul, in a coal formation; at Rosenau in Upper Hungary, in clay-slate, chlorite-slate, and talc-slate; in veins, along with ironstone, and ores of mercury, at Schemnitz and Kremnitz in Lower Hungary; Transylvania; Carinthia; Carniola; Salzburg; Tuscany; Sicily; in a coal formation at Wolfstein and Morsfeld in the Palatinate; at Moschellandsberg and Stahlberg in Deux Ponts; Allemont and Pellançon in France; at Almaden in Spain, in a coal formation; and in the neighbourhood of Conna in Portugal.

Asia.—Nertschinsk and Terentui in Siberia; also in the peninsula of Taygonos, near the mouth of the river Topolefka in Kamtschatka; and in Japan.

America.—Mines of cinnabar occur in different parts of New Spain. At Durasno, between Terra Neuva and San Luis de la Paz, cinnabar, mixed with globules of mercury, forms a horizontal bed, which rests on porphyry. This bed is covered with strata of slate-clay, impregnated with nitrate of potash, which include a bed of slate-coal, and contain fragments of petrified vegetables. The cinnabar vein of San Juan de la Chica, is six, nine, and even sometimes twenty feet in width. It occurs in pitchstone-porphyry, which is disposed in globular and concentric lamellar concretions, of which the centre is occupied with hyalite. The cinnabar, and a little native mercury, are sometimes observed in the middle of the porphyritic rock, at a very considerable distance from the vein. The cinnabar extracted from the veins of the mountain del Fraile, near the Villa de San Felipe, is found in porphyry with a hornstone base, which is traversed by veins of tinstone.

In the kingdom of new Granada, cinnabar occurs in three different places, namely, in the province of Antioquia, in the Valle de Santa Rosa, east from the Rio Cauca; in the mountain of Quindiu, in the pass of the central Cordillera, between Ibaque and Carthago, at the extremity of the ravine of Vermellon; and lastly, in the province of Quito, between the village of Azogue and Cuenca. The cinnabar is not only found in round fragments, mixed with small grains of gold, in the alluvial soil with which the ravine de Vermellon, at the foot of the table-land of Ibague Viejo, is filled: but they know the vein also from which the torrent appears to have detached these fragments, and which traverses the small ravine of Santa Anna. Near the village of Azogue, *to the* N.W. of Cuenca, the mercury is found, as in the department Mont Tonnerre, in a formation of quartzy sandstone, with a clay base or cement. This sandstone is nearly 4592 feet in thickness, and contains bituminous wood and mineral pitch.

In Peru, cinnabar is found near Valdivui, in the province of Pataz, between the eastern bank of the Maranon and the missions of Guailillas; at the foot of the great Nevado de Pelagato, in the province of Conchucos, *to* the east of Santa; near Huancavelica, in the intendancy of that name; near Guaraz, in the province of Guailas; and at the Baths of Jesus, in the province of Guamalies; to the south-east of Guacarachuco. The famous mine of Huancavelica, as to the state of which so many false ideas have been disseminated, is in the mountain of Santa Barbara, to the south of the town of Huancavelica, at a horizontal

zontal distance of 7606 feet. The height of the town above the level of the sea is 12,308 feet. If we add to this the height of the mountain Santa Barbara above the level of Huancavelica, we shall find the absolute height of this mountain to be 14,506 feet. The cinnabar is found in the vicinity of this town, in two very different repositories, in beds, and in veins. In the great mine of Santa Barbara, the cinnabar is contained in a bed of sandstone, of upwards of 1200 feet in thickness. This sandstone is analogous to that of the environs of Paris; and the mountains of Aroma and Cascas, in Peru, resemble pure quartz. The quartz rock which contains the cinnabar, forms a bed in a limestone conglomerate, from which it is only separated by thin layers of slate-clay. This conglomerate is covered with a flœtz limestone, and the fragments of compact limestone in the conglomerate seem to indicate, that the whole mass of the mountain of Santa Barbara itself reposes on what is called Alpine Limestone. The cinnabar does not fill the whole quartz bed of the great mine of Santa Barbara: it forms particular layers, and sometimes it is found in small veins, that occasionally unite into *stock-werke*. Hence, the metalliferous mass is only in general from 196 to 229 feet in breadth. Native mercury is very rare; but the cinnabar is accompanied with red iron-ore, magnetic iron-ore, galena, and iron-pyrites, and also with calcareous-spar, sulphate of lime, and fibrous alum. The metalliferous bed, at great depths, contains a good deal of orpiment. Cinnabar is also found near to Sillacasa, in small veins which traverse the alpine limestone; but these veins, which are frequently full of calcedony, do not follow regular directions: they cross each other, and form nests, often of considerable magnitude. It is these veins that at present furnish

furnish all the mercury of Peru, the metalliferous bed of the great mine of Santa Barbara having been completely abandoned, owing to the works having fallen in *.

The most important mercury mines at present in a state of activity are those near Almaden in Spain, which have been worked for upwards of 2000 years; at Idria in the Friaul; in the ci-devant Palatinate; Deux Ponts; and in Spanish America.

Uses.

It is the mineral from which the greatest quantity of the mercury of commerce is obtained. It is also used by the painter as a pigment; but artificial cinnabar, on account of the purity and brightness of its colour, is preferred. It is also used for tinting wax of a red colour.

Observations.

1. It is distinguished from *Red Silver*, by its scarlet-red streak, and the red trace it affords on paper; and also in being entirely volatilised when heated: From *Red Orpiment*, by the colour of its streak, that of red-orpiment being orange-yellow; and from *Red Lead-Spar*, also by the streak, that of the lead-ore being lemon-yellow.

2. It appears from Vitruvius, that the term *Minium* was derived from the name of a river in Spain; and there are several passages in Pliny, which shew that the term minium was applied to a substance corresponding with our cinnabar. He says, that almost all the minium in use

* Vide Black's Translation of Humboldt's New Spain, from which the above particulars in regard to the Spanish American mercury mines have been obtained.

use at Rome, came from Spain, and that the ore was sent over from Spain sealed. He also says, that those who were employed in reducing minium to powder, wore loose bladders over the face, lest they should inhale the dust; the effects of which were very pernicious. This custom is also observed at the present day, by those who are employed for a length of time in triturating preparations of mercury *.

3. The term *Cinnabar*, was originally applied to the drug commonly called *Dragon's Blood*, which is of a dull red colour: it was afterwards transferred to the ore of mercury now under consideration †.

4. Sage, in the Journal de Physique for 1784, and Estner, in his Mineralogie, B. iii. 2. s. 314. describe a native red oxide of mercury found at Idria; but it has not been met with by succeeding naturalists.

5. Baron Born, in his *Catalogue rais. d. l. Collect. d. Mlle. de Raab.* t. ii. p. 394. describes a mineral under the name *Cinnabre alcalin*, which is mentioned by Wideman, Estner, Reuss, and Hausmann, under the name *Stink Zinnober*. The following description is given of it:

Its colour is intermediate between crimson-red and blood-red. It occurs massive, disseminated, in vesicles, and indistinctly crystallised. Internally the lustre is shining and adamantine. The fracture is imperfect foliated, inclining to radiated. It is translucent. It is soft. When triturated, it emits a hepatic smell. It is said to be sulphuret of mercury, combined with sulphureted hydrogen. It is found at Idria, along with calcareous-spar, and iron-pyrites.

Third

* Kid's Min. vol. ii. p. 95.

† Ibid.

Third Subspecies.

Hepatic Cinnabar.

Quecksilber Lebererz, *Werner*.

This subspecies contains two kinds, viz. Compact Hepatic Cinnabar, and Slaty Hepatic Cinnabar.

First Kind.

Compact Hepatic Cinnabar.

Dichtes Quecksilber Lebererz, *Werner*.

Id. Werner, Pabst. b. i. s. 8.—Compact Hepatic Mercurial-ore, *Kirw.* vol. ii. p. 224.—Dichtes Quecksilber Lebererz, *Estner,* b. iii. s. 281. *Id. Emm.* b. ii. s. 140.—Mine de Mercure hepatique, *Broch.* t. ii. p. 104.—Dichtes Lebererz, *Reuss,* b. iii. s. 282. *Id. Lud.* b. i. s. 207. *Id. Mohs,* b. iii. s. 88.—Mercure sulphuré hepatique, *Brong.* t. ii. p. 243.—Dichtes Lebererz, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 76.—Mecure sulphuré bituminifere compacte, *Haüy,* Tabl. p. 78.—Dichtes Lebererz, *Haus.* Handb. b. i. s. 216.—Dichtes Quecksilber Lebererz, *Hoff.* b. iii. s. 33.—Hepatic Cinnabar, *Aikin,* p. 83.

External Characters.

Its colour is intermediate between dark cochineal-red and dark lead-grey.

It occurs massive.

Internally it is glimmering, and the lustre is semi-metallic.

The fracture is even, and sometimes passes into fine or small-grained uneven.

The

The fragments are indeterminate angular, and rather sharp-edged.

The streak is shining, and of a cochineal-red colour, inclining to lead-grey.

It is opaque.

It is soft.

It is sectile and easily frangible.

Specific gravity, 7.186 to 7.352, *Kirwan*; 7.100 *Klaproth*.

Constituent Parts.

Mercury, - - -	81.80
Sulphur, - - -	13.75
Carbon, - - -	2.30
Silica, - - - -	0.65
Alumina, - -	0.55
Oxide of Iron, - - -	0.20
Copper, - - -	0.02
Water, - - -	0.73
	100

Klaproth, Beit. b. iv. s. 24.

Second Kind.

Slaty Mercurial Hepatic-Ore.

Schiefriges Quecksilber Lebererz, *Werner*.

Schiefriges Lebererz, *Reuss*, b. iii. s. 284. *Id. Lud.* b. i. s. 207. *Id. Mohs*, b. iii. s. 89. *Id. Karsten*, Tabel. s. 60. *Id. Haus.* s. 76.—Mercure sulphuré bitumine testacé, *Haüy*, Tabl. p. 78. —Körniges

—Körniges und Schaaliges Lebererz, *Haus.* Handb. b. i. s. 217.—Schiefriges Quecksilber Lebererz, *Hoff.* b. iii. s. 96.

External Characters.

Its colour is nearly the same with the preceding kind, but sometimes so dark that it inclines to black.

It occurs massive and disseminated: seldom in roundish imbedded portions, and also in globular and concentric lamellar concretions.

The lustre of the principal fracture is shining, approaching to splendent; that of the cross fracture is glimmering, and both have a semi-metallic lustre.

The principal fracture is curved and thick slaty; the coarse fracture is even.

The fragments are slaty.

It is uncommonly easily frangible.

The streak is cochineal-red, inclining to brown.

It is rather lighter than the compact kind.

Geognostic Situation.

This mineral occurs in considerable masses in slate-clay and bituminous-shale. It is sometimes intermixed with cinnabar and iron-pyrites; and veins of native mercury and of cinnabar occasionally traverse it. Both kinds occur together.

Geographic Situation.

It occurs most abundantly in Idria: it is also met with at Almaden in Spain, Nertschinsk in Siberia, and in Deux Ponts.

Observations.

Observations.

1. This kind is characterised by its higher degree of lustre, slaty fracture, easier frangibility, and rather lower specific gravity.

2. The variety in globular and concentric lamellar concretions is named *Corallenerz.*

3. When exposed for some time to the air, it acquires a silver-brown tint of colour: hence the name *Hepatic* or *Liver-Ore* given to it.

4. It appears to contain more carbon than the compact kind. The two kinds appear to bear the same relation to each other that common alum-slate does to glossy alum-slate.

* Red Zinc, or Red Oxide of Zinc †.

Red Oxide of Zinc, *Bruce.*

Red Zinc-ore, *Bruce's* American Mineralogical Journal, p. 96. —*Cleaveland's* Min. p. 352.

External Characters.

Its colours are blood-red and aurora-red.

It occurs massive, disseminated.

Internally, on the fresh fracture it is shining; after long exposure to the air it becomes dull, and even covered with a pearly crust.

It has a single cleavage.

The fracture is conchoidal.

It

† This mineral is placed here, from its general resemblance in external aspect to the species of this genus. Farther examination will determine if the present is its proper place in the system.

It is translucent on the edges, or opaque.

It is easily scratched by the knife.

It is brittle.

It affords a streak which is brownish-yellow, approaching to orange.

Specific gravity 6.220.

Chemical Characters.

It is soluble in the mineral acids. It is infusible without addition before the blowpipe. With sub-borate of soda, melts with a transparent yellow bead. When exposed to the united flames of oxygen and hydrogen, it sublimes, attended with a brilliant white light. When pounded, mixed with potash, and exposed to heat, it fuses into an emerald-green mass, which, on solution, affords to water the same colour. On the addition of a few drops of nitric, sulphuric, or muriatic acids, the green-coloured fluid is immediately changed into a rose-red.

Constituent Parts.

Zinc, - -	76
Oxygen, - -	16
Oxides of Manganese and Iron,	8
	100

Bruce, American Min. Journ. p. 99.

Geognostic and Geographic Situation.

This mineral has been hitherto found only in North America, where it occurs in several of the iron-mines in Sussex County, New Jersey; as at the Franklin, Stirling, and Rutgers mines, and near Sparta. In some instances it it is imbedded in foliated granular limestone; while in others, it serves as a basis in which magnetic ironstone occurs, either in crystals or grains.

At Franklin, it also assumes a micaceous form, and is imbedded in a whitish oxide of zinc, which is often, in the same specimen, found adhering to the black oxide of iron.

Uses.

This species occurs abundantly in the United States of America, and promises to be a valuable acquisition to that country. Dr Bruce, to whom we are indebted for every thing we know of this mineral, remarks: "The recently discovered property of the malleability of zinc, at a temperature of 300° of Fahrenheit, has greatly enhanced its value, and raised it to a high rank among the useful metals. The inconvenience arising from its brittleness being removed, this metal is now applied to many of the purposes for which copper has been hitherto used. As the demand for metallic zinc must necessarily increase as its application to the arts becomes more general, the red zinc-ore will prove a source from which this metal may be procured in abundance; and a series of experiments sufficiently shews the ease with which it may be separated from the ore. In the manufacture of brass, this ore possesses advantages over those generally used; as, without previous preparation of ustulation, &c. it affords with copper a compound possessing a high degree of malleability, a fine colour, and every requisite of the best kind of brass, such as is used in the finest and most delicate workmanship, equal in every respect to that made from the reduced metal, or, as it is more generally termed, *spelter*. This mineral may also be advantageously employed

ployed in the manufacture of sulphate of zinc, or white vitriol of commerce. Experiments also prove, that the oxide or flowers of zinc may, without much difficulty, be obtained from this ore. The oxide of zinc has of late been recommended as a substitute for white-lead as a pigment, over which it possesses some advantages, as it is not liable to change, and in its preparation is not subject to those deleterious consequences so frequently attendant on all the preparations of lead."

Observations.

1. It is distinguished from *Red Silver*, by its infusibility before the blowpipe: from *Red Copper-ore*, by its superior specific gravity, and its solution in acids, which is colourless, whereas that of the red copper-ore is of a bright green: from *Red Lead-spar*, by its infusibility before the blowpipe, the red lead-spar melting into a blackish slag: *Red Orpiment*, with which it might be confounded, is distinguished from it by its volatility before the blowpipe, and giving out a blue flame, and a strong garlic smell; and its solubility in the mineral acids distinguishes it from *Rutile*, which is insoluble.

2. This interesting mineral was first discovered by Dr Bruce, and by him described in the American Mineralogical Journal.

3. The red colour of this ore is conjectured to be owing to the oxide of iron and manganese it contains.

CLASS IV.

ORDER VI. SULPHUR.

GENUS I. SULPHUR.

Schwefel, *Mohs*.

This genus contains three species, viz. Red Orpiment, Yellow Orpiment, and Prismatic Sulphur.

1. Red Orpiment, or Ruby Sulphur, or Hemi-Prismatic Sulphur.

Hemi-prismatisches Schwefel, *Mohs*.

Rothes Rauschgelb, *Werner*.

Sandaraca, *Plin.*—Arsenicum risigallum, *Wall.* t. ii. p. 163.—Realgar, et Soufre rouge des Volcans, *Romé de Lisle*, t. iii. p. 33.—Rothes Rauschgelb, *Werner*, Pabst. b. i. s. 210. *Id.* *Wid.* s. 975.—Realgar, *Kirw.* vol. ii. p. 261.—Realgar, Sandarac, Rubine d'Arsenic, *De Born*, t. ii. p. 199.—Rothes Rauschgelb, *Emm.* b. ii. s. 562.—Arsenic sulphuré, *Lam.* t. i. p. 358.—Arsenic sulphuré rouge, *Haüy*, t. iv. p. 228.—Le Realgar rouge, *Broch.* t. ii. p. 447.—Rothes Rauschgelb, *Reuss*, b. iv. s. 516. *Id. Lud.* b. iv. s. 301.—Rother Schwefel-arsenic, *Suck.* 2ter th. s. 425.—Roth Rauschgelb, *Bert.* s. 505. *Id. Mohs*, b. ii. s. 287.—Arsenic sulphuré rouge, *Lucas*, p. 163.—Rothes Rauschgelb, *Leonhard*, Tabel, s. 78.—Arsenic sulphuré realgar, *Brong.* t. ii. p. 88.—Arsenic sulphuré rouge, *Brard*, p. 362.—Dichtes Rauschgelb, *Karsten*, Tabel. s. 74.—Arsenic sulphuré rouge, *Haüy*, Tabl. p. 109.—Native Realgar, *Kid*, vol. ii. p. 205.—Realgar, *Haus.* Handb. b. i. s. 210.—Rothes Rauschgelb, *Hoff.* b. iv. s. 224.—Realgar, *Aikin*, p. 126.

External

External Characters.

Its colour is aurora-red, of various degrees of intensity; when the surface is weathered, the colour inclines to orange-yellow.

It occurs massive, disseminated, in flakes or membranes, and crystallised.

Its primitive figure is an oblique four-sided prism, in which the obtuse angle is 107° 42′. The following are some of the secondary figures:

1. Oblique four-sided prism, flatly acuminated on the extremities with four planes, which are set on the lateral planes *, Pl. 12. fig. 239.
2. The preceding figure, truncated on the acute lateral edges †.
3. No. 1. truncated on all the lateral edges ‡, Pl. 12. fig. 240.
4. No. 1. truncated on the obtuse lateral edges, and bevelled on the acute lateral edges §, Pl. 12. fig. 241.
5. The preceding figure, in which the edges formed by the meeting of the bevelling planes are truncated ||, Pl. 12. fig. 242.
6. Oblique four-sided prism, acuminated with four planes, which are set on the lateral planes, and all the angles formed by the meeting of the acuminating and lateral planes, truncated ¶.

The

* Arsenic sulphuré rouge emoussé, Haüy.

† Arsenic sulphuré rouge sexoctonal, Haüy.

‡ Arsenic sulphuré rouge dioctaedre, Haüy.

§ Arsenic sulphuré rouge octodecimal, Haüy.

|| Arsenic sulphuré rouge octoduodecimal, Haüy.

¶ Arsenic sulphuré rouge surcomposé, Haüy.

The crystals are seldom middle-sized, usually small, very small and minute.

The crystals are smooth, and frequently longitudinally streaked, and shining, passing into splendent.

Internally it is shining, and the lustre is resinous, inclining to adamantine.

A cleavage is discernible in the direction of both diagonals of the primitive prism.

The fracture is coarse and small-grained uneven, sometimes passing into imperfect conchoidal.

The fragments are indeterminate angular, and blunt-edged.

It is translucent but the crystals are semi-transparent.

It yields an orange-yellow coloured streak.

It is as hard as talc, but scarcely so hard as gypsum.

It is brittle, and easily frangible.

Specific gravity, 3.3, 3.4, *Mohs*. 3.3384, *Brisson*.

Chemical Characters.

It melts immediately before the blowpipe, and burns with a blue flame, giving out arsenical and sulphureous vapours. It generally leaves a minute and earthy residue.

Physical Character.

It is idio-electric by friction, acquiring the resinous or negative electricity.

Constituent Parts.

	Bannat.
Arsenic, - -	69
Sulphur, - -	31
	100

Klaproth, Beit. b. v. s. 238.

Geognostic Situation.

It occurs most frequently in veins in primitive rocks, especially in gneiss and clay-slate; also disseminated through primitive rocks, as in dolomite, where it is associated with iron-pyrites. It is rarely found in secondary rocks, when it is accompanied with yellow orpiment. It is occasionally of volcanic origin, occurring in the craters and fissures of volcanoes.

In veins it is usually accompanied with native arsenic, light red silver, galena or lead-glance; sometimes also with silver-white cobalt, iron-pyrites, grey copper, brown blende, grey and red antimony, quartz, heavy-spar, and seldom cross-stone, zeolite, and mineral pitch.

Geographic Situation.

Europe.—It occurs in veins at Andreasberg in the Hartz; disseminated in dolomite on St Gothard; in beautiful crystals at Joachimsthal in Bohemia, at Kapnic in Transylvania, and at Nagyag and Felsobanya in Hungary; and associated with volcanic substances at Vesuvius, Solfatara, and Puzzola.

Asia.—In the island of Japan *, in the mines of Kianfiu, five days journey from Nankin; and in the Burmah Dominions †.

West Indies.—It occurs in considerable quantity in the island of Guadaloupe.

America.—On the north-west coast of America, mixed with yellow orpiment.

Uses.

* Thunberg's Travels, vol. iii. p. 203.

† Ainslie's Materia Medica, p. 53.

Uses.

It is used as a pigment. The Chinese cut it into vases and figures of different shapes, and also into vessels for medical purposes. In these vessels some vegetable acid is permitted to remain for a certain time, and is then used as a remedy in disease *.

Observations.

1. It is distinguished from *Red Silver* by its inferior specific gravity, and its orange-coloured streak; from *Red Lead-spar* by its colour, form, inferior specific gravity, and accompanying minerals; from *Cinnabar*, by the colour of its streak, that of cinnabar being scarlet-red. The strong smell of garlic, and the white fumes which it emits before the blowpipe, are characters which readily distinguish it from those minerals with which it might be confounded.

2. It has been described under the following names, Sandarach, Ruby Arsenic, Ruby Sulphur, Risigallum and Realgar.

2. Yellow Orpiment, or Prismatoidal Sulphur.

Prismatoidescher Schwefel, *Mohs*.

Gelbes Rauschgelb, *Werner*.

Ἀῤῥενικὸν of *Theophrastus;* by the latter Greeks written Ἀρσενικὸν —Arsenicum, *Plin.* Hist. Nat. xxxiv. 18. s. 56. (ed. Bip. v. 269.)—Arsenicum auripigmentum, *Wall.* t. ii. p. 163.—Orpiment,

* Cleaveland's Mineralogy, p. 554.

piment, Orpin, *Romé de Lisle*, t. iii. p. 39.—Gelbes Rauschgelb, *Werner*, Pabst. b. i. s. 210. *Id. Wid.* s. 972.—Orpiment, *Kirw.* vol. ii. p. 260.—Oxide d'Arsenic sulphuré jaune, *De Born*, t. ii. p. 202.—Gelbes Rauschgelb, *Emm.* b. ii. s. 559. —Arsenic sulphuré jaune, *Haüy*, t. iv. p. 234.—Le Realgar jaune, *Broch.* t. ii. p. 444.—Gelbes Rauschgelb, *Reuss*, b. iv. s. 512. *Id. Lud.* b. i. s. 300.—Gelber Schwefelarsenic, *Suck.* 2ter th. s. 450.—Gelb-rauschgelb, *Bert.* s. 504. *Id. Mohs*, b. ii. s. 283.—Arsenic sulphuré jaune, *Lucas*, p. 164.—Gelbes Rauschgelb, *Leonhard*, Tabel. s. 78.—Arsenic sulphuré, Orpiment, *Brong.* t. ii. p. 89.—Arsenic sulphuré jaune, *Brard*, p. 363.—Blättriges Rauschgelb, *Karsten*, Tabel. s. 74.—Arsenic sulphuré jaune, *Haüy*, Tabl. p. 109.—Native Orpiment, *Kid*, vol. ii. p. 206.—Rauschgelb, *Haus.* Handb. b. i. s. 208.—Gelbes Rauschgelb, *Hoff.* b. iv. s. 220. —Orpiment, *Aikin*, p. 127.

External Characters.

Its colour is perfect lemon-yellow, which sometimes inclines to orange-yellow.

It occurs massive, disseminated, stalactitic, reniform, botryoidal, in crusts, in granular and concentric curved lamellar concretions, and crystallised.

Its primitive form appears to be an oblique four-sided prism, the dimensions of which are unknown. The following are the secondary figures:

1. Low oblique four-sided prism, acutely bevelled on the extremities, the bevelling planes set obliquely on the obtuse edges.
2. Flat double four-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other.

On the fresh fracture it is splendent, and the lustre is intermediate between adamantine and semimetallic.

Its

Its cleavage is prismatoidal.

The fragments are indeterminate angular, and blunt-edged in the great, but slaty in the small.

It is translucent; but in small leaves transparent.

Its colour is not altered in the streak.

It is rather harder than red orpiment.

It is sectile.

It is flexible; but not elastic.

It splits easily.

Specific gravity, 3.4, 3.6, *Mohs*; 3.435, *Kirwan*; 3.400, *Breithaupt*.

Constituent Parts.

	Turkey.
Arsenic, - -	62
Sulphur, - -	38
	100

Klaproth, Beit. b. v. s. 238.

Geognostic Situation.

It occurs very rarely in primitive mountains, principally in veins in flœtz rocks, along with copper-pyrites, iron-pyrites, quartz, and calcareous-spar.

Geographic Situation.

Europe.—It occurs, along with red silver, in granite, at Wittichen in Swabia: in the Hartz; at Moldawa and Saska in the Bannat; Nagyag, and Felsobanya in Transylvania; Neusohl in Hungary; Wallachia; and Servia.

Asia.—In Natolia and China.

America.—Zimapan in Mexico; and the north-west territory of the United States.

Observations.

Observations.

1. This mineral is distinguished from ***Red Orpiment***, by colour, form, cleavage, and specific gravity: from ***Yellow Lead-spar***, by lustre, sectility, softness, and inferior specific gravity; from ***Yellow Zinc Blende***, by colour, fracture, softness, and inferior specific gravity; from ***Sulphur***, by colour and fracture; and from ***Mica***, by form, want of elasticity, colour, and greater specific gravity.

2. Hausmann describes a mineral under the name ***Slaggy Orpiment***, which he says has a conchoidal fracture, glistening and resinous lustre. It is found at Andreasberg in the Hartz, associated with native arsenic, red silver, and lead-glance.

3. Yellow Orpiment differs from the substance commonly called Arsenic at the present day, in containing a portion of sulphur; and in being consequently of a yellow colour; whereas our arsenic is perfectly white.

Pliny and Theophrastus describe arsenic as having a yellow colour. Thus Pliny says, that the best arsenic is "coloris in auro excellentis." Theophrastus says, on account of its resemblance in colour, *ochra* (ὤχρα) is used instead of arsenic; but the term ὤχρα itself is apparently derived from its yellow colour; and that it was of this colour, appears further probable, from its being changed to a red by calcination, which is mentioned by Theophrastus; and being thus converted into the substance called μιλτος, which answers exactly to our red ochre. Of ***Sandaraca***, which is used as a synonym for realgar or red orpiment, Pliny says, "melior quo magnis rufescit." The term Αρσενικὸν, from which our word Arsenic is derived,

was

was an epithet applied by the ancients to those natural substances, the properties of which were found to be of a strong, and, as it were, *masculine* character; and as the poisonous quality of arsenic was soon found to be remarkably powerful, the term was especially applied to that form of it which was most commonly met with. The arsenic of commerce of the present day is in some instances of a yellow colour, owing to its containing a portion of sulphur.—*Kid*, Min. v. ii. p. 206, 207.

3. Prismatic Sulphur.

Prismatischer Schwefel, *Mohs*.

Natürlicher Schwefel, *Werner*.

This species is divided into two subspecies, viz. Common Sulphur, and Volcanic Sulphur.

First Subspecies.

Common Sulphur.

Gemeiner Natürlicher Schwefel, *Werner*.

This species is divided into two kinds, Compact Common Sulphur, and Earthy Common Sulphur.

First Kind.

Compact Common Sulphur.

Sulphur, *Plin.* Hist. Nat. lib. xxxv. (ed. Bip. vol. v. p. 322.)—Sulphur nativum purum flavum, *Wall.* t. ii. p. 123.—Soufre, *Romé*

Romé de L'isle, t. i. p. 28. *Id. De Born*, t. ii. p. 91.—Natürlicher Schwefel, *Wid.* s. 646. *Id. Werner*, Pabst. b. i. s. 368. —Native Sulphur, *Kirw.* vol. ii. p. 69.—Natürlicher Schwefel, *Estner*, b. iii. s. 178. *Id. Emm.* b. ii. s. 189.—Soufre, *Lam.* t. i. p. 68.—Le Soufre natif, *Broch.* t. ii. p. 37.—Soufre, *Haüy*, t. ii. p. 277.–287. —Schwefel, *Reuss*, b. iii. s. 384. *Id. Lud.* b. i. s. 184. *Id. Suck.* 2ter th. s. 38. *Id. Bert.* s. 338. *Id. Mohs*, b. ii. s. 277. *Id. Leonhard*, Tabel. s. 47.—Soufre, *Brong.* t. ii. p. 68.—Schwefel, *Kirsten*, Tabel. s. 58. *Id. Haus.* s. 67.—Sulphur, *Kid*, vol. ii. p. 30.—Gemeiner natürlicher Schwefel, *Lenz*, b. ii. s. 1038.—Dichter Schwefel, *Haus.* Handb. b. i. s. 69.—Fester gemeiner Schwefel, *Hoff.* b. ii. s. 253.—Sulphur, *Aikin*, p. 58.

External Characters.

The principal colour is sulphur-yellow, of different degrees of intensity: it occurs also honey-yellow, lemon-yellow, orange-yellow, straw-yellow, and wax-yellow. The honey-yellow sometimes inclines to yellowish-brown, and the straw-yellow to yellowish-grey.

It occurs massive, disseminated, in granular concretions, and crystallised.

Its primitive figure is a pyramid of 107° 19'; 84 24'; basis = 102° 41' *, Pl. 12. fig. 243.

The following are some of the secondary figures:

1. The pyramid sometimes terminates in a line, Pl. 12. fig. 244.; sometimes appears truncated on the apices ‡, Pl. 12. fig. 245. or two opposite angles ‖, Pl.

* Soufre primitif, Haüy.

† Soufre cuneiforme, Haüy.

‡ Soufre basé, Haüy.

‖ Soufre unitaire, Haüy.

Pl. 12. fig. 246.; edge of the common basis is occasionally truncated *, Pl. 12. fig. 247.

2. Pyramid acuminated with four planes, which are set on the lateral planes †, Pl. 12. fig. 248. The apices of the acumination are sometimes truncated ‡, Pl. 12. fig. 249.
3. Double six-sided pyramid, with two opposite broad, and four smaller, lateral planes, and which end in a line ||, Pl. 12. fig. 250.
4. The preceding figure acuminated on the extremities with four planes, and the acuminating planes set on the smaller lateral planes §, Pl. 12. fig. 251.
5. In delicate acicular crystals.

The crystals are middle-sized, small, and very small, seldom large.

The surface of the crystals is generally smooth, seldom drusy.

Internally it varies from shining to glimmering, and the lustre is intermediate between adamantine and resinous.

The cleavage is prismatic, and axifrangible.

The fracture is uneven, inclining sometimes to splintery, sometimes to imperfect conchoidal.

The fragments are angular, and blunt-edged.

It is translucent; the crystals are semi-transparent and transparent, and they refract double.

It is harder than talc, and sometimes even harder than gypsum.

It

* Soufre prisme, Haüy.

† Soufre diodecaedre, Haüy.

‡ Soufre octodecimal, Haüy.

|| Soufre emoussé, Haüy.

§ Soufre unibinaire, Haüy.

It is brittle, and easily frangible.

When rubbed, it exhales a faint sulphureous smell, and becomes resino-electric.

Specific gravity 1.9, 2.1, *Mohs.*

Chemical Characters.

It is easily inflammable, burning with a lambent bluish flame, and a suffocating odour.

Geognostic Situation.

Common sulphur occurs in considerable abundance in primitive mountains, in a state of combination with metals, forming the different genera of Pyrites, Glance and Blende; but it rarely appears pure or uncombined: while in secondary mountains, it is more abundant in the pure uncombined state than in combination with metals. It is also met with in alluvial districts, particularly near sulphureous springs. The primitive rocks in which common native sulphur occurs, are mica-slate and porphyry; and the most frequent of the secondary rocks in which it is contained, are gypsum, clay, marl, and limestone. Its mode of distribution in rocks varies: in primitive rocks it has been hitherto found only in beds and veins; in secondary mountains in beds, imbedded masses, disseminated, in veins, and lining the walls of drusy cavities.

Geographic Situation.

Europe.—In the island of Iceland, where it occurs in considerable quantity, it is associated with gypsum, or in crusts investing alluvial substances. Near Kracau in Poland, its accompanying rocks are bluish-grey marl, gypsum, limestone, and occasionally selenite, and rarely celestine,

tine, and brown and black coal; but it is not intermixed indiscriminately with all these rocks, being in general inclosed in the marl and gypsum, in masses, from the size of a man's head to that of a pea, or lining the walls of drusy cavities. Very superb specimens of crystallized sulphur are found at Conil, near Cape Trafalgar; the strata of the district are grey gypsum and clay, and in these are large drusy cavities, which, when first opened, are found filled with a yellowish sulphureous water, and their sides are lined with fine crystals of calcareous-spar, and beautiful and large crystals of common sulphur. Sicily is rich in common sulphur, which occurs in layers, imbedded masses, or in drusy cavities in sandstone, but most frequently and abundantly in secondary gypsum. A similar formation to that of Sicily occurs at Urbino in the Papal States. In Arragon in Spain, sulphur occurs in beds, from three to four inches thick, in a secondary formation of alternate beds of gypsum, selenite, and compact slaty marl: the same formation appears to occur in Murcia. Sulphur frequently occurs disseminated in the gypsum of the north of Germany, as at Lauenstein in Hanover; massive and crystallized varieties are collected in gypsum in the glaciers of Pesay in Switzerland; it is sometimes met with in drusy cavities in flint at Polignis, in the department of Jura: disseminated through sandstone at Buodoshegy in Transylvania; intermixed with red manganese at Kapnic; and with red orpiment at Felsobanya: in veins of copper-pyrites that traverse granite at Schwartswald in Swabia: in mica-slate at Glasshütte, near Schemnitz in Hungary; and a very new formation is that which occurs in superimposed crystals on bituminous-wood, or earth-coal, in Thuringia.

Asia.—It occurs in the gold mines of Catharinenburg, and the galena veins in the Uralian Mountains in Siberia.

Africa.

Africa.—In considerable abundance on Mount Atlas, in northern Africa; and imbedded in basalt in the Isle of Bourbon.

America.—In California; on sides of springs in the United States; between Alausi and Ticsau, in Quito in Peru, in mica-slate, in a bed associated with quartz; and it is said also in primitive porphyry in that country.

Second Kind.

Earthy Common Sulphur.

Erdiger gemeiner Natürlicher Schwefel, *Werner.*

Soufre pulverulent, *Haüy.*

Erdiger gemeiner Schwefel, *Hoff.* b. iii. s. 261.

External Characters.

Its colour is pale straw-yellow.

It occurs massive and disseminated.

Internally it is dull.

The fracture is fine earthy.

The fragments are indeterminate angular and blunt-edged.

It is opaque.

It does not soil.

It alternates from very soft to friable.

Geognostic and Geographic Situations.

It occurs in drusy cavities in flint, and along with the compact varieties in gypsum, and other rocks.

Second

Second Subspecies.

Volcanic Sulphur.

Vulcanischer Natürlicher Schwefel, *Werner.*

Le Soufre natif volcanique, *Broch.* t. ii. p. 42.—Vulcanischer Schwefel, *Reuss,* b. iii. s. 90. *Id. Mohs,* b. ii. s. 282. *Id. Leonhard,* Tabel. s. 47. *Id. Karsten,* Tabel. s. 38. *Id. Lenz,* b. ii. s. 1038. *Id. Hoff.* b. iii. s. 262.—Volcanic Sulphur, *Aikin,* p. 58.

External Characters.

Its colour is pale sulphur-yellow, which sometimes passes into grey.

It occurs massive, stalactitic *, vesicular, corroded, perforated; and crystallised in pyramidal figures.

It is glistening, and the lustre is resinous, inclining to adamantine.

The fracture is coarse and small grained uneven.

The fragments are indeterminate angular, and blunt-edged.

It is slightly translucent.

In other characters it agrees with the preceding subspecies.

Geognostic and Geographic Situations.

Europe.—It occurs only in volcanic countries, where it is found more or less abundantly amongst lavas. Solfatara, in

* Spallanzani observed stalactites of volcanic sulphur, three feet long and two inches thick, in a grotto formed in the walls of the crater of Vulcano.

in the vicinity of Vesuvius, is one of the most famous repositories of volcanic sulphur, and it is there collected in considerable quantities, for the purposes of commerce. It is also found in the island of Iceland, and in such quantity that it is collected as an article of trade; on Ætna; and in the Lipari Islands.

Africa.—Island of Teneriffe, and island of Bourbon.

America.—In the islands of St Lucia, St Domingo, Martinique, and Guadaloupe.

Asia.—Island of Java.

Uses.

When burnt, it affords sulphuric acid; it enters into the composition of gunpowder; is used in various metallurgic processes, and in bleaching; it forms a constituent part of some cements; is employed in taking casts; and is an article in the materia medica.

CLASS IV.

CLASS IV.

INFLAMMABLE MINERALS.

ORDER I.—RESIN *.

GENUS I.—HONEYSTONE.

Crystal-Harz, *Mohs.*

THIS Genus contains one Species, viz. Pyramidal Honeystone.

1. Pyramidal Honeystone.

Pyramidales Crystal-Harz, *Mohs.*

Honigstein, *Werner.*

Id. Wid. s. 639.—Succin transparent en Cristaux octaedres, *De Born*, t. ii. p. 90.—Mellilite, *Kirw.* vol. ii. p. 68.—Honigstein, *Emm.* b. ii. s. 86.—La Pierre de Miel, ou le Mellite, *Broch.* t. ii. p. 73. *Id. Haüy*, t. iii. p. 335.—Honigstein, *Reuss*, b. ii. s. 52. *Id. Leonhard*, Tabel. s. 47. *Id. Karsten*, Tabel. s. 58. —Mellite, *Brong.* t. ii. p. 52.—Mellilite, *Kid*, vol. ii. p. 39. —Honigstein, *Lenz*, b. ii. s. 1100. *Id. Haus.* Handb. b. iii. s. 811. *Id. Hoff.* b. iii. s. 334.—Mellite, *Aikin*, p. 63.

External

* So named from the resinous aspect of the minerals of the order.

External Characters.

Its colour is honey-yellow, which on the one side inclines to wax-yellow, and on the other passes into reddish brown and hyacinth-red.

It rarely occurs massive, but very distinctly crystallised.

Its primitive figure is a pyramid of 118° 4′, and 93° 22′. The following are some of the secondary figures:

1. The primitive pyramid truncated on the apices.
2. Pyramid truncated on the apices, and on the angles of the common base.
3. When the truncations on the angles increase in magnitude, there is formed a low rectangular four-sided prism, rather flatly acuminated, with four planes, which are set on the lateral edges.
4. When the truncations on the angles become so large that the edges of the common basis are changed into angles, an irregular rhomboidal dodecahedron is formed.
5. The angles on the common base flatly bevelled, and the bevelling planes set on the lateral planes.

The crystals are middle-sized, and small.

Externally it is smooth and splendent.

The lustre is shining or splendent, and intermediate between vitreous and resinous.

The cleavage is pyramidal.

The fracture is perfect and flat conchoidal.

The fragments are indeterminately angular, and rather sharp-edged.

It is semi-transparent, or translucent, and refracts double, in the direction of the pyramidal plane.

It is harder than gypsum, but not so hard as calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, 1.4, 1.6, *Mohs;* 1.560, 1.593, *Breithaupt.*

Chemical Characters.

Before the blowpipe it becomes white and opaque, with black spots, and is at length reduced to ashes: when heated in a close vessel, it becomes black.

Physical Character.

It becomes slightly resino-electric by friction.

Constituent Parts.

Alumina, - -	16
Mellilitic Acid, -	46
Water of crystallization, -	38
	100

Klaproth, Beit. b. iii. s. 114.

Geognostic and Geographic Situations.

It occurs superimposed on bituminous wood and earth-coal, and is usually accompanied with sulphur. It has been hitherto found only at Artern in Thuringia. The Swiss locality mentioned by some authors is very dubious.

Observations.

1. Its name is borrowed from its honey-yellow colour.
2. It differs from *Amber*, in being crystallised, refract-

 ing

ing double, and in being harder, heavier, and less powerfully electric.

3. It is chemically distinguished from *Amber:* on burning coal amber intumesces, and diffuses a fragrant odour; Honeystone, on the contrary, becomes white, without intumescence or fragrant odour.

Genus II.—MINERAL RESIN.

Erd-Harz, *Mohs.*

This genus contains two species, viz. Yellow Mineral Resin, and Black Mineral Resin. * Retin Asphalt ** Fossil Copal.

1. Yellow Mineral Resin or Amber.

Gelbes Erdharz, *Mohs.*

This species is subdivided into three subspecies, viz. White Amber, Yellow Amber, Earthy Amber.

First Subspecies.

White Amber.

Weisser Bernstein, *Werner.*

Id. Werner, Pabst. b. i. s. 367.—Le Succin blanc, *Broch.* t. ii. p. 69.—Weisser Bernstein, *Reuss,* b. iii. s. 166. *Id. Leonhard,*

hard, Tabel. s. 47. *Id. Karsten,* Tabel. s. 58. *Id. Haus.* s. 117. *Id. Lenz,* b. ii. s. 1093. *Id. Haus.* Handb. b. i. s. 93. *Id. Hoff.* b. iii. s. 326.

External Characters.

Its colour is frequently dark yellowish-white, which sometimes inclines to straw-yellow.

It occurs massive, or inclosed in the yellow subspecies.

It is glistening, approaching to shining, and the lustre is resinous.

The fracture is conchoidal, but not so perfect as in the yellow subspecies.

The fragments are indeterminate angular, and sharp-edged.

It is only translucent.

In other characters, it resembles the following subspecies.

Observations.

Its white colour, and inferior lustre and transparency, distinguish it from *Yellow Amber.*

Second Subspecies.

Yellow Amber.

Gelber Bernstein, *Werner.*

Id. Werner, b. i. s. 367.—Le succin jaune, *Broch.* t. ii. p. 70.—Gelber Bernstein, *Reuss,* b. iii. s. 169. *Id. Leonhard,* Tabel. s. 47. *Id. Karsten,* Tabel. s. 58. *Id. Haus.* s. 117. *Id. Lenz,* b. ii. s. 1095. *Id. Haus.* Handb. b. i. s. 93. *Id. Hoff.* b. iii. s. 325.

External Characters.

Its colour is honey-yellow, and frequently it passes on the one side into wax-yellow, yellowish and reddish-brown, and this last into hyacinth-red; and on the other side sometimes into green. It is generally of a darker colour externally than internally.

It generally occurs in broad and blunt angular pieces, having a rough uneven surface; sometimes disseminated. Often with inclosed insects.

Externally it is generally dull; internally it is splendent and shining, and the lustre is resinous.

The fracture is large and perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is almost always transparent.

It is harder than gypsum, but not so hard as calcareous-spar. It is softer than honeystone.

Its streak is white.

It is rather brittle, and easily frangible.

Specific gravity 1.0, 1.1, *Mohs*.

Chemical Character.

It burns with a yellow-coloured flame, and fragrant odour, at the same time intumescing, but scarcely melting.

Physical Characters.

When rubbed, it gives out an agreeable smell, and becomes strongly resino-electric. This latter property was known

known to the ancients, who termed amber *electrum*; from whence is derived the word *electricity* *.

Constituent Parts.

It is composed of Carbon, Hydrogen, and Oxygen. An acid named *Succinic* is obtained from it by distillation.

Geognostic

---

* The appearances and electrical property of amber are so often alluded to in ancient authors, that it is not necessary to shew by quotations that they were familiar with that substance; and though the history of its origin is much involved in fable, yet they seem to have had some idea that it was found in the north of Europe:—

——————— Κελτοὶ δ' ἐπὶ βάξιν ἔθεντο
Ὡς ἄρ' Ἀπόλλωνος τάδε δάκρυα Λητοΐδαο,
Ἐμφέρεται δίναις· ἅτε μυρία χεῦε πάροιθεν·
Ἦμος Ὑπερβορέων ἱερὸν γένος εἰσαφίκανεν (*a*).

Pliny says, in speaking of amber, "Certum est gigni in insulis Septentrionalis Oceani (*b*):" and, in another place, "Ab adverso (Britanniarum) in Germanicum mare sparsæ Glessariæ (insulæ); quas Electridas Græci recentiores appellavere, quod ibi electrum nasceretur (c)." In another place, he says, that in the spring-time it was washed on a part of the coast of Germany, from an island in the North Sea; concluding with these words: "Incolas pro ligne ad ignem uti eo, proximisque Teutonis vendere (*d*)." From the foregoing passages, it seems very probable, that the opinion of Solinus respecting the origin of amber is correct: he says that it was originally brought from the northern sea, through Pannonia and Illyria, into the country bordering on the river Po; and hence Phaeton's sisters, or the poplars of that river, are fabled to have wept amber; this substance being easily mistaken for a vegetable gum.—*Kid's* Mineralogy, vol. ii. p. 37.

(*a*) Apoll. Rhod. lib. iv. lin. 611,—614.

(*b*) Nat. Hist. t. vi. p. 266. ed. Brot.

(c) Hist. Nat. lib. iii.

(*d*) Hist. Nat. lib. xxxvii.

Geognostic Situation.

This mineral occurs in beds of bituminous-wood * and moor-coal; also in a conglomerate formed by the aggregation of fragments on the sea shores; in sandy soil; frequently floating on the sea; and it is said to have been observed imbedded in secondary limestone.

Geographic Situation.

Europe.—It is thrown up by the sea on the coasts of Norfolk, Suffolk, and Essex, and occurs imbedded in a gravel-pit at Kensington, near London. It occurs in greatest quantity in East Prussia; also on the coast of the Baltic, in Courland, Liefland, Russia, Swedish Pomerania, and West Prussia. It is found in a sandy soil in Poland, at a great distance from the sea, where it is intermixed with cones of the Pinus abies. It occurs also in France, on the coasts of Sicily, Spain, near Alicant, and in the Asturias, in one of which it is said to occur imbedded in limestone; in the kingdom of Saxony; and in Switzerland, Moravia, Austria, and the Bannat of Temeswar.

Asia.—It is found imbedded in coal at the mouth of the Jenisei, in Siberia; in a similar situation in the Bay of Penschincha, in the same country; and is one of the mineral productions of China.

America.—It is found in different places in the United States; thus it occurs in New Jersey, in Croswick's Creek, four miles from Trenton, in alluvial soil. It occurs in grains, or in small masses, seldom exceeding an inch in length; it rests on bituminous wood, or even sometimes penetrates it, and is sometimes connected with pyrites. The bed

* It would appear, that many of the fossilised trees with which the amber is associated, are of the palm tribe.

bed of bituminous wood which contains the amber, rests on a coarse ferruginous sand, and is covered by a soft bluish clay, inclosing masses of iron-pyrites. Above the clay is a bed of sand. Amber also occurs near Woodbury in the same state, in large plates in marl; also at Cambden, opposite Philadelphia *. Grains and masses of amber occur in brown coal in Greenland.

Africa.—It is said to occur on the coast of Madagascar.

Uses.

On account of its beautiful colour, great transparency, and the fine polish it receives, it is considered as an ornamental stone, and is cut into necklaces, bracelets, snuff-boxes, and other articles of dress. Before the discovery of the diamond, and the other precious stones of India, it was considered to be the most precious of jewels, and was employed in all kinds of ornamental dress. Great quantities of it are annually exported from Dantzig to Constantinople, the Levant, Persia, and France. The most considerable purchasers of amber are the merchants of Armenia and Greece; but it is still uncertain how they dispose of it. It is conjectured by some, that it is purchased from them by pilgrims, previous to their journey to Mecca, and that on their arrival there, it is burnt in honour of the prophet Mahomet. It is also an important article of exchange in Africa. When dissolved in oil, it forms a species of varnish, named *Amber varnish*.

Observations.

1. The only minerals with which it is likely to be confounded, are *Honeystone* and *Fossil Copal:* its strong electrical

* Cleaveland's Mineralogy.

electrical property, and single refracting power, distinguish it from Honeystone; and its colour and difficult fusibility from Fossil Copal.

2. It frequently includes bodies of different kinds, as grains of sand, pieces of iron-pyrites, and also insects of the genera *Staphylinus*, *Blatta*, *Termes*, which are not natives of Europe; and also European insects, particularly the *Culex pipiens*. Born mentions a specimen of amber, containing a species of Gorgonia: another author describes a specimen containing the seed-vessels of the *Pinus abies*: in some cabinets, there are specimens including pinnated leaves, resembling those of ferns, and other specimens inclosing drops of transparent water.

3. Masses of considerable size have been met with in the amber-mines on the coasts of the Baltic. Thus, in the year 1576, a piece of amber weighing 11 pounds, was found in Prussia, and sent to Prague, as a present to Rodolph II.; and a few years ago, a mass, weighing upwards of 13 pounds, and whose contents amounted to 318½ cubic inches, was dug up in the same country. Five thousand dollars are said to have been offered for this latter mass; and the Armenian merchants assert, that in Constantinople it would sell for thirty or forty thousand dollars *.

4. Various conjectures have been proposed in regard to its origin and formation. By some, it is held to be a vegetable gum or resin, altered by processes unknown to us: others consider it a variety of mineral oil, thickened by absorption of oxygen; and it has also been alleged to be inspissated mineral-oil.

5. The

* Neues allgemeines Journal der Chemie, b. i. s. 224.

5. The pitch-coal sometimes found along with it, is by the amber-diggers named *Black Amber*, and is sold at a great price.

6. This mineral is sometimes named *Succinum*, from the word *succus*, it having been conceived that amber was an inspissated juice. Thus, Pliny remarks, "Arboris succum esse prisci nostri credidere, ob id *succinum* appellantes *." It was also by Pliny and other ancient writers, named *Electrum*, from its resemblance in colour to the metallic alloy of the ancients, which consisted of gold and silver, and was called by the same name; or from Ἠλεκτωρ, one of the names of the sun †.

7. When one part of the empyreumatic oil obtained by distilling mineral pitch, is boiled several times with one and a half parts of turpentine, a compound is formed, which bears a great resemblance to amber, and which is frequently cut into necklaces, and other ornaments, and sold as true amber.

Third Subspecies.

Earthy Amber.

Bernerde, *Werner*.

Bernerde, *Hoff.* b. iv. s. 171.

External Characters.

Its colour is pale yellowish-brown, which inclines to honey-yellow, but has always a considerable intermixture of grey.

It

* Plin. Hist. Nat. t. vi. p. 266. ed. Brot.

† Kid's Mineralogy, vol. ii, p. 36.

It is friable, and rarely inclines to compact. It is composed of dull dusty particles, which are either more or less coherent, or are loose.

It soils slightly.

Feels fine, but meagre.

Nearly supernatant.

Chemical Character.

It burns like amber.

Geognostic and Geographic Situations.

It occurs imbedded in beds of brown coal and alum-earth, and frequently intermixed with bitumen, near Zittari, and at Muskau in Saxony.

Observations.

Its colours and smell distinguish it from earth-coal.

* Retinite.

Retin-Asphalt, *Hatchett.*

Retin-asphalt, *Hatchett,* in Phil. Trans. for 1804. *Id. Kid,* vol. ii. p. 66.—Erdharze, *Wagner,* in Von Moll's Ephemeriden der Berg und Hüttenkunde, b. iv. s. 20.—Retin-asphalt, *Aikin,* p. 68.—Retinit, *Hoff.* b. iv. s. 173.

External Characters.

Its colours are yellowish, liver, and reddish brown, passing into brownish and hyacinth red, and inclining to orange-yellow: the yellowish-brown passes into honey-yellow,

yellow, and the liver-brown often inclines to green. The colours are generally mixed with grey, and frequently may occur in the same specimen.

It occurs massive, in angular pieces, and in thick crusts.

The external surface is generally rough, and is often cracked.

The lustre varies from shining to glistening, and is resinous.

The fracture is imperfect conchoidal or uneven.

It alternates from semitransparent to translucent on the edges.

It is soft, and very soft.

It is rather brittle and easily frangible.

When first taken from its repository, is elastic, flexible, and on exposure becomes rigid: it is even sometimes rigid when first dug up.

Specific gravity, 1.135, *Hatchett;* 1.126, *Steffens.*

Chemical Characters.

When placed on a hot iron it melts, smokes, and burns with a bright flame, giving out a fragrant odour; it is soluble in potash, and partly so in spirit of wine.

Constituent Parts.

Resin, - -	55	91
Asphalt, - -	42	9
Earth, - -	3	
	100	100
	Hatchett, Phil. Trans. for 1804.	*Bucholz.*

Geognostic and Geographic Situations.

It is found at Bovey Tracey in Devonshire, adhering to brown-coal. A similar mineral has been met with near Naumberg

Naumberg in the circle of Saale at Langenbogen, near Halle; at Wildshut in the Innviertel in Austria; and at Utigshof in Moravia.

Observations.

1. This curious mineral was first discovered, described, and analysed by Mr Hatchett.

2. Colour, fracture, softness, and easy frangibility characterise this mineral, and also distinguish it from amber, to which it is more nearly allied than to mineral-pitch.

3. It has been described under the name *Mineral Caoutchouc*.

** Fossil Copal.

Fossil Copal, or Highgate Resin, *Aikin*.

External Characters.

Its colour is pale muddy yellowish-brown.
It occurs in irregular roundish pieces.
The lustre is resinous.
It is semi-transparent.
It is brittle.
It yields easily to the knife.
Specific gravity 1.046.

Chemical Characters.

It gives out a resinous aromatic odour when heated; melts into a limpid fluid; takes fire when applied to the flame of a candle; and burns away entirely before the blowpipe. Insoluble in potash ley.

Geognostic

Geognostic and Geographic Situations.

It is found in the bed of blue clay at Highgate, near London.

Observations.

The preceding description of this mineral is that of Mr Aikin, which I have extracted from his Manual of Mineralogy.

2. Black Mineral Resin.

Schwarzes, Erd-Harz, *Mohs.*

This species is divided into three subspecies, viz. Naphtha, Mineral Oil or Petroleum, and Mineral Pitch or Bitumen.

First Subspecies.

Naphtha.

Ναφθα of the ancient Greeks.—Vid. *Plin.* Hist. Nat. t. ii. (ed. Bip.) 1. p. 198.—Bitumen candidum? *Plin.* Hist. Nat. xxxv. (ed. Bip. v. p. 324.)—Bitumen Naphtha, *Wall.* Syst. Min. t. ii. p. 98.—Naphte, *Romé de Lisle,* t. ii. p. 192. *Id. De Born,* t. ii. p. 75. *Id. Wid.* s. 617. *Id. Kirw.* vol. ii. p. 42.—Bitumine liquide blanchâtre, *Haüy,* t. iii. s. 312.—Le Naphte, *Broch.* t. ii. p. 59.—Naphtha, *Reuss,* b. iii. 3. s. 96.—Bitume Naphte, *Brong.* t. ii. p. 19.—Naphtha, *Leonhard,* Tabel. s. 48. —Liquides Bergöl, *Karsten,* Tabel. s. 58.—Naphtha, *Haüy,* s. 117. *Id. Kid,* vol. ii. p. 61. *Id. Lenz,* b. ii. 1045. *Id. Haus.* Handb. b. i. s. 89. *Id. Aikin,* p. 59.

External

External Characters.

Its colours are yellowish-white, yellowish-grey, and wine-yellow.

It is perfectly fluid.

It is shining and resinous.

It feels greasy.

It exhales an agreeable bituminous smell.

Specific gravity 0.7.

Chemical Characters.

It takes fire on the approach of flame, affording a bright white light.

Constituent Parts.

It is a compound of Carbon, Hydrogen, and a little Oxygen.

Geognostic and Geographic Situations.

This mineral is seldom found in a pure state. It is said to occur in considerable springs on the shores of the Caspian Sea; in the Caucasus; Japan; Persia; and France; also in Sicily; and some districts in Italy, as Calabria, Modena, and Parma. These springs issue from rocks of different kinds, as limestone, marl, and sandstone.

Uses.

In Persia, Japan, and some parts of Italy, where it occurs in considerable quantity, it is used in lamps, in place of oil, for lighting streets, churches, &c. When mixed with certain vegetable oils, it forms an excellent varnish; and formerly it was employed as a vermifuge medicine.

Second Subspecies.

Mineral Oil, or Petroleum.

Erdöl, *Werner.*

Bitumen liquidum, *Plin.* Hist. Nat. xxxv.—Maltha tarde fluens, *Wall.* t. ii. p. 92.—Petrole, *Romé de Lisle,* t. ii. p. 591. *Id. De Born,* t. ii. p. 75.—Petrol, *Kirw.* vol. ii. p. 43. *Id. Estner,* b. iii. s. 97. *Id. Emm.* b. ii. s. 43.—Bitumine liquide noirâtre, *Haüy,* t. iii. p. 312.—L'Huile minerale commune, ou le Petrol, *Broch.* t. ii. p. 59, 60.—Gemeines Bergöl, *Reuss,* b. iii. s. 96.–101. *Id. Mohs,* b. ii. s. 302. *Id. Leonhard,* Tabel. s. 48.—Bitumen Petrole, *Brong.* t. ii. p. 24.—Verdicktes Bergöl, *Karsten,* Tabel. s. 58.—Steinöl, *Haus.* s. 117. —Petroleum, *Kid,* vol. ii. p. 62.—Bergöl, *Lenz,* b. ii. s. 1047. —Flussiges Bergtheer, *Haus.* Handb. b. i. s. 89.—Erdöl, *Hoff.* b. iii. s. 266.—Petroleum, *Aikin,* p. 59.

External Characters.

Its colour is dark blackish-brown, which sometimes inclines to green.

It is fluid, but approaches more or less to the viscid state.

It is shining and resinous.

It feels greasy.

It is semi-transparent, translucent, and opaque.

It exhales a strong bituminous odour.

It is so light as to swim on water.

Chemical Characters.

It inflames easily, emits a bluish flame, and yields a smoke

smoke more or less opaque, according to the density of the oil, and sometimes leaves a very small earthy residue.

Constituent Parts.

It is composed of Carbon, Hydrogen, and a little Oxygen.

Geognostic Situation.

It generally flows from rocks of the coal formation, and usually from the immediate vicinity of beds of coal; also from limestone rocks. It occurs in marshes, on the surface of spring water; or it flows or trickles unmixed from its repository.

Geographic Situation.

Europe.—Oozing from secondary rocks at St Catherine's Well, near Edinburgh, and in the island of Pomona, one of the Orkneys. Filling cavities and veins in limestone at Pitchford and Madeley in Shropshire. Several springs of this mineral occur in France, as at Gabian in Herault; in Auvergne; and at Pechelbrunn in Alsace, the sandstone is very highly impregnated with it. It is also found on the Lake Tegern, in Bavaria; near Neufschatel in Switzerland; at Amiano, twelve leagues from Parma; in Mount Zibio, near Modena; and a spring has been seen rising from the bottom of the sea in the Bay of Naples, which pours out much mineral oil. It is also met with in Sicily; in the salt-mines in Transylvania; in Gallicia; and in Moldavia, springs of petroleum flow from a track where there is an alternation of beds of sandstone, marl, gypsum, and rock-salt.

Asia.—On the shores of the Caspian Sea; it is also met with at Semenowa, in Siberia, and near the stream of Taliza, in the Altain Mountains. There are very productive mines of mineral oil in the kingdom of Ava: about five hundred shafts or pits are sunk through soil, sandstone, slate-clay, and coal, and it is from the coal that the oil issues. When drawn from the pit, it is much mixed with water, from which it is separated by decantation. These mines afford annually 400,000 hogsheads of petroleum. Mineral oil is also met with in Persia, and Japan.

America.—On the banks of the Ohio; and, according to travellers, many springs in Kentucky, Pennsylvania, and New-York, carry along with them quantities of this mineral. It is also a production of Newfoundland, and of the island of Trinidad.

Uses.

In Piedmont, Persia, Japan, and other countries, it is used in lamps, in place of oil, for lighting streets and churches. It is also used for warming rooms, when mixed with earth, and inflamed. It is occasionally employed instead of common tar, to preserve wood from decay, and from worms; also as a varnish; and in the composition of fire-works.

Third Subspecies.

Mineral Pitch, or Bitumen.

This species is divided into three kinds, viz. Earthy Mineral Pitch, Slaggy Mineral Pitch, and Elastic Mineral Pitch.

First Kind.

Earthy Mineral Pitch.

Erdiges Erdpech, *Werner.*

Semi-compact Mineral Pitch, or Maltha, *Kirw.* vol. ii. p. 46.—La Poix minerale terreuse, *Brock.* t. ii. p. 65.—Erdiges Bergpech, *Reuss*, b. iii. s. 107. *Id. Lud.* 1r th. s. 193. *Id. Suck.* 2ter th. s. 45. *Id. Bert.* s. 342. *Id. Mohs*, b. ii. s. 307. *Id. Leonhard*, Tabel. s. 48.—Thonartiges Erdpech, *Karsten*, Tabel. s. 58.—Erdiges Erdpech, *Haus.* s. 117. *Id. Lenz*, b. ii. s. 1051.—Cohesive Mineral Pitch, *Aikin*, p. 60.

External Characters.

Its colour is blackish-brown.
It occurs massive.
It is faintly glimmering, inclining to dull.
The fracture is earthy, or small grained uneven.
The fragments are blunt-edged.
The streak is shining and resinous.
It is very soft.
It is sectile.
It feels greasy.
It is so light as almost to swim in water.
It smells strongly bituminous.

Chemical Characters.

It burns with a clear and brisk flame, emits an agreeable bituminous smell, and deposites much soot.

Constituent

Constituent Parts.

Inflammable Matter, -	50.50
Silica, - - -	28.50
Alumina, - - -	15.50
Lime, - - - -	4.25
Oxide of Iron, - -	1.19

Lenz, Min. b. ii. s. 1052.

Geognostic and Geographic Situations.

It occurs in the Iberg in the Hartz, along with slaggy mineral pitch, in veins that traverse grey-wacke; at Prague, in calcareous-spar veins that traverse transition greenstone; at Voltrarers in Neufchatel; it is said also at Carharrack in Cornwall; and in the pitch lakes of Trinidad.

Second Kind.

Slaggy Mineral Pitch, or Asphaltum.

Schlackiges Erdpech, *Werner*.

Ἀσφαλτος of the Greeks, *Aristotelis* Lib. de Min. Ascult. expl. a J. Beckman, Gott. 1786, 4to, p. 280.—Bitumen, *Plin.* Hist. Nat. xxxv.—Bitumen solidum coagulatum friabile, Asphaltum, *Wall.* t. ii. p. 93.—Asphalte, ou Bitume de Judée, *Romé de Lisle*, t. ii. p. 592. *Id. De Born*, t. ii. p. 78.—Bergpech, ou Judenpech, *Wid.* s. 624.—Asphaltum, or Compact Mineral Pitch, *Kirw.* vol. ii. p. 46.—Asphaltum, *Hatchett*, Lin. Trans. vol. iv. p. 132.—Schlackiges Erdpech, *Estner*, b iii. s. 110. *Id. Emm.* b. ii. s. 50.—Asphalte, *Lam.* t. ii. p. 533. 635.—

 Bitume

Bitume solide, *Haüy*, t. iii. p. 313.—La Poix minerale scoriacée, *Broch*. t. ii. p. 66.—Schlackiges Bergpech, *Reuss*, b. iii. s. 113. *Id. Lud*. b. i. s. 193. *Id. Suck*. 2ter th. s. 48. *Id. Bert*. s. 343. *Id. Mohs*, b. ii. s. 307.—Bitume asphalte, *Brong*. t. ii. p. 25. —Schlackiges Erdpech, *Leonhard*, Tabel. s. 48. *Id. Karsten*, Tabel. s. 58. *Id. Lenz*, b. ii. s. 1052.—Schlackiges Erdpech, *Haus*. Handb. b. i. s. 85. *Id. Hoff*. b. iii. s. 274.—Compact Mineral Pitch, *Aikin*, p. 60.

External Characters.

Its colour is pitch-black, which sometimes approaches to velvet-black.

It occurs massive, disseminated, sometimes globular, reniform, and stalagmitic.

Externally and internally it is splendent and shining, and the lustre is resinous.

The fracture is either imperfect, or very perfect conchoidal.

The fragments are pretty sharp-edged.

It is soft, passing into very soft.

It is opaque.

It is sectile.

It retains its lustre in the streak.

It is easily frangible.

It feels greasy.

Specific gravity 1.0, 1.159,

When held between the fingers emits a bituminous smell.

Constituent

Constituent Parts.

Slaggy Mineral Pitch from Avlona in Albania.

Carbonated Hydrogen, -	36	cubic inches.
Bituminous Oil, -	32	grains.
Ammoniacal Water, -	6	
Carbon, - -	30	
Silica, -	7.50	
Alumina, - -	4.50	
Lime, - -	0.75	
Oxide of Iron, -	1.25	
Oxide of Manganese, -	0.50	

Klaproth, Beit. b. iii. s. 318.

The above quantities were obtained from 100 grains, and are partly products, partly educts.

Geognostic and Geographic Situations.

Europe.—It occurs in veins in reniform and imbedded masses in secondary limestone in Fifeshire; in clay ironstone in East Lothian; in veins, at Haughmond Hill in Shropshire; and in mineral veins in Cornwall. Near Grund in the Hartz, along with sparry iron, brown iron-ore, and heavy-spar; at the Iberge the galena is intermixed with it; in veins, along with calcareous-spar and brown iron-ore, at Kamsdorf in Saxony; at Violenberg, near Grund, in pieces the size of a hen's egg, mixed with slaty glance-coal, in veins composed of compact brown iron-ore, cellular quartz, and straight lamellar heavy-spar. It is also met with at Nordberg and Dannemora in Sweden; Morsfeldt in the Palatinate; in the quicksilver mines of Deux Ponts; incrusting calcedony in Auvergne; in Salzburg;

burg; Switzerland; Avlona in Albania, in thick beds in sandstone; and Semenowa in Russia.

Asia.—It is met with in the mountains of Caucasus; in abundance at the Lake of Asphaltes in Judea, where it occurs in masses on the shores, or in pieces floating on the surface of the water, appearing to be derived from strata or rocks of slaggy mineral pitch in the neighbourhood; also on the Tigris and Euphrates, in the Uralian Mountains.

America.—Mexico. In the Island of Trinidad, there is a lake three miles in circumference, covered with a bituminous substance, of the nature of slaggy mineral pitch, and considerable quantities of this mineral are found in Barbadoes.

Uses.

The Egyptians employed it in the process of embalming bodies *. The Turks quarry it in Albania, and use it, when mixed with common rosin, for paying the bottoms of ships, and for smearing the rigging. The same use is made of the mineral pitch of Trinidad, and it is supposed to protect the bottoms of ships from the attack of the teredo or borer, so frequent in the West Indian seas. The Arabians still use a solution of it in oil to besmear their horse harness, to preserve it from insects. The ancients also

* Rouelle concludes, from experiments which he made on mummies, that the Egyptians employed slaggy mineral pitch in embalming the dead. This operation was performed in three different ways: the first with slaggy mineral pitch alone: the second with a mixture of this bitumen, and a liquor extracted from cedar, called *Cedria*; and the third with a similar mixture, to which resinous and aromatic substances were added.—*Hauy*, Mineralog. t. ii. p. 315, 316.

also used it as an ingredient in mortar; and it is said that the walls of the famous city of Babylon were built with a mortar of this kind. The German translator of J. Bar. de Vignola's *Civil Baukunst*, observes, "I may here also remark, that we find in the accounts of travellers that buildings are often constructed with pitch; and that Peter de Val mentions, that he examined very old buildings, the stones of which were cemented by means of mineral pitch, and which were still very firm, and in good order." Klaproth says, that the slaggy mineral pitch of Avlona burns with a strong and lively flame, and is considered as the principal ingredient in the *Greek Fire*, so much employed in former times.

Observations.

1. The substances described under the names *Asphalt*, *Jews Pitch*, *Mumia mineralis*, *Mineral Pitch*, *Bitumen of Judea*, principally belong to this subspecies, although under these names, by some mineralogists, Earthy Mineral Pitch is understood.

2. Gagat or Jet, is a variety of pitch coal, and therefore cannot be arranged under this species.

3. The term *Asphalt*, sometimes applied to this substance, is derived from the name of the Lake of Judea, where it occurs in abundance.

Third Kind.

Elastic Mineral Pitch.

Elastiches Erdpech, *Werner*.

Elastic Bitumen, *Hatchett*, Linn. Trans. vol. iv. p. 146. &c.—Mineral Cahoutchouc, *Kirw*. vol. ii. p. 48.—Elastiches Erdpech,

pech, *Estner*, b. iii. s. 106. *Id. Emm.* b. iii. s. 106.—Caboutchou fossile, *Lam.* t. ii. p. 540.—La Poix minerale elastique, *Broch.* t. ii. p. 64.—Bitume elastique, *Haüy*, t. iii. p. 313, 314.—Elastiches Bergpech, *Reuss*, b. iii. s. 110. *Id. Lud.* b. i. s. 192. *Id. Suck.* 2ter th. s. 46.—Elastisches Federharz, *Bert.* s. 343.—Elastisches Erdpech, *Mohs*, b. ii. s. 304. *Id. Leonhard*, Tabel. s. 48. *Id. Haus.* s. 117. *Id. Karsten*, Tabel. s. 58. *Id. Lenz*, b. ii. s. 1052.—Dichter Elaterite, *Haus.* Handb. b. i. s. 87.—Elastisches Erdpech, *Hoff.* b. iii. s. 271.—Elastic Mineral Pitch, *Aikin*, p. 60.

External Characters.

Its colours are blackish-brown, sometimes inclining to brownish-black, sometimes to reddish-brown.

It occurs massive, reniform, and sometimes with impressions.

Internally it is shining and glistening, and the lustre is resinous.

The fracture is curved slaty, or conchoidal.

The fragments are indeterminately angular, and also slaty.

It is translucent on the edges.

It is shining in the streak.

It is very soft.

It is perfectly sectile.

It is elastic flexible.

It is light, verging on swimming.

Specific gravity from 0.9053 to 1.233, *Hatchett*. 0.930, *La Metherie*. 0.9021, *Jordan*.

Constituent

Constituent Parts.

100 Grains afforded the following products and educts:

Carbonated Hydrogen,	38	cubic inches.
Carbonic Acid,	4	
Bituminous Oil,	73	grains.
Acid Water,	1.50	
Carbon,	6.25	
Lime,	2.0	
Silica,	1.50	
Oxide of Iron,	0.75	
Sulphate of Lime,	0.50	
Alumina,	0.25	

Klaproth, Beit. b. iii. s. 112.

Geognostic and Geographic Situations.

It is found in the cavities of a vein in the lead-mine called Odin, which is situated near the base of Mamtor, to the north of Castletown in Derbyshire. The vein traverses limestone, and contains galena or lead-glance, accompanied with fluor-spar, calcareous-spar, quartz, blende, calamine, selenite, and slaggy mineral pitch. It is said to have been discovered at Neufchatel, and in the island of Zante.

Observations.

1. According to Hatchett, a transition is to be observed from Mineral Oil, through Slaggy Mineral Pitch, to Elastic Mineral Pitch.

2. Like the elastic gum called Cahoutchouc, it removes the traces of graphite (black lead), but it at the same time soils the paper a little.

3. The

3. The first account of this mineral was published by Dr Lister in the Philosophical Transactions for 1673. It was found in an old forsaken mine. He calls it a subterraneous fungus, and is uncertain whether it belongs to the vegetable or mineral kingdom; but rather inclines to the former, and hints that it may have grown out of the old birch props used in the mine. It was first accurately examined by Mr Hatchett.

Order II.

ORDER II.—COAL.

Steinkohle, *Mohs.*

GENUS I.—COAL.

This Genus contains three Species, viz. Brown Coal, Black Coal, and Glance Coal.

1. Brown Coal.

Braun Kohle, *Werner.*

This species is divided into five subspecies, viz. 1. Bituminous Wood, or Fibrous Brown Coal. 2. Earthy Coal, or Earthy Brown Coal. 3. Alum Earth. 4. Common Brown Coal, or Conchoidal Brown Coal; and, 5. Moor Coal, or Trapezoidal Coal.

First Subspecies.

Bituminous Wood, or Fibrous Brown Coal.

Bituminöses Holz, *Werner.*

Vegetabile fossile bituminosum, *Wall.* t. ii. p. 415.—Bituminöses Holz, *Wid.* s. 631. *Id. Werner,* Pabst. b. i. s. 365.—Carbonated Wood, *Kirw.* vol. ii. p. 60.—Bituminöses Holz, *Estner,* b. iii. s. 166. *Id. Emm.* b. ii. s. 54.—Le Bois bitumineux commun ou parfait, *Broch.* t. ii. p. 44.—Bituminöses Holz, *Reuss,* b. iii. s. 146.—Holzige Braunkohle, *Lud.* b. i. s. 186. *Id. Suck.* 2ter th. s. 60.—Bituminöses Holz, *Bert.* s. 351. *Id. Mohs,*

Mohs, b. ii. s. 311.—Lignite fibreux, *Brong*. t. ii. p. 32.—Bituminöses Holz, *Leonhard*, Tabel. s. 48.—Holzige Afterkohle, *Haus*. s. 116.—Fasrige Braunkohle, *Karsten*, Tabel. s. 59.—Bituminöses Holz, *Lenz*, b. ii. s. 1057.—Holzförmige Braunkohle, *Haus*. Handb. b. i. s. 80.—Bituminöses Holz, *Hoff*. b. iii. s. 278.

External Characters.

Its colours are pale and dark blackish brown, and wood brown, which sometimes approaches to reddish-brown.

Its external shape resembles exactly that of stems and branches of trees, but is usually compressed.

Its principal fracture is glimmering, sometimes approaching to glistening: the cross fracture is shining. The first is lighter coloured than the second.

The fracture is fibrous in the small, slaty in the great, and corresponds with the woody texture: the cross fracture in some varieties is splintery.

The fragments are splintery, or cuneiform, but seldom indeterminately angular.

It is opaque.

The streak is shining.

It is soft, passing into very soft.

It is sectile.

It is slightly elastic-flexible.

It is rather easily frangible.

Specific gravity 1.0, 1.383, *Wiedeman*.

Chemical Characters.

It burns with a clear flame, and evolves, during combustion, a peculiar bituminous smell, which is very different from that of black coal.

Constituent

Constituent Parts.

According to Vauquelin, the bituminous wood of Rollo contains the following ingredients:

Vegetable Earth,	-	54.0
Sulphate of Iron,	-	10.7
Sulphur,	- -	0.8
Oxide of Iron,	-	12.7
Sulphate of Lime,	-	0.7
Silica,	- -	0.2
Loss,	- -	

Geognostic Situation.

It usually occurs in alluvial land, in beds of common brown coal; sometimes also forming whole beds, part of which is converted into common brown coal and earth-coal. It sometimes also occurs in fragments, branches, &c. in clay; and in the Prussian amber-mines it is found in considerable quantity, and occasionally with adhering amber. Rocks of the secondary trap formation sometimes contain beds or imbedded portions of this mineral; and it is also met with in imbedded masses in secondary limestone and sandstone.

Geographic Situation.

In England, at Bovey Tracey, near Exeter; at the mouth of the Ouse, in Sussex: in Scotland, in the secondary trap formation, accompanied with pitch-coal, in the island of Skye; in separate pieces in trap-tuff, in the island of Canna; in limestone in the island of Skye; and in the coal formation in the counties of Fife and Mid-Lothian. It occurs

curs in considerable beds in the trap-rocks of the island of Iceland. On the Continent of Europe, it is met with both in Upper and Lower Saxony; also in Bohemia, Silesia, Moravia, Bavaria, Austria, Stiria, Transylvania, Russia, Poland, and France.

Use.

It is employed as fuel where great heats are not required.

Observations.

1. In Iceland, where it occurs in great quantity, it is called *Suturbrand.*

2. It passes into Common Brown Coal, with which it is often confounded.

Second Subspecies.

Earth-Coal, or Earthy Brown Coal.

Erdkohle, *Werner.*

Le Bois bitumineux terreux, *Broch.* t. ii. p. 45.—Erdkohle, *Reuss,* b. ii. 3. s. 159.—Lignite terreux, *Brong.* t. ii. p. 33.—Erdige Braunkohle, *Leonhard,* Tabel. s. 49.—Erdige Afterkohle, *Haus.* s. 116.—Erdige Braunkohle, *Karsten,* Tabel. s. 58.—Erdige bituminöses Holz, *Lenz,* b. ii. s. 1059.—Erdige Braunkohle, *Haus.* Handb. b. i. s. 80.—Erdkohle, *Hoff.* b. iii. s. 282.

External Characters.

It passes from blackish-brown, through wood-brown, into yellowish-grey. Sometimes it inclines to pitch-black.

It occurs massive. Its consistence is between cohering and loose, but more inclined to the latter.

Its particles are coarse, dusty, and soil a little.

Internally it is faintly glimmering, passing into dull.

The fracture in the more cohering masses is fine earthy.

The streak is somewhat shining.

Specific gravity 1.2.

Chemical Characters.

It burns easily, and diffuses, during combustion, a smell like that of burning bituminous wood. Alkohol dissolves a brownish-coloured bitter substance, having many of the properties of vegetable extract. By distillation it affords a honey-coloured oil, which is soluble in alkohol, and appears to be intermediate between resin and volatile oil. When this oil is freed of its watery parts, by exposure to a gentle heat, and then allowed to cool, it acquires the consistence of white cerate *.

Constituent Parts.

Earth Coal of Schraplau.

Carbonated Hydrogen,	59.0	cubic inches.
Carbonic Acid, -	8.5	
Acid Water, -	12.0	
Empyreumatic Oil, -	30.0	
Coal, - -	20.25	
Lime, - -	2.0	
Sulphate of Lime, -	2.5	
Clay, - -	0.5	
Oxide of Iron, -	1.0	
Sand, - -	11.5	

Klaproth, Beit. b. iii. s. 320.—323.

Geognostic

* This oil, according to Klaproth, resembles very much in its properties the substance called Sea or Lake Wax, which is found at Bargusin, on the shores of the Lake Baikal.

Geognostic and Geographic Situations.

It is found, along with bituminous wood, in Thuringia, in the district of Mansfeldt; and in the circles of Saal and Leipsic, it occurs in beds from twenty to forty feet thick, having an extent of several square miles.

Uses.

It is used as fuel where no great degree of heat is required, as in heating rooms, salt, nitre, and alum works, and in distillation. But to render it fit for these purposes, it must be moistened with water, beat in troughs, then made into bricks, and dried. Sometimes it is intermixed with small black coal, to increase the intensity of the heat. Its ashes are used with advantage as a manure; and a colour resembling umber prepared from it. It is also used as a *bistre* colour.

Observations.

1. It passes into Bituminous Wood, from which it differs principally in its state of aggregation.

2. When much iron-pyrites is dispersed through it, alum is prepared from it, as is the case at Muhlbach, and Komothan in Bohemia.

3. Its name is derived from its state of aggregation.

Third Subspecies.

Alum Earth.

Alaunerde, *Werner.*

Terra aluminaris, *Wall.* t. ii. p. 32.—Alaunerde, *Wid.* s. 398.—*Id. Estner,* b. ii. s. 647. *Id. Emm.* b. ii. s. 299.—Aluminite bitumineux, *Lam.* t. ii. p. 116.—La terre alumineuse, *Broch.* t. i. p. 383.—Alaunerde, *Reuss,* b. ii. 3. s. 152. *Id. Lud.* b. i. s. 110. *Id. Suck.* 2ter th. s. 528. *Id. Bert.* s. 218. *Id. Mohs,* b. ii. s. 311. *Id. Leonhard,* Tabel. s. 48. *Id. Karsten,* Tabel. s. 58.—Erdige Afterkohle, *Haus.* s. 116.—Alaunerde, *Lenz,* b. ii. s. 1063.—Erdige Braunkohle, *Haus.* Handb. b. i. s. 80.—Alaunerde, *Hoff.* b. iii. s. 285.

External Characters.

Its colours are blackish-brown, and brownish-black.

It is massive.

It is dull, sometimes glimmering; but this is owing to an intermixture of mica.

The fracture in the great, is thick or thin slaty, in the small, earthy.

It breaks into tabular pieces.

The streak is shining.

It feels rather meagre, and sometimes greasy.

It is sectile, and uncommonly easily frangible.

It is very soft, inclining to friable.

Chemical Characters.

When exposed to heat, it burns with a flame; and when left some time exposed to a moist atmosphere, it becomes warm, and at length takes fire.

Constituent Parts.

Charcoal, - -	19.65
Sulphur, - -	2.85
Silica, - -	40.00
Alumina, - -	16.00
Oxide of Iron, -	6.40
Sulphate of Iron, -	1.80
Sulphate of Lime, -	1.50
Magnesia, -	0.50
Sulphate of Potash, -	1.50
Muriate of Potash, -	0.50
Water, - -	10.75
	101.45

Klaproth, in Gehlen's Journ. vi. 44.

Geognostic Situation.

It occurs frequently in beds of great magnitude in alluvial land. It has been remarked, that where beds of brown coal have a covering of clay, that they afford good fuel; but when the cover is sand, the subjacent coal is alum earth.

Geographic Situation.

It is found in Bohemia, Saxony, Austria, Naples, Hungary, and in the Vivarais in France.

Uses.

It is first exposed to the air for several months, and then lixiviated,

lixiviated, to obtain the alum it contains: it is rarely used for fuel.

Fourth Subspecies.

Common Brown Coal, or Conchoidal Brown Coal.

Gemeine Braunkohle, *Werner*.

Braun Kohle, *Estner*, b. iii. s. 126.—La Houille brun, *Broch.* t. ii. p. 47.—Gemeine braun Kohle, *Reuss*, b. ii. 3. s. 154. *Id. Lud.* b. . s. 187. *Id. Suck.* 2ter th. s. 63. *Id. Bert.* s. 345. *Id. Mohs*, b. ii. s. 311. *Id. Leonhard*, Tabel. s. 48. *Id. Karsten*, Tabel. s. 58. *Id. Haus.* s. 117.—Muschliche Braunkohle, *Lenz*, b. ii. s. 1060.—Gemeiner Braunkohle, *Haus.* Handb. b. i. s. 78. *Id. Hoff.* b. iii. s. 287.

External Characters.

Its colour varies from blackish-brown to brownish-black.

It occurs massive, and sometimes ligniform.

Internally it is shining, and sometimes glistening; and the lustre is resinous.

The fracture is rather imperfect large conchoidal; and sometimes shews the fibrous woody texture.

The fragments are indeterminate angular, and more or less sharp-edged.

The colour is lighter in the streak.

It is soft and very soft.

It is rather brittle and easily frangible.

Specific gravity 1.2.

Chemical Characters.

It burns with a weak blue-coloured flame, and emits a smell like that of burning bituminous wood.

Constituent Parts.

200 Grains of the Bovey brown coal, by distillation, yielded,

		Grains.
1.	Water, which soon came over acid, and afterwards turbid, by the mixture of some bitumen, - - - -	60
2.	Thick brown oily bitumen, - -	21
3.	Charcoal, - - - - -	90
4.	Mixed gas, consisting of hydrogen, carbonated hydrogen, and carbonic acid,	29
		200

Hatchett, Phil. Trans. 1804.

Geognostic Situation.

It occurs in alluvial land, and in secondary or flœtz-trap rocks.

Geographic Situation.

It is found at Bovey near Exeter; in the Leitmeritzer, Saatzer, and Ellbogner circles in Bohemia; in the counties of Mansfeldt, Thuringia, Magdeburg, and the circles of Saal and Leipsic, in Lower Saxony; in Hessia, in the famous hill called the Meissner; at Kaltennordheim, in the district of Eisenach; at Stockhausen and Hoen in Westerward; Island of Bornholm in Denmark; in the Faroe Islands; Greenland.

Use.

It is used as fuel.

Observations.

Observations.

1. It is distinguished by its high degree of lustre, and conchoidal fracture.

2. We find in it, 1. Iron-pyrites: 2. Honeystone: 3. Amber: 4. A substance resembling Retinite.

3. It is to be observed passing into Bituminous Wood and Moor-Coal; sometimes also into Pitch-Coal.

Fifth Subspecies.

Moor-Coal, or Trapezoidal Brown-Coal.

Moorkohle, *Werner*.

Moorkohle, *Estner*, b. iii. s. 129.—La Houille limoneuse, *Broch.* t. ii. p. 48.—Moorkohle, *Reuss*, b. iii. s. 157. *Id. Lud.* b. i. s. 187.—Moorbraunkohle, *Suck.* 2ter th. s. 64.—Moorkohle, *Bert.* s. 346. *Id. Mohs*, b. ii. s. 313. *Id. Leonhard*, Tabel. s. 49.—Trapezoidische Braunkohle, *Karsten*, Tabel. s. 58. *Id. Haus.* s. 116.—Moorkohle, *Lenz*, b. ii. s. 1065.—Trapezoidische Braunkohle, *Haus.* Handb. b. i. s. 79.—Moorkohle, *Hoff.* b. iii. s. 289.

External Characters.

Its colour is dark blackish-brown, often passing into brownish-black.

It occurs massive, when first dug, but soon bursts and splits into rhomboidal pieces.

The lustre of the principal fracture is glimmering, of the cross fracture glistening, and the lustre is resinous.

The principal fracture is imperfect slaty; the cross fracture even, approaching to flat conchoidal.

The

The fragments are trapezoidal, approaching to cubical, seldom indeterminate angular.

It is soft and very soft.

It is sectile.

The streak is shining.

It is uncommonly easily frangible;—the most frangible species of coal.

Specific gravity.

Chemical Characters.

Nearly the same as those of brown coal.

Geognostic Situation.

It occurs in great beds in alluvial land, and in floetz-trap rocks.

Geographic Situation.

It occurs in the Leitmeritzer, Saatzer and Ellbogner circles in Bohemia; at Thalern, near Krems in Austria; also in Transylvania, Moravia, the island of Bornholm in the Baltic Sea; the Faroe Islands; and with imbedded amber in Greenland. It occurs more frequently in Bohemia than in any other country.

Observations.

1. Its fracture and rhomboidal fragments distinguish it from other kinds of brown coal.

2. It is the most abundant kind of brown coal.

2. Black

2. Black Coal.

Schwartzkohle, *Werner.*

This species is divided into fonr subspecies, viz. Slate-Coal, Cannel-Coal, Foliated Coal, and Coarse Coal. * Soot-Coal.

First Subspecies.

Slate-Coal.

Schieferkohle, *Werner.*

Lithanthrax petrosus, *Wall.* Syst. Min. ii. 99. (in part).—Schieferkohle, *Estner*, b. iii. s. 147.—La Houille schisteuse, ou le Schieferkohle, *Broch.* t. ii. p. 52.—Schieferkohle, *Reuss*, b. iii. s. 132. *Id. Voigt*, s. 10. *Id. Lud.* b. i. s. 189.—Schiefer Steinkohle, *Suck.* 2ter th. s. 53.—Schieferkohle, *Bert.* s. 347. *Id. Mohs*, b. ii. s. 316. *Id. Leonhard*, Tabel. s. 49. *Id. Karsten*, Tabel. s. 58. *Id. Lenz*, b. ii. s. 1068. *Id. Haus.* Handb. b. i. s. 74. *Id. Hoff.* b. iii. s. 296.

External Characters.

Its colour is intermediate between velvet-black and dark greyish-black. Sometimes it presents a pavonine or peacock-tail tarnish, sometimes a columbine tarnish.

It occurs massive *, and in ovoidal and columnar concretions.

It is shining or glistening, and the lustre is resinous.

The principal fracture is nearly straight, and generally thick

* According to Haüy, this coal may be split into right rhomboidal prisms of about 95°.—*Lucas*, t. ii. p. 259.

thick slaty; the cross fracture is imperfect and flat conchoidal, and sometimes even or uneven.

The fragments are sometimes slaty, sometimes trapezoidal, or indeterminate angular.

It is harder than gypsum, but not so hard as calcareous-spar.

The lustre is heightened in the streak.

It is brittle, inclining to sectile.

It is easily frangible.

Specific gravity—

According to *Kirwan*,	1.250 to 1.370	English.
	1.259	From Irvine in Scotland.
Wiedeman,	1.277	
Richter,	1.28125 to 1.3730	From Sabrze in Silesia.
	1.32132 to 1.3820	Bielschowitz.
Breithaupt,	1.342 to 1.463	Postchaphel.

Chemical Characters.

It burns longer than cannel coal; cakes more or less, and after combustion leaves a slag.

Constituent Parts.

Slate-Coal of Waldenburg.	Slate-Coal of Sabrze.	Slate-Coal of Bielschowitz.	Slate-Coal of Whitehaven.
Bitumen, 36.875	Bitumen, 32.934	Bitumen, 37.890	Carbon, 56.8
Carbon, 57.993	Carbon, 63.312	Carbon, 58.172	Mixture of Asphalt and Maltha, in which the asphalt predominates, 43.0
Earth, 5.823	Earth, and Oxide of Iron, 3.904	Earths, and Oxide of Iron, 3.937	
Iron, and Oxide of Manganese, 1.157			
Richter, Neue Gegenst. d. Chem. vi. 234.	*Richter*, Neue Gegenst. d. Chem. vi. 224.	*Richter*, Neue Gegenst. d. Chem. vi. 224.	*Kirwan.*

Geognostic

Geognostic and Geographic Situations.

In England it is found in vast quantity at Newcastle, and in the great expanse of the coal formation in that neighbourhood; in the whole tract of the coal formation which stretches from Bolton, by Allonby, Workington to Whitehaven; in Scotland, in almost every quarter of the great river-district of the Forth; in great quantity in the river-district of the Clyde, at Cannoby, Sanquhar, and Kirkconnel, in Dumfriesshire: it is found also in Thuringia; electorate of Saxony; Bohemia; Silesia; Hungary; the Tyrol; Stiria; Bamberg; Bavaria; Salzburg; and France.

Observation.

It passes sometimes into Cannel and Foliated Coal.

Second Subspecies.

Cannel-Coal.

Kennelkohle, *Werner.*

Lithanthrax piceus, *Wall.* Syst. Min. ii. 99.—Cannelkohle, *Estner,* b. iii. s. 151.—La Houille de Kilkenny, ou le Kennelkohle, *Broch.* t. ii. p. 53.—Cannelkohle, *Reuss,* b. iii. s. 130. *Id. Voigt,* s. 172. *Id. Lud.* b. i. s. 189. *Id. Suck.* 2ter th. s. 53. *Id. Bert.* s. 348. *Id. Mohs,* b. ii. s. 320.—Houille compacte, *Brong.* t. ii. p. 3.—Kannelkohle, *Leonhard,* Tabel. s. 50. *Id. Karsten,* Tabel. s. 58.—Cannel Coal, *Kid,* vol. ii. p. 52.—Kennelkohle, *Lenz,* b. ii. s. 1071. *Id. Haus.* Handb. b. i. s. 75. *Id. Hoff.* b. iii. s. 303.—Candle Coal, *Aikin,* p. 61.

External

External Characters.

Its colour is intermediate between velvet and greyish-black.

It is massive.

Internally it is glistening, or glimmering, and the lustre is resinous.

The fracture is large and flat conchoidal, or even.

The fragments are irregular, cubical, or trapezoidal.

It is harder than gypsum, but not so hard as calcareous-spar.

It is brittle.

It is rather easily frangible.

Specific gravity,—

According to	*Kirwan,*	1.232
	Watson,	1.237
	La Metherie,	1.270
	Blumenbach,	1.275

Geognostic Situation.

It occurs along with the preceding subspecies in the coal formation.

Geographic Situation.

It is found in England near Whitehaven, Wigan in Lancashire, Brosely in Shropshire, Athercliff near Sheffield; in Scotland, at Gilmerton, in the neighbourhood of Edinburgh, and Muirkirk in Clydesdale.

Uses.

On account of its solidity, and the good polish it is capable of receiving when pure, it is cut into drinking-vessels

sels of various kinds, inkholders, snuff-boxes, &c.; but its principal use is as fuel.

Observations.

According to the Bishop of Llandaff, its name is derived from the word *candle*, because in some places the poor people use it in place of lights. In Scotland it is named *Parrot Coal.*

Third Subspecies.

Foliated Coal.

Blätterkohle, *Werner.*

Id. Estner, b. iii. s. 155.—Le Charbon lamelleux, *Broch.* t. ii. p. 54.—Blätterkohle, *Reuss,* b. iii. s. 128. *Id. Voigt,* s. 72. *Id. Lud.* b. i. s. 189. *Id. Suck.* 2ter th. s. 52. *Id. Bert.* s. 347. *Id. Mohs,* b. ii. s. 347. *Id. Leonhard,* Tabel. s. 50. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1069.—Glanzkohle, *Haus.* Handb. b. i. s. 73.—Blätterkohle, *Hoff.* b. iii. s. 303.

External Characters.

Its colour is velvet-black, and sometimes it has a pavonine or columbine tarnish.

It occurs massive, and in lamellar concretions.

The lustre is splendent and resinous.

The fracture is uneven.

Thc fragments are indeterminate angular, approaching to trapezoidal.

It is softer than cannel coal.

It is intermediate between brittle and sectile.

It

It is very easily frangible.

Specific gravity 1.344, 1.406, *Breithaupt.*

Constituent Parts.

		Whitehaven.
Carbon,	- -	57.00
Bitumen,	-	41.3
Ashes,	-	1.7
		100 *Kirwan.*

Geognostic Situation.

It occurs in the coal formation, although not abundantly, and generally accompanied with slate-coal.

Geographic Situation.

It is found in the kingdom of Saxony, in Silesia, and in the coal-fields of this country.

Observations.

1. It is distinguished by its lamellar concretions, splendent lustre, and easy frangibility. It is nearly allied to Slate Coal, but in that subspecies the lustre is lower, and the lamellar concretions are wanting.

2. It frequently falls into pieces by the action of the weather, and sometimes even catch fire. These changes are caused by the decomposition of intermixed iron-pyrites.

Fourth

Fourth Subspecies.

Coarse Coal.

Grobkohle, *Werner.*

Id. Estner, b. iii. s. 158.—La Houille Grossiere, ou la Grobkohle, *Broch.* t. ii. p. 55.—Grobkohle, *Reuss*, b. iii. s. 123. *Id. Lud.* b. i. s. 190. *Id. Suck.* 2ter th. s. 51. *Id. Bert.* s. 346. *Id. Leonhard*, Tabel. s. 50. *Id. Lenz*, b. ii. s. 1073. *Id. Haus.* Handb. b. i. s. 76. *Id. Hoff.* b. iii. s. 306.

External Characters.

Its colour is dark greyish-black, inclining to brownish-black.

It occurs massive, and in granular concretions, which are intimately aggregated together.

It is glistening and resinous.

The principal fracture is imperfect, and thick scaly; the cross fracture is fine-grained uneven.

The fragments are sometimes indeterminate angular; sometimes rather blunt-edged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity 1.454, *Breithaupt.*

Geognostic Situation.

It is found in the coal formation.

Geographic Situation.

It occurs in coalworks in the neighbourhood of Dresden; also at Neustadt and Hohenstein in the Hartz; near Sabrze

Sabrze in Upper Silesia; and in the district of Hameln in Hanover.

Observations.

This subspecies is characterised by its colour, and granular concretions.

* Soot-Coal †.

Russ-Kohle, *Voigt.*

Russ-Kohle, *Karsten,* Tabel. s. 58.—Houille fuligineuse, *Haüy.*

External Characters.

Its colour is dark greyish-black.

It occurs massive.

It is dull or glimmering, and the lustre inclines to semi-metallic.

The fracture is uneven, sometimes inclining to earthy.

The fragments are blunt-edged.

It is shining in the streak.

It soils.

It is soft.

It is brittle, and easily frangible.

It is light.

Chemical Characters.

It burns with a bituminous smell, cakes, and leaves a small quantity of ashes.

Geognostic

† It is named *Clod Coal* in West Lothian?

2

Geognostic and Geographic Situations.

It occurs, along with slate-coal, in West Lothian, and other parts in the river-district of the Forth; and on the Continent, it is met with in Saxony and Silesia.

3. Glance Coal.

Harzlose Steinkohle, *Mohs.*

This species contains two subspecies, viz. Pitch Coal, and Glance Coal.

First Subspecies.

Pitch-Coal, or Jet.

Pechkohle, *Werner.*

Gemma Samothracea, *Plin.* Hist. Nat. xxxvii.?—Bitumen gagas, *Waller.* Syst. Min. t. ii. p. 106.—Pechkole, *Estner,* b. iii. s. 132.—La Houille piciforme, ou le Pechkole, *Broch.* t. ii. p. 49.—Pechkohle, *Reuss,* b. iii. s. 142. *Id. Lud.* b. i. s. 188. —Pechsteinkohle, *Suck.* 2ter th. s. 58.—Pechkohle, *Bert.* s. 349. *Id. Mohs,* b. ii. s. 317. *Id. Leonhard,* Tabel. s. 49. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1066. *Id. Haus.* Handb. b. i. s. 78. *Id. Hoff.* b. iii. s. 293.—Jet, *Aikin,* p. 62.

External Characters.

Its colour is velvet-black.

It occurs massive; and it is said also in plates, and sometimes in the shape of branches, with a regular woody internal structure.

Internally

Internally it is splendent, and the lustre is resinous.

The fracture is large and perfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It is soft.

It affords a brown-coloured streak.

It is rather brittle.

It is easily frangible.

It does not soil.

Specific gravity, according to Wiedeman, 1.308.

Chemical Characters.

It burns with a greenish flame. Its chemical constitution is still imperfectly understood.

Geognostic Situation.

It occurs along with brown coal, in beds in flœtz trap and limestone rocks; also in beds and in imbedded portions in bituminous-shale.

Geographic Situation.

It occurs in secondary trap rocks in the Isle of Skye; in a similar situation in the Faroe Islands. On the Continent, it is met with in the Meissner hill in Hessia; at Irsenberg in Bavaria; in a bed of bituminous wood at Kunnerdorf in Bohemia; in a bed of loam above moor-coal, in the Saxon Erzgebirge; in bituminous-shale in limestone in Stiria.

Uses.

It is used as fuel, either in its natural state, or when converted into coaks. According to a report published in

3 the

the "Journal des Mines," twelve hundred men are employed in the district of Aude in France, in fabricating, with the pitch-coal of that neighbourhood, rosaries, buttons, ear-rings, necklaces, bracelets, snuff-boxes, drinking-vessels, &c. One thousand hundred weight are yearly expended for this purpose; and, to Spain alone, the value of 18,000 livres is sold. In Prussia, the amber-diggers, who name it Black Amber, cut it into various ornamental articles.

Observations.

1. It is distinguished by its splendent resinous lustre, and perfect conchoidal fracture.

2. According to Voigt, it is to be observed passing on the one side into glance-coal, and on the other into brown coal.

3. Its name is derived from its pitchy aspect. It was formerly known by the name Gagat or Jet, a name derived from the river Gaga, or the city Gagas in Lesser Asia, where it was formerly dug.

4. It is named Black Amber by the Prussian amber-diggers, because it is found accompanying amber, and, when rubbed, becomes faintly electric.

5. Several varieties of slaggy mineral pitch, and cannel coal, are known by the name of Jet.

Second Subspecies.

Glance-Coal.

Glanzkohle, *Werner.*

This subspecies is subdivided into four kinds, viz. Conchoidal Glance-Coal, Slaty Glance-Coal, Columnar Glance-Coal, and Fibrous Coal.

First Kind.

Conchoidal Glance-Coal.

Muschliche Glanzkohle, *Werner.*

Anthracite compacte, *Haüy.*

Id. Estner, b. iii. s. 135.—La Houille eclatante, ou le Glanzkohle, *Broch.* t. ii. p. 50.—Glanzkohle, *Reuss,* b. iii. s. 138. *Id. Voigt,* s. 90. *Id. Leonhard,* Tabel. s. 49.—Schlagiger Anthracit, *Karsten,* Tabel. s. 58. *Id. Haus.* s. 115.—Muschlicher Anthracite, *Lenz,* b. ii. s. 1077.—Muschlicher Glanzkohle, *Hoff.* b. iii. s. 315.

External Characters.

Its colour is iron-black, of various degrees of intensity, which rather inclines to brown; and on the surface it has sometimes a tempered-steel coloured tarnish.

It occurs massive and vesicular; the interior of the vesicles has a tempered-steel coloured tarnish.

Internally it is splendent and shining, and the lustre is imperfect metallic.

The fracture is perfect and flat conchoidal, also small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is rather brittle.

It is easily frangible.

Specific gravity 1.5, *Mohs.*

In thin pieces it emits a ringing sound.

Chemical Characters.

It burns without flame or smell, and leaves a white coloured ash.

Constituent

Constituent Parts.

Inflammable Matter,	-	96.66
Alumina,	- -	2.00
Silica and Iron,	-	1.38

Schraub. Beschr. d. Meissner, s. 146.

Geognostic Situation.

It occurs in beds in clay-slate, grey-wacke, Lydian-stone and alum-slate, through which latter it is often disseminated, and gives the glossy appearance to glossy alum-slate. It is much more abundant in secondary rocks, as in those of the coal and of the trap formations.

Geographic Situation.

It occurs in beds in the coal formation of Ayrshire, as near Cumnock and Kilmarnock; in the coal districts in the river-district of the Forth; and in Staffordshire in England. On the Continent, it is met with in the Meissner in Hessia, at Schönfeld in Saxony; and in the Alps of Switzerland.

Observations.

1. It appears to pass into Slaty Glance-coal, (coal-blende).

2. On the Meissner, it occurs along with other kinds of coal, in the following order, beginning with the uppermost: 1. Columnar coal: 2. Conchoidal glance-coal: 3. Pitch-coal: 4. Common brown-coal, passing into pitch-coal: 5. Brown-coal, with inclosed bituminous wood and earth-coal: 6. Bituminous wood.—*Voigt.*

Second Kind.

Slaty Glance-Coal.

Schriefege Glanzkohle, *Werner.*

Anthracite feuilleté, *Haüy.*

Plombagine charbonneuse, ou Anthracolite, *De Born*, t. ii. p. 296.—Kohlenblende, *Wid.* s. 653.—Native mineral Carbon, *Kirw.* vol. ii. p. 49.—Kohlenblende, *Estner*, b. iii. s. 197. *Id. Emm.* b. ii. s. 77.—Anthracite de Dolomieu, *Lam.* t. i. p. 76. —La Blende charbonneuse, ou la Kohlenblende, *Brock.* t. ii. p. 79.—Anthracite, *Haüy*, t. iii. p. 307.—Kohlenblende, *Reuss*, b. iii. s. 183.—Anthracite, *Brong.* t. ii. p. 55.—Kohlenblende, *Leonhard*, Tabel. s. 50.—Gemeiner Anthracit, *Karsten*, Tabel. s. 58. *Id. Haus.* s. 115.—Schiefriger Anthrazit, *Lenz*, b. ii. s. 1078. *Id. Haus.* Handb. b. iii. s. 317. *Id. Hoff.* b. iii. s. 317.

External Characters.

Its colour is dark iron-black, seldom inclining to brown; those varieties that border on graphite, incline to steel-grey.

It occurs massive.

Internally it is shining and glistening, and the lustre is imperfect metallic.

The principal fracture is more or less perfect slaty; the cross fracture small and imperfect conchoidal, or uneven.

The fragments are pretty sharp-edged, and sometimes trapezoidal.

It is rather softer than conchoidal glance-coal.

It is easily frangible.

It is intermediate between sectile and brittle.

Specific

Specific gravity 1.530, *Klaproth*. 1.415, *Thomson*. 1.300, *La Metherie*. 1.468, *Groese*. 1.526, *Kirwan*.

Chemical Characters.

According to Dolomieu, when reduced to powder, and heated in a crucible, it does not give any sulphureous or bituminous odour, and, on distillation, it affords neither sulphur nor bitumen. By exposure to a considerable heat, it burns without flame, and at length is consumed, leaving a greater or lesser portion of ash, according to its purity.

Constituent Parts.

	Panzenberg.	*Dolomieu.*
Carbon,	90	72.05
Silica,	4 to 2	13.19
Alumina,	4 to 5	3.29
Oxide of iron,	2 to 3	3.47
Loss,	-	8.00
	100	100.00

Geognostic Situation.

It occurs in imbedded masses, beds and veins, in primitive, transition, and secondary rocks. It occurs in Spain, in gneiss; in Switzerland and Savoy, in mica-slate and clay-slate; at Lischwitz, near Gera in Saxony, in transition rocks; in trap rocks, as in the Calton Hill at Edinburgh; in the coal formation in the river district of the Forth; and in a similar formation near the village of Brandau, in the Saatzer circle in Bohemia.

Geographic

Geographic Situation.

Europe.—It is found in several flœtz districts in Scotland, as near West Craigs in West Lothian, Dunfermline in Fifeshire, Cumnock, and Kilmarnock in Ayrshire, and in the island of Arran. In similar rocks in England, as in the southern parts of Brecknock, Caermarthenshire, Pembrokeshire, and Birch Hill, near Walsal in Staffordshire: also at Kilkenny in Ireland. On the Continent, it is met with at Kongsberg in Norway, where it is associated with native silver, in veins that traverse mica-slate: in the Hartz, in veins of red and brown iron-ore, which traverse grey-wacke; in imbedded masses in grey-wacke in Dauphiny; in mineral veins at Schemnitz in Hungary.

America.—Abundantly in the United States *.

Asia.—In the government of Katharinoslow in Siberia.

Observations.

In this country it is named *Blind Coal.*

Third Kind.

Columnar Glance-Coal.

Stangenkohle, *Voigt.*

Houille bacillaire, *Haüy.*

Stangenkohle, *Leonhard,* Tabel, s. 50. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1067.—Stänglicher Anthrazit, *Haus.* Handb. b. i. s. 72.—Stangenkohle, *Hoff.* b. iii. s. 295.

External

* Vid. Maclure's interesting Sketch of the Mineralogy of the United States, Dr Bruce's Mineralogical Journal, and particularly that valuable work, Cleaveland's Elementary Treatise on Mineralogy and Geology.

External Characters.

Its colours are velvet-black and greyish-black. It occasionally exhibits a tempered-steel tarnish.

It occurs massive, disseminated; also in prismatic concretions, which are sometimes straight, sometimes curved; and vary in thickness from a few lines to upwards of an inch, and from an inch to four or five inches in length.

The lustre is shining and glistening, and imperfect metallic.

The fracture is more or less perfect, and small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is opaque.

It agrees in hardness with the other kinds.

It is brittle, and easily frangible.

Specific gravity 1.403, *Breithaupt.*

Chemical Characters.

It burns without flame or smoke.

Geognostic and Geographic Situations.

It forms a bed several feet thick, in the coal-field of Sanquhar in Dumfriesshire; at Saltcoats in Ayrshire, it occurs, not only in beds, along with greenstone, slate-clay, clay ironstone, and bituminous-shale, in the coal formation of that district, but also imbedded in the greenstone; about four miles from new Cumnock, also in Ayrshire, there is a bed of columnar glance-coal, from three to six feet thick, in which the columns are arranged in rows like basalt, and which

which is intermixed with compact, scaly, and columnar graphite. Both the graphite and columnar glance-coal are contained in the coal formation, and in some places contemporaneous masses of greenstone are imbedded in the coal *. It occurs also at the Meissner in Hessia, where it is associated with conchoidal glance-coal, pitch-coal, brown-coal, bituminous wood, and earth-coal, and covered with greenstone and basalt.

Fourth Kind.

Fibrous Coal, or Mineral Charcoal.

Mineralische Holzkohle, *Werner*.

Mineralische Holzkohle, *Leonhard*, Tabel. s. 50.—Fasriger Anthracit, *Karsten*, Tabel. s. 58. *Id. Haus.* s. 115. *Id. Lenz*, b. ii. s. 1082.—Fasriger Anthrazit, *Haus.* Handb. b. i. s. 72. —Mineralische Holzkohle, *Hoff.* b. iii. s. 319.

External Characters.

Its colour is dark greyish-black, which sometimes approaches to velvet-black.

It occurs massive, in thin layers, and single pieces; also in fibrous distinct concretions.

It is glimmering, bordering on glistening, and the lustre is silky or pearly.

The fragments are indeterminate angular, blunt-edged, sometimes also splintery.

It soils strongly.

It

* Jameson's Mineralogical Description of Dumfriesshire, p. 160, 161, 162.

It is soft, passing into friable.
It is very easily frangible.

Chemical Characters.

When exposed to a strong heat, it burns without flame or smoke; some varieties scarcely yield to the most intense heat.

Geognostic and Geographic Situations.

It occurs imbedded, or in thin layers, in black coal, sometimes inclosed in pitchstone, and it is said also occasionally associated with some varieties of brown coal. It is met with in the different coal-fields of Great Britain, and also in similar situations on the continent of Europe.

Observations.

1. Its fibrous concretions and silky lustre distinguish it from all the other kinds of coal.

2. It is not certain that this mineral is wood mineralised. Several of the varieties may be original carbonaceous matter, crystallised in fibrous concretions.

APPEN-

APPENDIX.

APPENDIX.

Minerals whose Characters and place in the System have not been determined.

* Earthy and Saline Minerals.

Metalliferous Minerals.

EARTHY AND SALINE MINERALS.

1. Allophane.

Allophan, *Stromeyer*.

External Characters.

Its principal colour is blue, but it also occurs green and brown.

It occurs massive, disseminated, small reniform, and botryoidal.

Externally and internally it is shining or glistening, and the lustre is vitreous.

The fracture is small and imperfect conchoidal.

The fragments are sharp-edged.

It is transparent, but only translucent on the edges in the brown varieties.

It is semi-hard.

It is brittle, and uncommonly easily frangible.

Specific gravity 1.852 to 1.889, *Stromeyer*.

Chemical Characters.

It readily gelatinates in acids.

Constituent Parts.

Water, -	41.301
Silica, -	21.922
Alumina, -	32.202
Lime, - -	0.730
Sulphate of Lime, .	0.517
Carbonate of Copper,	3.058
Hydrate of Iron,	0.270
	100 *Stromeyer*.

Geognostic

Geognostic and Geographic Situations.

It occurs in a bed of ironshot limestone in grey-wacke-slate in the Forest of Thuringia.

Observations.

1. It is characterized by its uncommonly easy frangibility, and low specific gravity: it is distinguished from *Hyalite* and *Opal* by colour, inferior hardness, and low specific gravity.

2. It has been described under the name Riemannite, in honour of M. Riemann, who first noticed it. Its present name was given to it by Stromeyer.

2. Amblygonite.

Amblygonit, *Breithaupt*.

External Characters.

Its colours are greenish-white, pale mountain-green, and celandine-green, and marked externally with reddish and yellowish-brown spots.

It occurs massive; and crystallized in oblique four-sided prisms.

Internally it is shining and vitreous.

Its cleavage is said to be parallel with the sides of an oblique four-sided prism of 106° 10′ and 73° 50′.

The fracture is uneven.

The fragments are oblique rhomboidal.

It ranges from translucent to translucent on the edges.

It is as hard as felspar.

It is brittle, and easily frangible.

Specific gravity 3.00, 3.04, *Breithaupt*.

 Chemical

Chemical Characters.

It melts easily before the blowpipe into a white enamel. During fusion, it emits a reddish-yellow phosphoreal light, and intumesces, and loses a considerable quantity of some volatile ingredient.

Geognostic and Geographic Situations.

It occurs in granite, along with green topaz and tourmaline, near Penig in Saxony.

Observations.

1. It is distinguished from *Felspar* by its cleavage, and greater specific gravity; and from *Prismatic Spodumene* by its cleavage.

2. It appears to be a species of the genus Spodumene.

3. The name is from the Greek word ἀμβλυγωνιος, which refers to its blunt-edged prismatic form.

3. Aplome, *Haüy.*

This mineral has a deep brown or orange-yellow colour. Occurs crystallized in rhomboidal dodecahedrons, which are so streaked as to point out the cube as its primitive form. In lustre, fracture, and hardness, it agrees with common garnet, but its specific gravity is lower, not exceeding 3.444. It is found on the banks of the river Lena in Siberia.

4. Basalt-Jasper.

Basalt-Jaspis, *Friesleben*.

External Characters.

Its principal colour is lavender-blue; but it also occurs pearl, bluish, greenish, and yellowish grey, and from the latter it passes into yellowish and liver brown. Sometimes these colours are arranged in stripes.

It occurs massive, and coarsely disseminated.

Internally it ranges from glistening to glimmering, and the lustre is resinous, inclining slightly to vitreous.

The fracture is small and imperfect conchoidal, and sometimes coarse-grained uneven.

The fragments are rather sharp-edged.

It is opaque.

It is hard in a middling degree.

Specific gravity 2.41. The specific gravity is probably higher.

Geognostic and Geographic Situations.

It occurs imbedded in basalt in many districts in Germany.

Observations.

1. This substance has been described under a variety of names: thus Dr Zimmermann names it *Systyl;* other authors *Basaltic Hornstone;* and Dr Reuss describes it as a variety of *Porcelain Jasper*. It is conjectured to be nearly allied to Azurestone.

2. Gmelin

2. Gmelin describes a blue mineral found on Vesuvius, which bears some resemblance to basalt-jasper *.

5. Fibrolite.

Id. Bournon, Ph. Trans. 1802, p. 289. *Id. Haüy*. *Id. Delam.* *Id. Karsten*. *Id. Lucas*.

External Characters.

Its colours are white and grey.

It occurs crystallized in rhomboidal prisms, the angles of whose planes are 80° and 100°.

Internally it is glistening.

The principal fracture is fibrous, the cross fracture is uneven.

It is harder than quartz.

Specific gravity 3.214.

Constituent Parts.

Alumina, - -	58.25
Silica, - -	38.00
Iron, and loss, -	3.75
	100

Chenevix, Phil. Trans. 1802, p. 335.

Geographic Situation.

It is found in the Carnatic.

Observations.

It was first described and named by Bournon.

L l 2 6. Gehlenite.

* Schweigger's Journ. f. Chemie und Physik, b. xiv. Heft 3.

6. Gehlenite.

External Characters.

This mineral is described as a subspecies of Vesuvian at pages 138. and 139. of Vol. I. It would have been better to have marked it off with an asterisk, and placed it beside Vesuvian, as a substance nearly allied to it, and not as belonging to the same species, because its hardness and specific gravity are inferior to that of Vesuvian. The following analysis of it has been lately published:

Constituent Parts.

Lime, - -	35.50
Silica, - -	29.64
Alumina, - -	24.80
Oxide of Iron, -	6.56
Volatile ingredients,	3.30
	99.60

Fuchs, in Schweig. Journ. Bd. xv. h. 4. s. 377.

7. Holmite, *Clarke.*

External Characters.

It occurs crystallized in the form of an oblique four-sided prism, and possesses a specific gravity of 3.597.

Constituent

Constituent Parts.

Lime, - - - -	27
Carbonic Acid, -	21
Alumina, - -	$6\frac{1}{2}$
Silica, - - - -	$6\frac{1}{2}$
Oxide of Iron, -	29
Water, - -	10

Holme.

Observations.

It was named in honour of Mr Holme, who analysed it. Its geognostic situation is unknown.

8. Humite.

Humite, *Bournon.*

Id. Bournon, Cat. Min. p. 52.

External Characters.

Its colour is reddish-brown.

It occurs crystallised in octahedrons, which are always more or less truncated and bevelled.

The planes are frequently transversely streaked.

Its lustre is shining.

It is transparent.

It scratches quartz with difficulty.

Geognostic and Geographic Situations.

It occurs at Somma, near Naples, in a rock composed of grey-coloured granular topaz, mixed with grains of pale yellow

yellow and green topaz, which latter is sometimes crystallised in cavities; also with brown and olive-green mica, and white haüyne.

Observations.

The preceding account is from Bournon's *Catalogue Mineralogique*, and it contains all that is known of the species. It was named by Bournon in honour of Sir Abraham Hume, Baronet, a zealous cultivator of mineralogy, and possessor of one of the most valuable and splendid mineralogical cabinets in England.

9. Konite or Conite.

Konit, *Friesleben*.

External Characters.

Its colours are ash, yellowish, and greenish grey; but on exposure to the air becomes brown.

It occurs massive, also stalactitic, with pyramidal impressions of quartz, and in crusts.

Internally it is dull.

The fracture is small-grained uneven, also fine splintery, and occasionally flat conchoidal.

The fragments are rather sharp-edged.

It is translucent on the edges, or opaque.

It is semi-hard.

It is brittle, and rather easily frangible.

Specific gravity 2.83—2.899.

Chemical Characters.

It becomes black before the blowpipe, but does not melt. It dissolves with feeble effervescence in nitrous acid.

Constituent

Constituent Parts.

Carbonate of Magnesia,	67.5
Carbonate of Lime, -	28.0
Oxide of Iron, - -	3.5
Water, - - - -	1.0
	100.0

Geognostic and Geographic Situations.

It occurs in the trap hill named Meissner in Hessia. It is said also to have been found in Saxony and Iceland.

10. Lievrite.

Lievrit, *Werner*.

Yenite, *Lelievre,* Journal des Mines, N. 121. p. 65. *Id. Haüy,* Tabl. p. 42. & 182.—Ilvait, *Steffens,* b. i. s. 356.—Lievrit, *Hoff.* b. ii. s. 376—Yenit, *Lenz,* b. i. s. 215.

External Characters.

Its colour is intermediate between dark greyish-black and iron-black, but sometimes passes through raven-black into blackish-green.

It occurs massive; also in distinct concretions, which are small and scopiform radiated, and in others which are thin and straight prismatic; and crystallized in the following figures:

1. Oblique four-sided prism, acuminated on the extremities with four planes, which are set on the lateral planes *.

2. Four-

* Yenit quadrioctonal, Haüy.

2. Four-sided prism, which is almost rectangular, bevelled on the extremities, and the bevelling planes set on the obtuse edges.
3. The preceding figure, in which the angles of the bevelment are bevelled.
4. The preceding figure, in which the angles of the second bevelment are truncated, and the obtuse lateral edges of the prism bevelled.

The crystals vary from acicular to the thickness of half an inch: they are frequently scopiformly aggregated, sometimes superimposed, and sometimes imbedded.

The lateral planes of the crystals are longitudinally streaked.

The lustre of the fracture is glistening and semi-metallic.

The fracture is uneven.

The fragments are indeterminate angular, rather sharp-edged.

It is opaque.

It is hard in a low degree: it scratches glass with ease, and gives a few sparks with steel, but is scratched by adularia.

It does not change its colour in the streak.

is easily frangible.

Specific gravity 3.825, 4.061, *Lelievre*.

Chemical Characters.

It is attacked by the three mineral acids, but does not gelatinate with them. When exposed to heat, it becomes magnetic; its colour is changed from black into dark reddish-brown, and it loses about 2 *per cent.* of weight. Before the blowpipe, it melts easily, and without intumescence, into an opaque black bead, which has a dull metallic aspect,

pect,

pect, and is attracted by the magnet, but does not possess polarity. It dissolves in glass of borax, with a slight ebullition.

Constituent Parts.

Silica,	28.0	Silica, -	29	Silica,	30.0	Silica,	30.0
Alumina,	0.6	Lime, -	12	Lime,	12.5	Alumina,	1.0
Lime,	12.0	Oxide of Iron		Oxide of Iron		Lime,	14.8
Oxide of Iron,	55.0	and Oxide of		and Oxide of		Oxide of Iron,	49.0
Oxide of Manganese,	3.0	Manganese,	57	Manganese,	57.5	Oxide of Manganese,	2.0
	98.6		98		100.0		96.8
	Descotils.		*Vauquelin.*		*Vauquelin.*		*Vauquelin.*

Geognostic and Geographic Situations.

It occurs in primitive limestone, along with epidote, quartz, garnet, magnetic ironstone, and crystallized arsenic-pyrites, at Rio la Marine, and Cape Calamite, in the island of Elba. It is said also to occur in Siberia.

Observations.

1. Colour, crystallization, kind of lustre, fracture, distinct concretions, opacity, hardness, and considerable weight, distinguish this mineral from all others with which it might be confounded.

2. Werner places it in the system between Schorl and Epidote: in the systems of Haüy, Steffens, and Lenz, it follows Augite. The quantity of iron it contains is remarkable; and if not accidental, shews that Lievrite probably belongs to a family different from any in the Wernerian system.

11. Omphacite.

11. Omphacite.

Omphazit, *Werner*.

External Characters.

Its colour is intermediate between pale leek and mountain green, and sometimes inclining to grass-green.

It occurs massive and disseminated; also in narrow and short radiated and granular distinct concretions.

Internally it ranges from glistening to glimmering, and the lustre is resinous.

Cleavage same as that of common augite.

The fracture is fine grained uneven.

It is feebly translucent.

It is as hard as felspar.

Specific gravity = 3.30.

Geognostic and Geographic Situations.

It occurs in primitive rocks with precious garnet, sometimes also with kyanite, mica, and actynolite, in the Sau-Alpe, in Carinthia; and near Hoff in Baireuth.

Observations.

1. It is considered by Werner as a distinct species; but the circumstance of its agreeing with Augite in cleavage, hardness, and specific gravity, prove that it is a mere variety of that species.

2. The name Omphacite is from *Omphax*, the name given by Pliny to a green-coloured mineral, and which Werner has adopted for this variety of augite.

12. Pharmacolite,

12. Pharmacolite, or Arsenic-Bloom.

Arsenikblüthe, *Werner*.

Pharmakolith, *Karsten*, Tabel. (1. Ausg.) 36. 75.—Chaux arseniaté, *Haüy*, t. ii. p. 293.—Pharmakolith, Nordeutsche Beit. z. Berg. und Huttenk. iii. s. 116. *Id. Karsten*, Tabel. (2. Ausg.) s. 74. *Id. Haus.* Handb. b. iii. s. 860. *Id. Aikin*, p. 65.

External Characters.

Its colours are reddish-white, snow-white, yellowish-white, and milk-white.

It occurs as a coating, in small balls, small reniform, and botryoidal, with a drusy surface; frequently in very delicate capillary shining crystals, which are scopiformly or stellularly aggregated.

Externally it is glimmering, and the lustre is silky.

Internally it is shining or glistening, and silky on the radiated, but dull on the earthy fracture.

The fracture is very delicate, straight, scopiform and stellular radiated, and sometimes passes into fibrous, also earthy.

The fragments are indeterminate angular, and also wedge-shaped.

It occurs in coarse and small granular distinct concretions.

It alternates from semi-transparent to opaque, which latter occurs in the varieties with earthy fracture.

It is very soft, passing into friable.

It is easily frangible.

It soils.

Specific gravity, 2.536, *Selb*. 2.640, *Klaproth*.

Chemical

Chemical Characters.

Before the blowpipe it is almost entirely dissipated, with a dense white arsenical vapour.

Constituent Parts.

	Wittichen.	Andreasberg.
Lime, -	25.00	27.28
Arsenic Acid,	50.44	46.58
Water, -	24.56	23.86
	100	96.82
	Klaproth, Beit. b. iii. s. 281.	*John*, in Gehlen's Journ f. Chem. und Phys b. iii. s. 539.

Geognostic Situation.

It occurs in veins along with tin-white cobalt, native arsenic, and frequently earthy red cobalt-ochre.

Geographic Situation.

It is found in veins in granite in the mine named Sophia near Wittichen in Furstenberg; at Andreasberg in the Hartz; Riegelsdorf; and Glucksbrunn in the Forest of Thuringia.

13. Pimelite, *Karsten.*

This mineral Werner considers to be a variety of Steatite. It occurs at Kosemutz in Silesia.

14. Rhætizite

14. Rhætizite.

Rhætizit, *Werner.*

External Characters.

Its colours are greyish, milk, and yellowish white, from which latter it passes into pale ochre and isabella yellow, and into brick-red; and on the other side into greyish-white, bluish and smoke grey.

It occurs massive; and in scopiform and promiscuous radiated distinct concretions, which are collected into others which are large and longish angulo-granular.

It is glistening, shining and pearly.

The fragments are wedge-shaped and splintery.

It is feebly translucent on the edges.

In other characters same as kyanite.

Geognostic and Geographic Situations.

It occurs in primitive rocks, associated with quartz, mica, and graphite, at Pfitzsch in the Tyrol.

Observations.

1. It is named from Rhætia, its only known locality.
2. It is a variety of Kyanite.

15. Sphærulite.

Sphærulit, *Breithaupt.*

External Characters.

Its principal colours are brown and grey.

It

It occurs in imbedded roundish balls and grains, wh are sometimes reniformly aggregated; also in stellular fibrous concretions.

Externally it is sometimes smooth, (when it has a mi incrustation), sometimes rough.

Internally it alternates from glimmering to dull.

The fracture is even and splintery.

It is opaque, or translucent on the edges.

It scratches quartz with difficulty.

It is brittle, and easily frangible.

Specific gravity 2.52,—2.40.

Chemical Characters.

It is nearly infusible before the blowpipe.

Geognostic and Geographic Situations.

It occurs in pearlstone and pitchstone-porphyries, where it is often associated with small scales of mica, and portions of felspar.

It occurs imbedded in pearlstone in the vicinity of Glashütte near Schemnitz; in the pitchstone of Meissen; and the hornstone balls found at Planitz are probably varieties of this mineral. It is also found in Iceland, imbedded in pitchstone.

Observations.

1. It is distinguished by its colour, form, and high degree of hardness. It is distinguished from *Obsidian* by colour, inferior lustre, and fracture; from *Pearlstone*, by greater hardness and specific gravity.

2. It is named *Sphærulite* from its form.

16. Spak, *Breithaupt.*

External Characters.

Its colours are yellowish and greyish white.

It occurs in small veins, and in thin prismatic distinct concretions.

Internally it is shining and resinous.

It has a threefold rectangular cleavage.

Its fracture is small grained uneven, also small splintery.

It is translucent.

It is soft, inclining to very soft.

It is brittle, and easily frangible.

It has a feeble sweetish saline taste.

Chemical Characters.

It is completely soluble in water.

Geognostic and Geographic Situations.

It occurs in the salt-mines of Wieliczka and Bochnia in Poland.

Observations.

1. Its taste is very different from that of common salt, and therefore cannot like that mineral be used with food.

2. It is said to be the Fibrous Rock-salt of Werner.

17. Skorodite.

Skorodit, *Breithaupt.*

External Characters.

Its colour is leek-green, which passes on the one side into

into celandine-green and blackish-green, on the other into liver-brown.

It occurs massive, and disseminated, but most frequently crystallised, in very short broad rectangular four-sided prisms, acutely acuminated on both extremities, with four planes, which are set on the lateral edges.

The narrow lateral planes are longitudinally streaked; the others are smooth, and ranging from shining to splendent, and the lustre is intermediate between vitreous and pearly.

There is one distinct cleavage parallel with the broader lateral planes of the prism, consequently in the direction of the shorter diagonal of an oblique four-sided prism.

The fracture is intermediate between uneven and small and imperfect conchoidal.

It is translucent on the edges, or semitransparent.

It is as hard as calcareous-spar.

It is easily frangible.

Chemical Characters.

It easily melts before the blowpipe, with the copious emission of arsenical vapour, and is converted into a reddish-brown mass, which, when highly heated, so as to drive off all the arsenic, becomes attractable by the magnet. These phenomena shew that this mineral is an arseniate of iron, probably combined with manganese. It contains no copper.

Geognostic and Geographic Situation.

It occurs imbedded in a bed composed of quartz and hornstone, in primitive rocks in the Schneeberg mining district in Saxony; also at Löling in Carinthia.

18. Spind

18. Spinellane *.

External Characters.

Its colour is plum-blue.

It occurs crystallised, in rhomboids of 117° 23′; and 62° 37′; and in six-sided prisms acuminated with three planes.

It scratches glass.

Geognostic and Geographic Situations.

It occurs on the shores of the Lake of Laach, in a rock composed of grains and small crystals of glassy felspar, quartz, hornblende, black mica, and magnetic iron-ore, in small grains.

Observation.

It is said to be a variety of Hauyne.

19. Steinheilite.

This beautiful mineral has been ascertained to belong to the species Prismato-rhomboidal Iolite.

20. Stilpnosiderite †, *Ulmann.*

External Characters.

Its colour ranges from brownish-black to blackish-brown.

It occurs massive, small reniform, irregular dendritic, and in curved lamellar concretions.

* So named from its resemblance to Spinel.

† So named on account of its characteristic high lustre, and its ferruginous contents, from the Greek words στιλπνος, *shining*, and σιδηρος, *iron.*

Internally it is splendent and shining, and the lustre resinous.

The fracture nearly perfect conchoidal.

The fragments are sharp-edged.

It is opaque.

It affords a yellowish-brown streak.

It is hard in a low degree.

It is brittle, and easily frangible.

Specific gravity 3.77, *Breithaupt*.

Chemical Characters.

Is infusible without addition before the blowpipe; melted with borax, it forms a dark olive-green glass.

Constituent Parts.

Oxide of Iron,	-	80.50
Silica,	- -	2.25
Water,	- -	16.00
Oxide of Manganese, a trace.		
		98.75 *Ullmann.*

It is said by other mineralogists to contain a considerable portion of phosphoric acid.

Geognostic and Geographic Situations.

It generally occurs along with brown iron, and is sometimes associated with green lead-spar. It is found in Saxony and Bavaria.

Observations.

1. It is very nearly allied to meadow iron-ore, and may prove to be a variety of that mineral.

2. It has been described under the names Slaggy or Vitreous Brown Iron-ore, Pitchy Iron-ore, and Glance Iron-ore.

* Chus...

* Chusite, Limbillite, Sideroclepte, Mellilite, and Succinite, minerals described by Saussure and Bonvoisin, appear to be varieties of Olivine and Augite.

METALLIFEROUS MINERALS.

21. Argentiferous Copper-Glance.

Silber Kupfer-glanz, *Hausmann.*

External Characters.

Its colour is blackish lead-grey.

It occurs massive and disseminated.

Internally it is shining or glistening, and the lustre is metallic.

The fracture is flat conchoidal, passing into even.

It becomes more shining in the streak, but the colour is not changed.

It is soft.

It is sectile, and rather difficultly frangible.

Specific gravity 6.255, *Stromeeyr.*

Constituent Parts.

Sulphuret of Copper,	38.654
Sulphuret of Silver,	60.646
Sulphuret of Iron,	0.700
	100 *Stromeyer.*

Geognostic and Geographic Situations.

This rare mineral is found only at Schlangenberg in Siberia, where it is associated with copper-pyrites, calcareous-spar, and hornstone.

 Observations.

Observations.

...ur, ...racture, softness, and perfect sectility, ... characters of this mineral.

... intermediate between copper-glance, brittle s... ... common silver-glance.

... Oxide of Arsenic.

...bluthe, *Karsten.*

... p. 225.—Arsenikblüthe, *Reu.* ... Tabel. s. 74.—Arsenic oxyd... ... t. ii. p. 447.—Arseniblüthe ...

... subspecies, viz. Common, Capi...

First Subspecies.

... Oxide of Arsenic.

... Arsenikblüthe, *Hausmann.*

... *Reu.* Handb. b. iii. s. 805.

External Characters.

... snow-white or milk-white, and sometime... ... reddish, yellowish, or greenish.

... or stalactitic crusts; sometime... ... tabular or prismatic crystals.

... shining or glistening, and the lustre i...

intermediate

intermediate between vitreous and adamantine; sometimes pearly.

The fracture is uneven, more or less inclining to radiated, and foliated.

It alternates from opaque to semitransparent.

It is soft.

Second Subspecies.

Capillary Oxide of Arsenic.

Haarförmige Arsenikblüthe, *Hausmann.*

Id. Haus. Handb. b. iii. s. 806.

External Characters.

Its colour is snow-white.

It occurs in very delicate capillary crystals, which are sometimes scopiform, sometimes globularly aggregated; and are often so delicate, that the whole appears like the finest mould.

The lustre is silky and shining.

Third Subspecies.

Earthy Oxide of Arsenic.

Erdige Arsenikblüthe, *Hausmann.*

Id. Haus. Handb. b. iii. s. 806.

External Characters.

Its colour is yellowish and greyish-white.

It

It seldom occurs massive; more frequently in crusts, and stalactitic.

It is dull.

The fracture is fine earthy.

It is opaque.

It sometimes occurs in curved lamellar concretions.

It is friable.

Geognostic and Geographic Situation of the Species.

It occurs at Andreasberg in the Hartz, along with native arsenic, red silver, antimonial silver, galena or lead-glance, yellow orpiment, and corroded quartz; at Biber, along with sulphate of cobalt; at Joachimsthal with orpiment. It is also found at Gistain in the Pyrennees, and at Saint Marie aux Mines in France; and in the Island of Guadaloupe.

Observations.

It very much resembles Pharmacolith, with which, indeed, it has been often confounded. An obvious chemical character may be used for distinguishing them;—the oxide of arsenic is soluble in water, which is not the case with pharmacolith.

23. Bismuthic Silver.

Wissmuth Silbererz, *Selb.*

Wismuthisches Silber, *Selb,* in Crell's Chem. Annal. 1793, 1. 10. *Id. Wid.* s. 716.—Wismuthblei, *Reuss,* b. ii. 4. s. 191. *Id. Karsten,* Tabel. s. 68.—Wismuthsilbererz, *Selb,* in den Mineralogischen Studien, b. i. s. 79.—Bismuthic Silver, *Aikin,* p. 28.

External

INDICES.

INDICES,

In which are Enumerated the Names given to Simple Minerals, by English, German, and French Mineralogists.

ENGLISH NAMES.

Aluminite,

A-

Calcedonyx,

D

Drawing-

Labrador

Mocha

GERMAN

GERMAN INDEX.

Bergseife

C

Chlorit,

Kalksinter,

Lidischerstein,

Opal,

Thonschie

FRENCH

FRENCH INDEX.

Quartz-

FINIS.

DIRECTIONS TO THE BINDER.

Plates I. II. III. and IV. end of Volume I.

Plates V. VI. VII. and VIII. end of Volume II.

Plates IX. X. XI. and XII. end of Volume III.

PLATE IX.

ORE.

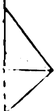


Fig. 175.

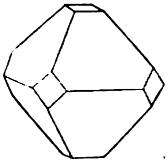


Fig. 176.

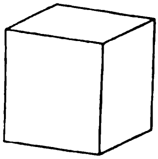
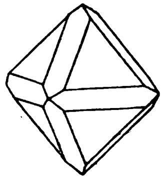


Fig. 177.



ORE.

Fig. 182.

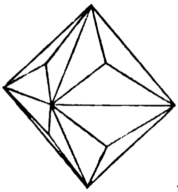


Fig. 183.

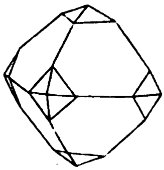
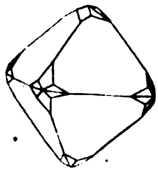


Fig. 184.



E.

8.

Fig. 189.

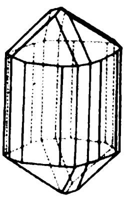


Fig. 190.

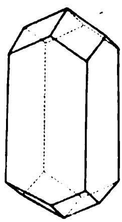
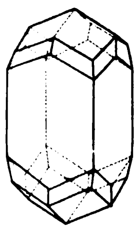


Fig. 191.



E. Mitchell sculpt.