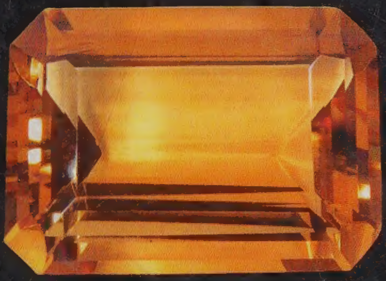
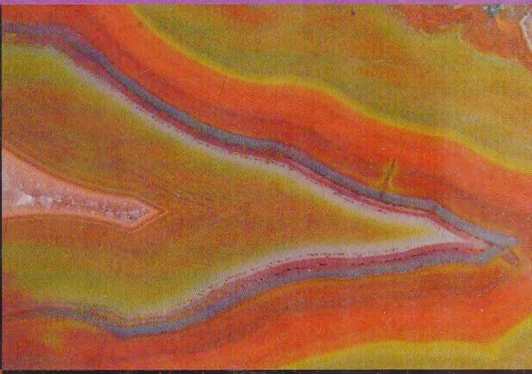
DESCRIPTIONS OF GEM MATERIALS


THIRD EDITION
(REVISED)

GLENN & MARTHA VARGAS

DESCRIPTIONS OF GEM MATERIALS

15

THIRD EDITION
Revised

BY GLENN AND MARTHA VARGAS

Authors of
Faceting For Amateurs
Diagrams For Faceting Volume 1
Diagrams For Faceting Volume 2
Diagrams For Faceting Volume 3

IN MEMORY OF
THE LATE
CHARLES J. PARSONS.
HE POINTED THE WAY.

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THE CONTENTS

Minerals on front cover clockwise from bottom left:

- Spiderweb Turquoise
- Citrine & Amethyst Rough
- Citrine (heat treated)
- Condor Agate
- Fortification Agate
- Crazy Lace Agate

Minerals on back cover from left to right:

- Ocean Jasper
- Rocky Butte Jasper
- Malachite & Chrysocolla

THE AUTHORS

The authors, Martha and Glenn Vargas have contributed significantly to the knowledge and understanding of gem materials and gem cutting techniques.

They were pioneers of modern faceting and their book, *Faceting for Amateurs*, first published in 1969, is still considered the authoritative source for information on faceting gemstones. Their first volume of *Diagrams for Faceting*, published in 1975, was the first such compilation of designs for gemstones. Volume 2 was published in 1983 and Volume 3 was published in 1987.

Glenn became interested in gemstones before World War II, when living in Blythe, California. At that time, he rockhounded in the rich deposits of western Arizona and the desert region of southern California. His friends in Blythe taught him the basics of cabochon cutting. So, when Glenn moved to Indio, California, he was already well versed in gem materials and gem cutting.

The Indio school board wanted to establish a lapidary class and Glenn was tapped for the position. He set the curriculum and taught the students cabochon cutting. Martha was in Glenn's first class and they became partners both in marriage and in their interest in gems and the art of lapidary.

After teaching the lapidary class for 3 to 4 years, Glenn and Martha decided that faceting would be a good addition the curriculum. They purchased a faceting machine around 1946 and shortly thereafter began teaching faceting to their students.

Their lapidary class moved to the College of the Desert where they taught the class for 15 years. At age 65, Glenn was forced to retire from the California college system. Glenn and Martha were offered a position teaching faceting at the University of Texas where they taught faceting for 26 years.

Martha Vargas passed away in 2000. At age 92, Glenn was still teaching faceting students twice a month. Glenn died March, 2009 at the age of 94. Glenn and Martha are sorely missed by the faceting and gemology communities.

PREFACE

Before *Descriptions of Gem Materials* was published, many gem cutters and gem enthusiasts used a pamphlet by Charles J. Parsons that described a limited number of gem materials. Because the pamphlet was narrow in scope, a more comprehensive resource was badly needed.

Glenn and Martha Vargas published the first edition of Descriptions of Gem Materials in 1972 to fill that need. It described slightly over 250 (220 natural and 30 man-made) materials that could be cut into gems.

This new revision of the third edition has information on over 550 gem materials, of which 346 are distinct natural minerals. The book also describes 56 man-made gems, many of which are available on the gem market.

As the most comprehensive book on gem materials, this book is a valuable reference for gem cutters, gemologists and all others with an interest in gemstones. It helps with gem identification, prepares the cutter for what may be expected when working a stone and informs mineralogists of the properties of all gems.

Information in this book has been gleaned from personal knowledge, the books that are listed in the bibliography, and to a large extent, the result of contact with eminent and patient mineralogists and gemologists that have courteously answered our many questions. They have been an important source of information.

Other informational leads came from mineral dealers when they came upon a new and interesting gem material. Gem cutters and collectors were also helpful in providing data.

The authors are indebted to the students in their gem identification classes. The first edition was used as a text and workbook. As a result, the students have made many suggestions that have been incorporated into subsequent editions.

These contributors are far too numerous to mention here, but without them this book would not have been published. The authors hope that they will understand the lack of mention of their identities.

INTRODUCTION

This book is intended as a reference for gem or rough material identification, or in preparation for gem cutting. It is hoped it will be of value for the student of gemology in finding the identity of an unknown gem. It should be of value to the cabochon or faceted gem cutter to help him identify or check identification of rough material, and give him information as to the possible behavior of the material when he begins to cut it.

The information presented is as concise and orderly as possible. Conciseness has its disadvantages in that only the more usual or normal characteristics can be given. If a reader wishes more complete information on possible variations, he should consult a work on mineralogy or gemology, some of which listed in the bibliography, Section 8, page 159.

Included herein are all of the gem materials that the authors know have been cut into gems. It is certain, however, that materials not included have been cut into gems, or soon will be. Some of the materials included do not deserve such inclusion, but whether or not they make good or poor gems, is not the concern here. The fact that a mineral has been cut into what someone calls a gem was the only virtue required. In some cases, very obscure and rare materials make surprisingly good gems, where on the other hand, more common and perhaps gemmy appearing materials have been found to make poor gems. Thus, the authors do not really recommend or condemn any of the materials. It has been found that what is a mundane gem material today, may become spectacular upon the discovery of a new deposit.

An explanation of terms is in order. The page for each gem material is laid out with physical characteristics on the left, and optical characteristics on the right.

Physical Characteristics

CHEMICAL CONSTITUENTS are the first items in the left column. The upper line is elements and radicals in their proper names. The second line contains the symbolic formula.

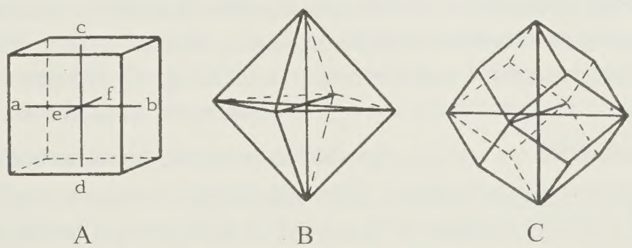
CRYSTAL SYSTEM of each mineral is the next item. Below are drawings of the most common forms of each system, which should be of assistance when trying to identify crystalline material. The form in which minerals appear is known as habit. Some of the most usual habits of crystals are named below with the examples. Other habits are also noted in the descriptions, and it is assumed that the wording adequately describes them.

FIGURE 1. ISOMETRIC CRYSTALS.

A - cubic

B - octahedral

C - dodecahedral. (Horizontal and vertical lines a-b, c-d, e-f are the crystallographic axes.)



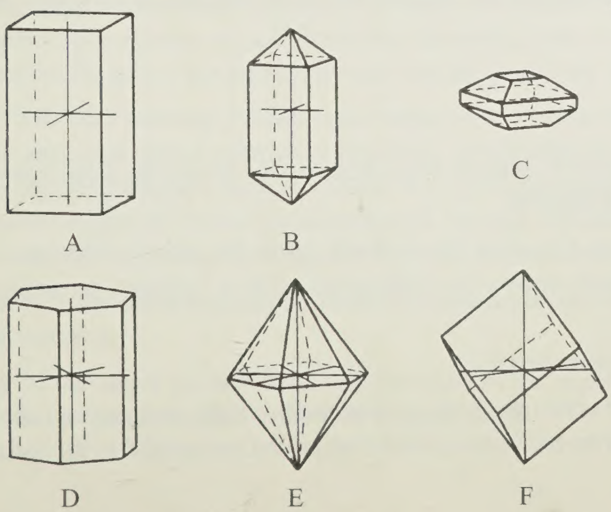


Figure 2. Tetragonal and hexagonal. The uniaxial crystals.

A - prismatic

B - prismatic (prism with, pyramid)

C - tabular (pyramid with prism and basal pinacoid)

D - prismatic

E - pyramidal

F - rhombohedral

Figure 3. Orthorhombic, monoclinic, and triclinic. The biaxial crystals.

A - prismatic

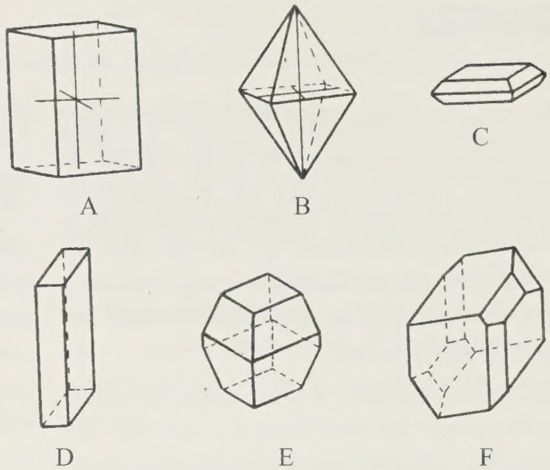
B - pyramidal

C - tabular (prism with basal pinacoid and pyramid)

D - prismatic

E - pyramidal (combined with other forms)

F - prismatic



HARDNESS of each mineral is listed, using Mohs scale. The usual range is given. A comparison of the Mohs and Knoop scales is given in Section 3, page 129.

SPECIFIC GRAVITY is the usual ratio of the weight of the material in question to an equal volume of water. Here again, the usual normal ranges are listed, with the usual normal point sometimes following in parentheses.

CLEAVAGE is noted in the following descending order; very perfect, perfect, distinct, indistinct, traces, none. For a few minerals, parting is noted instead of, or in conjunction with cleavage. From outward appearances, cleavage and parting seem identical, but the physical basis is different. Cleavage is the result of weakness along a plane that is part of the regular molecular pattern of the crystal, whereas parting takes place along a twinning or other unusual plane.

FRACTURE is the surface that results from a break. This is a separate characteristic from cleavage, even though it may occur with it. Conchoidal fracture is the smooth concave surface much resembling the inner surface of a clam shell. Uneven fracture covers a number of possibilities, but is not an excessively rough surface. Hackly fracture is a very rough surface. Splintery fracture is much like the end of a broken piece of wood. Fibrous fracture resembles the threads of asbestos. The latter three seldom show in gem materials.

STREAK is the color of the fine powder of a mineral. For minerals 6 in hardness and below, streak can be easily seen by drawing the mineral across an unglazed porcelain surface. For those over 6 in hardness, the porcelain streak plate is seldom successful, and streak must be obtained by pulverizing the material. A listing of an uncolored streak usually denotes a mineral that is above 6 in hardness and would have a white streak when pulverized.

INCLUSIONS are self-descriptive. The terms two-phase and three-phase need some clarification. A two-phase inclusion refers to a cavity obviously filled with a liquid containing a bubble or a movable solid. A three-phase inclusion is a solid and a bubble enclosed with a liquid. These types of inclusions are variable and even though not common, are not extremely rare.

Optical Characteristics

COLOR is the first of the optical properties. The lightest colors or hues are listed first, moving toward the darker ones. Any color listing enclosed within parentheses ( ) is rare for that material.

REFRACTIVE INDEX (RI) is shown in four different ways. A number shown singly (or in two parts) without any letter prefix indicates the RI of a nearly opaque material. A single number (or a pair) prefixed by n- indicates an isometric or amorphous mineral.

Isometric and amorphous minerals are grouped as isotropic materials.

UNIAXIAL minerals (tetragonal and hexagonal) are reported as two numbers, one prefixed by O- (the ordinary ray), the other by E- (the extraordinary ray). The ordinary ray vibrates in the horizontal plane of the crystal and parallel to the horizontal axes, but is traveling along the vertical axis of the crystal. It is always singly refractive and thus is identical to the isometric situation. This axis is known as the optic axis.

The extraordinary ray vibrates in the vertical plane of the crystal, which is identical to the vertical crystalographic axis, and is traveling through the horizontal axis. The RI in this case varies in accordance to the direction that the ray is vibrating. (Part of any extraordinary ray is also vibrating in a horizontal plane.)

BIAXIAL minerals (orthorhombic, monoclinic, and triclinic systems) are shown with three refractive indices, prefixed by the letters X-, Y-, and Z-. Each of these indicates a direction of light vibration with a different RI. The ray X and the ray Z both vibrate in such a direction that they have only single refraction and are again comparable to the isometric situation The ray Y is analogous to the extraordinary ray of uniaxial crystals. Thus, the rays X and Z are traveling down optic axes.

The uniaxial and biaxial minerals are grouped as anisotropic materials.

The isotropic and anisotropic materials and the use of the polariscope are discussed at the beginning of Section 5. page 143.

REFRACTIVE INDICES shown as more than one number are the usual low and high extremes, but it must be emphasized that in many cases some of these will show an RI of even lesser or greater amounts.

CRITICAL ANGLE is offered next, for those who intend to facet the material. The angle here was computed for the normal lesser RI. The critical angle is that angle (or smaller angles) at which light will emerge from a gem. Rays at greater angles will reflect off within the gem.

BIREFRINGENCE is the double refractive power of the mineral, and the measure is the numerical difference between the extremes of the refractive indices. The numbers indicate the following: up to .009, weak; .01 to .039, medium ; .04 to .099, strong; .10 and above, very strong.

PLEOCHROISM refers to the colors, or shades of a color seen through different directions (axes) of a mineral. Uniaxial minerals may be dichroic (having two colors) and biaxial minerals may be trichroic, (having three colors). Some uniaxial and biaxial minerals do not show pleochroism; obviously, the mineral must have color to show it. Amorphous and isometric minerals cannot exhibit pleochroism.

DISPERSION is the power of breaking light into the colors of the spectrum. The measure is the numerical difference in RI between the violet and red rays. The numbers indicate the same limits as for birefringence above. Any mineral in any crystalographic system might show this phenomenon.

PHOTOCHROISM is listed following dispersion, if the mineral exhibits it. The phenomenon of a mineral showing different colors in different types of light is not common, but neither is it rare. The alexandrite form of chrysoberyl is the best known, but others are listed here. A number of the new man-made materials also exhibit photochroism. Many of the dopants being used have a tendency to induce photochroism, which is becoming quite common.

DIAPHANEITY transparent, translucent, or opaque designations should need no explanation.

LUSTER is the appearance of the surface of a mineral, and is best observed on a freshly broken surface. Adamantine luster is that of high brilliance and reflection. Vitreous luster is that of glass, or a glassy look. (Glassy is an old term for vitreous.) The other types of luster are self-descriptive. In reality, luster is the reflectivity of the surface of a mineral. The smoother the surface the greater the reflectivity and thus the greater the luster.

The OPTICALLY heading indicates two items. First, whether the mineral is uniaxial (U) or biaxial (B), then followed by the optic sign (either positive or negative), which refers to the relative numerical differences between the indices. In the uniaxial minerals, the sign is positive (+) if the extraordinary ray has the higher RI, negative (-) if the ordinary ray has the higher RI. In the biaxial minerals, the sign is positive (+) if the intermediate ray (Y) is nearer numerically to the smaller index (X). It is negative (-) if the intermediate ray is nearer to the higher index (Z).

2V ANGLE is the last optical listing. This is the acute angle between the optic axes (indices X and Z). This is shown only for biaxial minerals.

If any of the above characteristics are not shown, the material either does not exhibit the omitted property, or the information was unavailable at the time of publication.

ETYMOLOGY the derivation of the names of minerals and gems follows the optical properties. The words in italics are the linguistic root, followed immediately by the language in parentheses. The name of the language is usually abbreviated. These are as follows: (Gr), Greek; (L), Latin; (Ger), German; (Ar), Arabic; (Sp), Spanish; (Fr), French.

Following the language designation is the English translation of the word, or words. Many minerals were named for individuals. These are given with their background if it was known to the authors. Other minerals were named for countries, states, or cities. Most are listed without comment, but if the geographical name is of interest, this is stated.

Last in the column, any alternate, varietal, or incorrect names are listed. The latter are always shown in quotes.

Using this Book

SECTION 1: Natural Gem Materials

This contains all of the natural minerals that have been known to be cut into gems. The section includes both faceting and cabochon materials.

SECTION 2: Man-made Gem Materials

The "synthetic" gem materials, are described similarly to those in Section 1. The tendency in this edition is to consider the term synthetic only for those materials that have a natural counterpart. The term man-made is used to encompass all manufactured materials, with perhaps the exclusion of outright imitations made of a variety of substances. This exclusion is often difficult to do.

SECTION 3: Table of Hardness

Lists the hardness range of all described materials in ascending order. If the hardness of an unidentified mineral is known, this may be the first identification step.

SECTION 4: Table of Specific Gravity

Lists the specific gravity range of all described materials in ascending order. When specific gravity is known, this may be a second identification step.

SECTION 5: Table of Refractive Index

Lists the refractive index range and optics for all transparent minerals described here. The optics are to the right of the RI ranges and indicate isotropic (I); uniaxial (U); and biaxial (B). Uniaxial and biaxial are also indicated as positive (+) or negative (-). When the RI of an unidentified mineral is known, Section 5 may be a further identification aid. Thus, if Sections 3-7 can be usable for any unknown, it would almost always be identifiable.

SECTION 6: Glossary of Important Geological Terms

Lists and defines geological terms used in this book.

SECTION 7: Index of Alternate Varietal & Incorrect Names

This is in part an index. It lists all common correct or incorrect synonyms of the described materials. Incorrect names are shown in quotes. Sections 1, 2, 7 are a combined index. Nearly any name for any cutting material, depending upon its usage, may be found in one of them.

Accompanying nearly all gem materials in Sections 1 & 2, is a pronunciation. This is placed to the far right, in line with the name of the material. The sound of the name is conveyed by a pseudo-phonetic system, using the spelling of common English sounds. If there is no pronunciation, it was assumed that the use of the name was so common that a pronunciation was not needed. In some cases, where more than one material is grouped together, the more obvious pronunciations were omitted. In all cases, the best source possible was used, thus some entries will be disputed. The intent here was not to be the final authority, but to convey as simply as possible, the sound that might be the most acceptable.

Section 1
NATURAL GEM MATERIALS

This section embraces all of the natural materials that are known to have been cut into gems of some type. The greatest bulk of these are minerals, many of them well known and popular. Some of the minerals included here are extremely rare and may have been found in gem quality very few times, perhaps only once.

A few of the materials described are rocks, but have some property, such as fine grain structure, cohesiveness, color, or other characteristics that allow their being made into a gem. In some cases, most of the rock is nondescript and highly variable, but it has included in it some material as a coloring matter, and this may be the only constant and desirable characteristic.

In a paragraph above the words "gem quality" were used. It is evidently nearly impossible to define this term. If we confine ourselves to the realm of faceting, we might be led to expect that gem quality would infer a clear flawless material. Indeed, this is what many people think of as gem quality material, but amateurs (and also professionals) have been faceting opaque materials for many years. However, in the short text following the descriptions, the words "facet quality" or "material clear enough to facet" are used on occasion. With this phrasing, it is inferred that the material must be clear, and at least reasonably flawless. This statement is made in full knowledge of the fact that these same minerals have been faceted when they were not clear and flawless. In fact, the authors have been guilty of doing exactly this, even though it is inferred that facet quality is only clear material.

If some kind of a definition of cabochon "gem quality" is attempted, the task seems to be hopeless. It appears that a passable definition for such, is anything that will not pass the requirements for faceting can be considered cabochon quality. This is especially true if it will hold together for the cutting process. Again, the authors have been involved in cutting cabochons from some very dubious materials.

Regardless, if we cannot really define cabochon quality, we can look at the finished product and assess it as a gem. Here, perhaps, are the true criteria. If the "gem" has no interesting pattern, colors, luster, brilliance, or will not take a good polish, then we can say with some finality, that the material it was cut from was not gem quality.

ACHROITE (see Tourmaline Group —elbaite-dravite series)

ACMITE (see aegerine)

ACTINOLITE (Amphibole Group)

ack-TIN-o-lite

Basic calcium magnesium iron silicate
$Ca_2(Mg, Fe)_5Si_6O_{22}(OH)_2$
Monoclinic
Habit- long bladed crystals, massive
Hardness- 5 to 6
Specific gravity- 3.0 to 3.3
Cleavage- perfect, fibrous, one direction
Fracture- uneven
Streak- white to light green
Inclusions- parallel needles

Color-Green
RI- X-1.599, Y-1.612, Z-1.622
Critical angle- 38°
Birefringence- .026, medium
Dichroism- distinct
Translucent, rarely transparent
Luster- vitreous
Optically- biaxïal negative
2V angle- 78°
Massive varieties- smaragdite, foliated
Name- *actinos* (Gr) - ray; from the radiating habit

Actinolite seldom appears in single crystals, but is usually massive groups of bladed crystals. The massive varieties may be cohesive enough to be cut into cabochons. Transparent crystals have been faceted. Madagascar is the only known source of facetable crystals. Michigan has produced cabochon material. Material from California has been cut into spheres.

ADAMITE

A-dam-ite

Basic zinc arsenate
Zn_2AsO_4OH
Orthorhombic
Habit- reniform groups, prismatic
Hardness- 3.5
Specific gravity- 4.34 to 4.35
Cleavage- distinct, one direction
Fracture- conchoidal
Streak- white
Inclusions- irregular flaws

Colorless, yellow, green, pink purple
RI- X-1.722, Y-1.742, Z-1.763
Critical angle- 35°
Birefringence- .041, strong
Dispersion- strong
Transparent to translucent
Luster- vitreous
Optically- biaxial positive or negative
2V angle- nearly 90°
Name- for Gilbert J. Adam, French mineralogist

Rarely found in single crystals; some of these are clear enough to facet lively gems. Normally in reniform groups of crystals. Mexico is the most likely source for facetable material. The usual reniform groups are not potential gem material. In 1981 the mine in Mexico produced a limited amount of large violet crystals, some of which could be faceted into gems up to one carat. Prices were very high.

AEGERINE (acmite) (Pyroxene Group)

EE-jer-ine

Sodium iron silicate
$NaFeSi_2O_6$
Monoclinic
Habit- long prismatic, tufted aggregates
Hardness- 6
Specific gravity- 3.55 to 3.6
Cleavage- good, two directions
Fracture- uneven, brittle
Streak- pale yellowish-gray

Color- Dark green to brownish-black
RI- X-1.750, Y-1.780, Z-1.80
Critical angle- 34.5°
Birefringence- .05, strong
Dispersion- ?
Translucent to opaque
Luster- vitreous to resinous
Optically- biaxial negative
2V angle 60° to 70°
Name- *Aegeria* (L) - a prophetic nymph
Alternate name- acmite; [*akme* (Gr) - point; for the long pointed crystals]

Massive material from Arkansas can be cut into cabochons with an interesting gray and black mottled pattern.

AGALMATOLITE

ag-al-MAT-o-lite

May be one of three minerals: Hydrous aluminum or potassium or magnesium silicate
Habit- massive
Hardness- 1 to 2.5
Specific gravity- 2.7 to 2.9
Cleavage- none
Fracture- uneven
Streak- white
Color- White, light shades of gray, green, red
Translucent to opaque
Luster- earthy to vitreous
Name- *agalmatos* (Gr) - image; from the long use for carving; a slang name is "figure stone"
Alternate name- pagodite, from the carvings

Agalmatolite may be a fine-grained form of talc, or a fine-grained form of the mineral pyrophyllite. Much agalmatolite is a type of pinite, that is usually from China. The most likely use for this material is for making carvings.

ALABASTER (see gypsum)

ALALITE (see diopside)

ALBITE (see Feldspar Group – plagioclase)

AL-bite

ALGODONITE & DOMEYKITE

al-go-DOAN-ite, DOE-may-kite

Copper arsenides
Cu_6As- algodonite
Cu_3As- domeykite
Hexagonal- algodonite
Isometric- domeykite
Habit- massive, reniform, botryoidal
Hardness- 3 to 4
Specific gravity- 7.2 to 8.3
Cleavage- none
Fracture- subconchoidal to uneven
Streak- dark
Color- Steel-gray, tarnishing to dark color
Opaque
Luster- bright metallic on fresh break
Names- for the Algodones mine in Chile [*algodon* (Sp) - - cotton], for Ignacio Domeyko, Chilean mineralogist

VARIETY:
Mohawkite - is algodonite, plus other arsenides, mixed in quartz. Mohawkite tarnishes, but not as rapidly as the purer forms. The name is from the Mohawk mine in Michigan.

Both of these minerals are found in nearly pure form in some copper mines. They are sometimes cut into cabochons, which soon alter to dark colors.

ALLANITE (Orthite) (Epidote Group)

ALLAN-ite, OAR-thite

A complex basic aluminum iron silicate
$(Ce,Ca,Y)_2(Al,Fe)_3(OH)$
Monoclinic
Habit- tabular, massive
Hardness- 5.5 to 6
Specific gravity 3.9 to 4.0
Cleavage- none
Fracture- conchoidal to uneven
Streak- black
Color- Brown to black
RI- X-1.64 to 1.81 (unimportant)
Translucent to opaque
Luster- resinous to metallic
Names- for Thomas Allan, English mineralogist, its discoverer
Name- *orthos* (Gr) - straight; for the straight radii of its crystals

Material from Texas can be cut into cabochons that are brown and black mottled. The overall look of the cabochons is splendent, but parts of the surface do not take a brilliant polish, and the splendent look is somewhat spotty.

ALLEMONTITE

al-eh-MONT-ite

Arsenical antimony
AsSb + As or Sb
Hexagonal
Habit- massive
Hardness- 3 to 4
Specific gravity- 5.8 to 6.2
Cleavage- perfect, one direction
Fracture- uneven
Streak- gray

Color- Tin-white, reddish-gray; tarnishes gray to black
Opaque
Luster- metallic
Name- for Allemont, France; the type locality
Name- *arsenikos* (Gr) - strong, masculine
Name- *antimonium* (L) - antimony, (it probably was used for the mineral stibnite)

This is a very unique material. It evidently is the mineral stibarsen (AsSb) mixed with an excess of either arsenic (As) or antimony (Sb). Some authors feel that it simply is a mixture of native arsenic and native antimony. The massive material has a bright white metallic luster and makes nice lusterous cabochons. Tarnishing is slow. A mine in British Columbia, Canada, produces excellent material.

ALMANDINE (See Garnet Group – pyralspite subgroup)

AL-man-dean

ALUNITE

AL-you-nite

Basic potassium aluminum sulfate
$KAl_3(SO_4)_2(OH)_6$
Hexagonal
Habit- massive, small rhombohedrons
Hardness- 3.5 to 4
Specific gravity- 2.6 to 2.9
Cleavage- distinct (crystals), one direction
Fracture- uneven to conchoidal
Streak- white

Color- White, ivory, yellow. Sometimes discolored with streaks of red, yellow or dark purple
RI- O-1.572, E-1.592
Critical angle- 39.5°
Translucent, seldom transparent
Luster- earthy to vitreous
Name- *alumen* (L) - alum; to alun (Fr)

Alunite has been cut into uninteresting cabochons. However, when impurities are present to give some color or pattern, the cabochons are much better. Transparent crystals are possible and could be faceted, but the gems would be poor.

AMAZONSTONE, AMAZONITE (see Feldspar Group – microcline)

AMBER and COPAL

AM-burr, coe-PALL

Oxygenated hydrocarbon
$C_4OH_6O_4$
Amorphous
Habit- lumps
Hardness- 2 to 2.5
Specific gravity- 1.01 to 1.1 (1.08)
Cleavage- none
Fracture- conchoidal, somewhat tough
Streak- white
Inclusions- insects, moss, twigs, etc.

Colorless, yellow, orange, red
RI- n-1.54
Critical angle- 40.5°
Transparent to translucent
Luster- resinous
Names- *anbar* (Ar) - ambergris, a very odorous secretion from sick whales
copalli (Sp) - resins in general for the Kauri Pine of New Zealand and Australia

VARIETIES:
Burmese or Chinese - colorless to red, from the Orient
Copal or kauri gum- light colors, from Australia & New Zealand (the Kauri Pine). Copal is a resin from presently living trees and not a fossil.
Roumanite - greenish-yellow to brown, from Romania
Sicilian - yellow to orange, from Sicily
Succinite - Baltic region, yellow to brownish-yellow to red [succinum (L) - amber]

In the polariscope, amber often shows anomalous double refraction. It melts at 300° F and will float in a saturated salt (NaCl) solution; whereas plastics will sink. It will dissolve in acids, but not ether, which attacks most plastics. Amber also burns brightly, where plastics will char. True amber is a fossil. Excellent amber comes from the Dominican Republic.

AMBLYGONITE (montebrasite)

am-BLIG-on-ite, mont-eh-BRAY-site

Basic lithium aluminum fluo-phosphate
$LiAlPO_4(F, OH)$
Triclinic
Habit- usually massive, crystals rare
Hardness- 6
Specific gravity- 3.0 to 3.1
Cleavage- perfect, two directions
Fracture- subconchoidal
Streak- white
Inclusions- parallel bands of veils

Colorless to yellow, orange, pinkish
RI- X-1.611, Y-1.621, Z-1.636
Critical angle- 38.5°
Birefringence- .024, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 75°
Name- *amblys & gonia* (Gr) - blunt angle; for the cleavage angle
Name- for Montebras, France, the type locality

Clear pieces often contain clouds in nearly parallel bands. Facetable pieces are uncommon. Brazil is the best known source. Actually, gem material is the mineral montebrasite that forms a series with amblygonite. Chemically they are virtually identical, and differ slightly in specific gravity. The above properties are for montebrasite, but the name is not used because of precedent.

AMETHYST (see quartz – crystalline)

AMETRINE (see quartz – crystalline)

AMMOLITE (see aragonite)

AMPHIBOLE GROUP (see individual minerals)

AM-fih-bole

ACTINOLITE - AMPHIBOLITE - ANTHOPHYLLITE - HORNBLENDE - NEPHRITE

AMPHIBOLITE (Amphibole Group)

am-FIB-oh-lit

A mixture of an amphibole and orthoclase
Habit- massive
Hardness- 6 (approx.)
Specific gravity- 2.85 (variable)
Cleavage- none
Fracture- uneven
Streak- brownish

Color- Spangled brownish
Translucent to opaque
Luster- vitreous to resinous
Name- *amphibolos* (Gr) - doubtful
Commercial name- "Fire jade"

The term amphibolite covers a wide group of materials. The characteristics of each will depend upon which of the amphiboles is in its makeup. If the amphibole is fibrous, the material might be silky. The material described here contains amphibole platelets of a brownish color, thus it is spangled. A unique spangled material was introduced in the 1970's, and called "fire jade". The location was not divulged by the distributors. A number of years later, the authors found it in mineral shops in Australia. The mineral has no jade properties, but it can be cut into unique cabochons that have a spangled, somewhat fiery look.

ANALCIME (Zeolite Group)

an-AL-seem

Hydrous sodium aluminum silicate
$NaAlSi_2O_6\ 2H_2O$
Isometric
Habit- trapezohedral crystals
Hardness- 5 to 5.5
Specific gravity- 2.22 to 2.29
Cleavage- traces, three directions
Fracture- conchoidal
Streak- white
Inclusions- many veils

Colorless, white, gray
RI- n-1.478 to 1.493
Critical angle- 42.5°
Transparent to nearly opaque
Luster- vitreous
Name- *analkes* (Gr) - weak; by friction it develops weak electricity
Alternate name- analcite

Transparent crystals may show anomalous double refraction in the polariscope, evidently due to strain. Facet quality crystals are rare, and make gems of low brilliance. Locations in Canada and Italy are the best probable sources of faceting material.

ANATASE (octahedrite)

ANA-tase, oct-uh-HEED-rite

Titanium dioxide
TiO_2
Tetragonal
Habit- octahedral, prismatic
Hardness- 5.5 to 6
Specific gravity- 3.82 to 3.97
Fracture- conchoidal to uneven
Streak- uncolored
Trimorphous with brookite and rutile
Inclusions- many veils

Color- Yellow, brown, reddish, blue, black
RI- O-2.56, E-2.49
Critical angle- 24°
Birefringence- .07, strong
Dispersion- strong
Transparent to opaque
Luster- adamantine to submetailic
Optically- uniaxial negative
Name- *anatasis* (Gr) - extension; due to the extended look of the crystals
Alternate name- octahedrite, for the common crystallization

Only rarely is anatase transparent, and then it can be cut into a brilliant gem. The strong dispersion and birefringence are excellent optical properties. A location in East Africa has produced a few excellent yellow crystals that have been cut into fine gems. Sizes have not been large. Another location, in Sweden, has produced deep blue transparent, but very small, crystals.

ANDALUSITE (chiastolite)

and-uh-LOO-site, kye-AST-toe-lite

Aluminum silicate
Al_2SiO_5
Orthorhombic
Habit- square prisms
Hardness- 7.5
Specific gravity- 3.1 to 3.2
Cleavage- distinct, three directions
Fracture- uneven
Streak- uncolored
Trimorphous with kyanite and sillimanite
Inclusions- numerous needles, (rutile?), mica flakes, see below for chiastolite

Color- Yellow, pink, green, red, brown, black
RI- X-1.634, Y-1.639, Z-1.643
Critical angle- 37.5°
Birefringence- . 009, weak
Trichroic- pink, green, yellow
Transparent to translucent and opaque
Luster- vitreous
Optically- biaxial negative, rarely pos.
2V angle- 85°
Name- for Andalusia, Spain, type locality
Name- *chiastros* (Gr) - marked with a cross (+)

VARIETY:
Viridine - a deep green variety found in Brazil [*viridis* (L) - green]

Crystals of andalusite seldom exhibit smooth faces. Clear material can be cut into excellent dichroic gems. The yellow trichroic color is usually not visible and gems appear dichroic pink and green. Chiastolite, an opaque variety, contains a black cross of carbonaceous material. The cross changes shape throughout the length of the crystal. These make interesting, but lusterless cabochons. Brazil is the best source of faceting material. California and Massachusetts produce excellent chiastolite.

ANDESINE (see Feldspar Group – plagioclase)

AN-des-ine

ANDRADITE (see Garnet Group – ugrandite subgroup)

AND-ruh-dite

ANGLESITE (Barite Group)

AN-gles-ite

Lead sulfate
$PbSO_4$
Orthorhombic
Habit- tabular, prismatic, massive
Hardness- 2.5 to 3
Specific gravity- 6.3 to 6.39
Cleavage- distinct, two directions
Fracture- conchoidal
Streak- white
Inclusions- many veils

Colorless, yellow, (green), (blue)
RI- X-1.877, Y-1.882, Z-1.894
Critical angle- 32°
Birefringence- .017, medium
Dispersion- strong
Transparent to opaque
Luster- adamantine to vitreous
Optically- biaxial positive
2V angle- 60° to 75°
Name- for the Isle of Anglesey, Wales

An extremely brittle material. Seldom found in distinct crystals. Colorless material usually has a yellowish tinge. Gems are very brilliant. Lead mines are the usual source of clear material.

ANHYDRITE

an-HIDE-rite

Calcium sulfate
$CaSO_4$
Orthorhombic
Habit- tabular, prismatic, massive
Hardness- 3 to 3.5
Specific gravity- 2.89 to 2.99
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Variety: vulpinite, for Vulpino, Italy
Inclusions- numerous cleavage cracks

Colorless, violet, reddish
RI- X-1.569, Y-1.575, Z-1.613
Critical angle- 39.5°
Birefringence- .044, strong
Trichroism- sometimes strong
Dispersion- .013, weak
Transparent to translucent
Luster- vitreous, sometimes pearly
Optically- biaxial positive
2V angle- 42°
Name- *anhydros* (Gr) - no water; from no water in the molecule (see gypsum)

Very rare, especially in crystals. It is very difficult to cut because of cleavage. Salt mines in Europe are the best sources for clear material. Pseudomorphs after halite have been found. Vulpinite is a foliated, silicious variety used for carvings.

ANORTHITE (see Feldspar Group – plagioclase)

AN-or-thite

ANTHOPHYLLITE

an-THAH-fee-lite

Basic magnesium iron silicate
$(Mg, Fe)_7Si_8O_{22}(OH)_2$
Orthorhombic
Habit- usually massive
Hardness- 5.5 to 6
Specific gravity- 2.85 to 3.57 (3.38)
Cleavage- perfect, one direction
Fracture- uneven
Streak- grayish to uncolored

Color- White, brown, gray, greenish
RI- X-1.596, Y-1.605, Z-1.615
Critical angle- 39°
Birefringence- .019, medium
Transparent to opaque
Luster- vitreous to silky
Optically- biaxial positive or negative
2V angle- 78° to 111°
Name- *anthophyllum* (L) - clove, for color

This is certainly not an exciting lapidary material, but it has been cut into cabochons. If clear crystals can be found, it is conceivably facetable. California has produced material that has been cut into cabochons.

ANTIGORITE (see serpentine)

APACHE TEAR (see obsidian)

APATITE GROUP (see individual minerals) (those not described in this book**)

CHLORAPATITE** - FLUORAPATITE - HEDYPHANE - HYDROXYLAPATITE** MIMETITE - PYROMORPHITE - VANADINITE - WILKEITE

APATITE (fluorapatite) (Apatite Group)

AP-uh-tite

Calcium fluo-phosphate
$Ca_5(PO_4)_3F$
Hexagonal
Habit- prismatic
Hardness- 5
Specific gravity- 3.1 to 3.2 (3.18)
Cleavage- imperfect, two directions
Fracture- conchoidal to uneven, brittle
Streak- white
Inclusions- rarely other mineral crystals

Colorless, green, yellow, violet, blue
RI- O-1.635, E-1.632
Critical angle- 37.5°
Birefringence- .003, weak
Dichroism- sometimes strong
Dispersion- .013, weak
Transparent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- *apate* (Gr) - deceit; the crystals resemble other minerals

VARIETIES:
Asparagus stone - yellowish-green [resembling the vegetable]
Colophonite - blue-green, brownish [*murokos* (Gr) - pipe clay; for the color]

A mineral of many colors; faceted gems are brilliant. It is brittle, and may cleave when heated. Facetable material is from many sources. Fluorapatite is the member of the apatite group of gem significance. Chlorapatite or hydroxylapatite possibly may be found as gem material. Ivory is hydroxylapatite.

APOPHYLLITE

ap-PA-fee-lite

Hydrous potassium calcium fluo-silicate
$KCa_4Si_8O_{20}(F,OH)\ 8H_2O$
Tetragonal
Habit- square prismatic, pyramidal
Hardness- 4.5 to 5
Specific gravity- 2.3 to 2.5 (2.4)
Cleavage- very perfect, one direction
Fracture- uneven
Streak- white
Inclusions- numerous cleavage cracks

Colorless, green, yellow, (pink)
RI- O-.535, E-1.537
Critical angle- 41°
Birefringence- .002, weak
Transparent to translucent
Luster- vitreous to pearly
Optically- uniaxial positive, also negative
Name- *apos & phyllum* (Gr) - off and leaf; it exfoliates when placed in a flame.

Rare in transparent crystals and then of interest only for faceting. It is not often cut as the cleavage is very troublesome. India is the best source.

AQUAMARINE (see beryl)

ARAGONITE GROUP (see individual minerals)

ARAGONITE - CERUSSITE - STRONTIANITE - WITHERITE

ARAGONITE (Aragonite Group)

ah-RA G-on-ite

Calcium carbonate
$CaCO_3$
Orthorhombic
Habit- prismatic, acicular, massive
Hardness- 3.5 to 4
Specific gravity- 2.85 to 2.95 (2.94)
Cleavage- distinct, one direction
Fracture- subconchoidal
Streak- white
Inclusions- sometimes irregular veils

Colorless, yellow, gray, (green), (violet)
RI- X-1.530, Y-1.680, Z-1.685
Critical angle- 39.5°
Birefringence- .155, very strong
Trichroism- weak
Dispersion- weak
Transparent to translucent
Luster- vitreous, inclining to resinous
Optically- biaxial negative
2V angle- 18°
Name- for Aragon, Spain; where first found

This is the major constituent of pearl. It strongly resembles calcite, but has only one cleavage. It will effervesce in hydrochloric acid as does calcite. Often found as hexagonal shaped trilling crystals. It sometimes is stalactitic, and can make interesting cabochons. Clear crystals can be cut into good faceted gems.

The thin iridescent shell of fossilized ammonites (snail-like animals) has been made into beautiful gems. Because of the soft nature of this iridescent aragonite, finished gems are usually capped with a layer of colorless quartz or synthetic spinel. It is sold under the trade names of ammolite, calcentine and korite. Most iridescent fossilized ammonite is from Alberta, Canada, but it has also been found in Morocco and Madagascar.

ARANDISITE

ah-RAND-ih-site

A basic tin silicate, a mixture of two constituents
No definite crystal structure
Habit- massive
Hardness- 5
Specific gravity- 4
Cleavage- none
Fracture- uneven
Streak- greenish

Color- Various shades of green
RI- about 1.76, sometimes anisotropic with an RI up to 1.82 (unimportant)
Translucent
Luster- waxy to resinous
Name- for the town of Arandis, Namibia near the tin mine where it is found

This is a rare one-location mineral found only in a tin mine in Namibia. It is thought to be a mixture of crystalline and colloidal phases of tin minerals. Arandisite has been cut into attractive green cabochons. Pieces of the material are sometimes covered with brown limonite (geothite) and this is often retained on the edges of the gem, making a unique color combination.

ARGILLITE

ARE-jil-ite

A compacted clay
Habit- massive
Hardness- 3 to 6
Specific gravity- 2.4 (approx.)
Cleavage- none
Fracture- uneven
Streak- brownish

Color- Gray, red, pink, brown, black
Opaque
Luster- earthy
Name- *argilla* (L) - clay; from its clay origin

Solid pieces of this material will produce cabochons with a velvety look. Obtaining a high polish is a little difficult. The velvety look is probably the material's greatest asset. Good material comes from Utah, which can be cut into interesting randomly banded cabochons. British Columbia and Alaska produce gray material. An Australian material, called zebra stone, is also an argillite. It has a pattern of red bars in a pink to cream-colored background. The bars are actually cylindrical to oval measuring up to about three inches in length. A slice of the material taken parallel to the bars gives a pattern of red stripes. A slice at 90° to the length of the bars gives a pattern of red ovals. It is composed of layers of clay and minute clear angular quartz particles, plus a few other minerals. It has a hardness of 3.

ASTROPHYLLITE

ah-STRAW-full-ite

Potassium sodium iron manganese
Titanium silicate hydroxide
$(K,Na)_3(Fe,Mn)_7 Ti_2Si_8 O_24(O,OH)_7$
Triclinic
Habit- tablular, bladed crystals, often in star-shaped clusters.
Massive material may be lamellar
Hardness- 3
Specific gravity- 3.34
Cleavage- perfect, one direction
Fracture- brittle, uneven
Streak- light yellowish

Color- Golden yellow, bronze,or yellowish brown
RI- X-1.680, Y-1.700, Z-1.730
Critical angle- 36°
Birefringence- .050, strong
Translucent to opaque
Luster- submetallic to metallic, cleavage surfaces may be pearl-like.
Optically- biaxial positive
2V angle- 70 to 90°
Name- *aster* - (Gr) star fyllon (Gr) - leaf

Material from the Kola Peninsula in Russia has recently been cut into very interesting cabochons with iridescent, ribbon-like structures.

ATACAMITE

ata-CAM-ite

Basic copper chloride
$Cu_2Cl(OH)_3$
Orthorhombic
Habit- slender prismatic, massive
Hardness- 3 to 3.5
Specific gravity- 3.76 (approx.)
Cleavage- perfect, one direction
Fracture- conchoidal, brittle
Streak- greenish

Color- Bright green to blackish-green
RI- X-1.831, Y-1.861, Z-1.880
Critical angle- 33°
Birefringence- .049, strong
Transparent to translucent
Luster- vitreous to adamantine
Optically- biaxial negative
2V angle- 74°
Name- for the Atacama Desert in Chile, where first found

The massive material has been cut into interesting green cabochons. Brittleness can be a problem during cutting. Crystals have always been very small, but a clear beautiful green. If larger crystals can be found, they could have an excellent faceting potential. Copper mines in Mexico and Chile are possible sources of lapidary material.

AUGELITE

AWE-jell-ite

Basic aluminum phosphate
$Al_2PO_4(OH)_3$
Monoclinic
Habit- prismatic, tabular
Hardness- 5
Specific gravity- 2.69 to 2.7
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- white
Inclusions- irregular veils

Colorless to yellowish
RI- X-1.574, Y-1.576, Z-1.588
Critical angle- 39.5°
Birefringence- .014, medium
Transparent
Luster- vitreous
Optically- biaxial positive
2V angle- 51°
Name- *auge* (Gr) - brightness; for its transparency

An extremely rare material, found at only a few locations. Faceted gems are not spectacular, rarity is their only real virtue. An exhausted California mine has produced nearly all of the facetable material.

AUGITE (Pyroxene Group)

AWE-jite

Calcium sodium magnesium aluminum silicate
$(Ca,Na)(Mg,Fe,Al)(Si,Al)_{2}0$
Habit- crystals short prismatic, massive
Hardness- 5.5 to 6
Specific gravity- 3.23 to 3.52
Cleavage- good, three directions
Fracture- uneven to conchoidal
Streak- grayish-green

Color-Pale to dark brown, to black, green
RI- 1.671 to 1.761 (unimportant)
Translucent to opaque
Name- *auge* (Gr) - brightness; for the brilliant cleavage surface

Large crystals can be cut into jet black cabochons. Most crystals are quite small. But, the shape being somewhat thick, nicely lends itself to a cabochon shape. In 1982, some medium-deep green pieces came from Italy. Gems of 2 to 3 mm were cut. The material contained holes, making the very small gems a necessity. The gems are nice, even though small. It is hoped that there is the possibility of some larger pieces.

AURICHALCITE

aw-rih-CAL-site

Basic zinc copper carbonate
$(Zn, Cu)_5(CO_3)_2(OH)_6$
Habit- crystals slender, rarely massive
Hardness- 1 to 2
Specific gravity- 3.96
Cleavage- perfect, one direction in crystals
Fracture- uneven, very brittle
Streak- white

Color- Blue to greenish-blue
RI- 1.654 to 1.756 (unimportant)
Transparent to translucent
Luster- silky
Name- *aurichalkos* (Gr) - mountain brass

Actually, this mineral contains the usual constituents of brass. On rare occasions, crystalline masses are dense enough to cut into silky cabochons. Mines in Arizona and Utah are the better possibilities for this form of the mineral.

AVENTURINE (see quartz - crystalline and feldspar group)

AXINITE (ferroaxinite) (Axinite Group)

AXE-in-ite

Basic calcium iron aluminum boro-silicate
$(Ca_2FeAl_2BSi_4O_{15}(OH)$
Triclinic
Habit- sharp axe-like crystals
Hardness- 6.5 to 7
Specific gravity- 3.26 to 3.36 (3.29)
Cleavage- distinct, one direction
Fracture- conchoidal
Streak- uncolored
Inclusions- numerous veils, probably blobs of liquids

Color- Yellow, bluish, violet, brown
RI- X-1.678, Y-1.685, Z-1.688
Critical angle- 36.5°
Birefringence- .010, medium
Trichroism- strong, colorless to purple to brown
Dispersion- weak
Transparent to sub-translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 65° to 70°
Name- *axine* (Gr) - axe; from the shape of the crystals

This mineral usually appears in crystals, but they are seldom truly clear. Inclusions are usually numerous wispy veils. The sharp-edged crystals are a positive identification characteristic. Faceted gems are excellent, even if included. A single mine in Baja California, Mexico, has produced virtually all of the good faceting material. New finds have been recently made in California. These have produced excellent crystal specimens, but virtually no faceting material.

AZURITE

AS-your-ite

Basic copper carbonate
$Cu_3(CO_3)_2(OH)_2$
Monoclinic
Habit- crystals variable, massive
Hardness- 3.5 to 4
Specific gravity- 3.77 to 3.89 (3.80)
Cleavage- nearly perfect, two directions
Fracture- conchoidal
Streak- blue, lighter than color
Inclusions- often crystals of malachite

Color- Deep azure blue
RI- X-1.730, Y-1.758, Z-1.836
Critical angle- 35°
Birefringence- .106, very strong
Trichroism- strong, blue to blue-purple
Faintly transparent to opaque
Luster- vitreous
Optically- biaxial positive
2V angle- 68°
Name- *azul & lazul* (Ar) - heaven; for the blue color
Alternate name- Chessylite; for Chessy, France, where it is found

At best, this mineral is transparent only against a strong light. It has been faceted, but gems are not brilliant. Its greatest lapidary use is an ornamental stone. It sometimes makes brilliant blue cabochons. When mixed with malachite, cabochons can be especially striking. Namibia is the best source of facetable crystals.

BADDELEYITE

bad-DELL-ee-ite

Zirconium dioxide
ZrO_2
Monoclinic
Habit- tabular, usually rolled pebbles
Hardness- 6.5
Specific gravity- 5.5 to 6.0
Cleavage- distinct, one direction
Streak- uncolored
Inclusions- none observed

Colorless, yellow, brown, black
RI- X-2.13, Y-2.19, Z-2.20
Critical angle- 28°
Birefringence- .07, strong
Dispersion- strong
Transparent to translucent
Luster- vitreous to adamantine
Optically- biaxial negative
2V angle- 30°
Name- for Joseph Baddeley, discoverer

This unusual rare mineral is seldom cut. If it were more common, it would be popular. Brazil has produced some facetable material. Cubic Zirconia (Section 2, page 128) is a man-made variant of this mineral.

BAHIANITE

bah-EE-an-ite

Hydrous aluminum antimony oxide
$Al_5Sb_3O_{14}(OH)_2$
Monoclinic
Habit- rounded pebbles, crystals rare
Hardness- 9
Specific gravity- 4.78 to 5.46 (5.26)
Cleavage- perfect, one direction
Fracture- uneven
Streak- brownish
Inclusions- none

Color- Honey-yellow to brown to tan
RI- X-1.81, Y-1.87, Z-1.92
Critical angle- 35° (unimportant)
Birefringence- .11 (unimportant)
Dispersion- weak
Opaque (possibly translucent)
Luster- adamantine
Optically- biaxial negative
2V angle- large
Name- for the State of Bahia, Brazil

This mineral was discovered in 1978, having originally been thought to be cassiterite. It evidently has an excellent cabochon potential. Polished surfaces are brilliant and show a fibrous or radiating structure. The hardness of 9 may offer some polishing problems.

BARITE GROUP (see individual minerals) (the complete group)

ANGLESITE - BARITE - CELESTITE

BARITE (Barite Group)

BARE-ite

Barium sulfate
$BaSO_4$
Orthorhombic
Habit- tabular, prismatic, massive
Hardness- 2.5 to 3.5
Specific gravity- 4.3 to 4.6
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Inclusions- numerous white veils

Colorless, blue, yellow, brown, (red)
RI- X-1.636, Y-1.637, Z-1.648
Critical angle- 38°
Birefringence- .012, medium
Dispersion- weak
Transparent to opaque
Luster- vitreous, inclining to resinous
Optically- biaxial positive
2V angle- 37°
Name- *barys* (Gr) - heavy; from the high specific gravity

This is a fairly common mineral, but clear crystals are somewhat rare. Most crystals are included. Some of the inclusions are two-phase. Facetable crystals are from Colorado, South Dakota, and England. Massive material can sometimes be cut into cabochons. New York produces a nice chatoyant, pink massive material.

BAUXITE

BOX-ite, also BOZE-ite

Aluminum oxides and hydroxides
A rock, a mixture of oxides
Habit- massive, oolitic
Hardness- 2.5, highly variable
Specific gravity- variable
Cleavage- none

Color- White, gray, yellow, red, brown
Opaque
Luster- earthy
Name- for Baeux (or Baux), a French town

In the oolitic form (cemented spherules), this mineral makes interesting cabochons. Seldom does it take a good polish, due to the variation in hardness. Aluminum (bauxite) mines are the only source of material. As it is the important ore of the metal, very little reaches the lapidary market.

BAYLDONITE

BAIL-done-ite

Basic lead copper arsenate
$PbCu_3(AsO_4)_2(OH)_2$
Monoclinic
Habit- mammilliary, drusy, fibrous
Hardness- 4.5
Specific gravity- 5.5
Cleavage- poor
Fracture- fibrous
Streak- white

Color- Green to yellowish
RI- X-1.95, Y-1.97, Z-1.99
Translucent to opaque
Luster- submetallic
Optically- biaxial positive
Name- for John Bayldon, mineralogist

This rare material sometimes appears in copper mines; Namibia is presently the best source. It is cut into cabochons, but they are not very interesting.

BENITOITE

ben-EAT-oh-ite

Barium titano-silicate
$BaTiSi_3O_9$
Hexagonal
Habit- ditrigonal, bipyramidal
Hardness- 6 to 6.5
Specific gravity- 3.60 to 3.69 (3.64)
Cleavage- poor
Fracture- conchoidal
Streak- uncolored
Inclusions- blobs of serpentine, cracks

Colorless, light to sapphire blue
RI- O-1.757, E-1.804
Critical angle- 34.5°
Birefringence- .047, strong
Dichroic- blue and colorless
Dispersion- .047, strong
Transparent to opaque
Luster- vitreous
Optically- uniaxial positive
Name- for San Benito County, California

This is an excellent gem material from a single location in California. Truly colorless pieces are rare in spite of a colorless axis viewed in the dichroscope. The crystallization of benitoite is notable. The crystal class, ditrigonal, was long considered by early mineralogists as a possibility, but no mineral showed this class until benitoite was discovered. Presently, it is the only example.

BERYL

BARE-ill

Beryllium aluminum silicate
$Be_3Al_2 Si_6O_{18}$
Hexagonal
Habit- usually prismatic crystals
Hardness- 7.5 to 8
Specific gravity- 2.63 to 2.83 (2.72)
Cleavage- imperfect
Fracture- conchoidal
Streak- uncolored
Inclusions- parallel needles in heliodor and aquamarine; and see below

Colors: see below
RI- O-1.566-1.602, E-1.562-1.594
Critical angle- 39.5°
Birefringence- .006, weak
Dichroism- strong in emerald
Dispersion- .014, medium
Transparent to translucent
Luster- vitreous to resinous
Optically- uniaxial negative
Name- *berylios* (Gr) - a gem

VARIETIES:
Aquamarine - blue to greenish-blue [aqua & marine (L) - seawater color]
Emerald - bluish-green [*smaragdus* (Gr); to esmeraude, to *esmeralde* (Fr)]
Goshenite - colorless [For Goshen, Massachusetts]
Heliodor - golden to yellow to orange [*helios* (Gr) - sun & *dore* (Fr) - gilded]
Morganite - pink to peach color [for J. P. Morgan, mineralogist]
Red beryl - deep rose to red (at times incorrectly called "red emerald" and "bixbite")

This is a highly variable mineral. Impurities that produce the various colors and shades of the colors have an effect on RI, specific gravity, and hardness. Natural emerald often contains three-phase inclusions (a liquid, a solid, and a bubble). The color of emerald, a bright bluish-green, is due to a chromium impurity. A green beryl is fairly common (it has no varietal name); its color is due to an impurity other than chromium, thus it cannot be classed as emerald. Locations for most varieties are worldwide. Red beryl is found only in Utah.

BERYLLONITE

bare-ILL-on-ite

Sodium beryllium phosphate
$NaBePO_4$
Orthorhombic
Habit- prismatic tabular
Hardness- 5.5 to 6
Specific gravity- 2.8 to 3.0 (2.85)
Cleavage- perfect to poor, 3 directions
Fracture- conchoidal
Streak- uncolored
Inclusions- many liquid-filled cavities

Colorless to light yellow
RI- X-1.552, Y-1.558, Z-1.562
Critical angle- 40°
Birefringence- .01, medium
Dispersion- .014, medium
Transparent
Luster- vitreous
Optically- biaxial negative
2V angle- 67°
Name- for the beryllium in its molecule

This mineral is found only in a few locations in Maine. Most crystals contain many inclusions. Faceted gems are not spectacular.

BISBEEITE

BIZ-bee-ite

A mixture of chrysocolla and plancheite
Copper silicates
Habit- massive
Hardness- 2 to 4 (chrysocolla), 5.5 (plancheite)
Specific gravity- 2.7 (approx)
Cleavage- imperfect
Fracture- irregular
Streak- bluish

Color- Various shades of blue
RI- 1.5 to 1.7 (unimportant)
Translucent to opaque
Name- for Bisbee, Arizona; where it was first found

This mixture is rarely found, and only in copper mines. It can be cut into interesting, but somewhat lusterless cabochons.

BISMUTOTANTALITE (see tantalite)

BLACK CORAL (see page 27)

BLENDE (see sphalerite)

BOLEITE

BO-lee-ite

Basic hydrous lead silver copper chloride
$Pb_9Ag_3Cu_8Cl_{21}(OH)_{16}\ H_2O$
Tetragonal
Habit- cubes, octahedrons (twins)
Hardness- 2.5
Specific gravity- 5.05
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- blue
Inclusions- cleavage and twinning cracks

Color- Deep indigo blue
RI- O-2.05, E-2.03
Critical angle- 30°
Birefringence- .02, medium
Faintly transparent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- *boleo* (Fr) - copper

This mineral is known from only a few copper mines from widely scattered regions of the world. Baja California, Mexico, is the most notable, where some deep-colored clear crystals have been found and been faceted. The twinning (or parting?) planes are very weak and may be very troublesome. Boleite was first thought to be isometric because of the cubic and octahedral crystals. Careful investigation showed them to be tetragonal twins.

Pseudoboleite, a very closely related mineral (a basic hydrous lead copper chloride) forms as layers on the cubic forms of boleite. This combination can easily be discerned by a slight notch on the edges of the crystals.

BORACITE

BORE-ah-site

Magnesium chloro-borate
$Mg_3B_7O_{13}Cl$
Orthorhombic
Habit- cubic, octahedral, tetrahedral
Hardness- 7
Specific gravity- 2.9 to 3.0
Cleavage- poor
Fracture- conchoidal to uneven
Streak- uncolored
Inclusions- many irregular veils

Colorless, yellowish, greenish
RI- X-1.658, Y-1.662, Z-1.668
Critical angle- 37°
Birefringence- .01, medium
Transparent to translucent
Luster- vitreous, inclining to adamantine
Optically- biaxial positive
2V angle- 82.5°
Name- for the boron in its molecule

This mineral is rare in sizes large enough to facet gems over one carat. If it were common it would be popular. Crystals are ordinarily found in salt beds, the most notable are in Germany. Previously, this mineral was thought to be isometric, but careful study has revealed it to be a pseudoisometric type of orthorhombic form. This has explained a double refraction that was thought to be anomalous.

BORNITE

BORN-ite

Copper iron sulfide
Cu_5FeS_4
Isometric
Habit- massive, cubic
Hardness- 3
Specific gravity- 4.9 to 5.4
Cleavage- poor
Fracture- conchoidal to uneven
Streak- pale grayish-black

Color- Reddish-brown quickly altering to iridescent colors
Opaque
Luster- metallic
Name- for Ignatius von Born, Austrian mineralogist
Alternate name- peacock copper; for the iridescent colors

Some iridescent massive material makes excellent cabochons. Otherwise, the material has a small lapidary potential. Crystals are rare.

BOWENITE (see serpentine)

BRAZILIANITE

bra-ZIL-yun-ite

Basic sodium aluminum phosphate
$NaAl_3(PO_4)_2(OH)_4$
Monoclinic
Habit- prismatic
Hardness- 5.5
Specific gravity- 2.94 to 2.98
Cleavage- perfect, one direction
Fracture- conchoidal
Streak- white
Inclusions- veils and cleavage cracks are very common

Color- Yellow, yellowish-green
RI- X-1.603, Y-1.612, Z-1.623
Critical angle- 38.5°
Birefringence- .02, medium
Pleochroism- weak
Dispersion- .014, medium
Transparent, seldom opaque
Luster- vitreous
Optically- biaxial positive
2V angle- 70° to 75°
Name- for Brazil; where it was first discovered

Crystals are often veiled, and internal cleavage cracks are common. This material makes clear intense yellow gems. Brazil is the only known source. The mine was closed for a number of years; was reopened in the early 1980's, then closed again. At the time of publication, brazilianite is essentially off the market.

BRECCIA, CONGLOMERATE, OOLITE

BRET-ch-ia, con-GLOM-er-ut, OH-OH-lite

The most common ***breccias*** are angular lava particles, cemented together with lava. Some of these can be cut into gems. The breccias of real lapidary interest are agate or jasper cemented with chalcedony or opal. Many are known and some are popular. Some are various materials cemented with calcite. [*breccia* (It) - a stone fragment]

VARIETIES:

Conglomerate is composed of cemented rounded particles. That which is cemented with some form of quartz has lapidary potential. [*conglomare* (L) - to roll together]

Oolite is composed of spherules (usually calcite), the result of either concretionary or radiating crystal growth, cemented together with either calcite or chalcedony. Some oolites, especially those cemented with chalcedony, make unusual cabochons. [*oion* (Gr) - egg]

Quartzite probably belongs here also. It is sand cemented with quartz (possibly also chalcedony). It sometimes has excellent lapidary potential. [literally- quartz stone]

BREITHAUPTITE

bree-THAWP-tite

Nickel antimonide
NiSb
Hexagonal
Habit- usually massive
Hardness- 5.5
Specific gravity- 7.54
Cleavage- none
Fracture- uneven
Streak- dark colored

Color- Copper red
Opaque
Luster- metallic
Name- for J. A. F. Breithoupt, German mineralogist

This mineral, found in cobalt deposits, is sometimes cut into cabochons of moderate interest. Its only attributes are color and luster.

BROCHANTITE

BRO-shan-tite

Basic copper sulfate
$Cu_4SO_4(OH)_6$
Monoclinic
Habit- prismatic, massive
Hardness- 3.5 to 4
Specific gravity- 3.9
Cleavage- perfect, one direction
Fracture- conchoidal
Streak- pale green

Color- Emerald green, blackish green
RI- X-1.728, Y-1.771, Z-1.800
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 72°
Name- for A. J. M. Brochant de Villiers, French mineralogist

Compact massive material has been appearing from Arizona copper mines. It has a bad tendency to undercut, but can be cut into bright cabochons.

BRONZITE (see enstatite)

BROOKITE

BROOK-ite

Titanium dioxide
TiO_2
Orthorhombic
Habit- pseudo-octahedral, tabular
Hardness- 5.5 to 6
Specific gravity- 4.11 to 4.14
Fracture- subconchoidal to uneven
Streak- white, gray, yellowish
Trimorphous with anatase and rutile
Inclusions- none observed

Color- Yellow, pinkish, light brown, black
RI- X-2.583, Y-2.585, Z-2.700
Critical angle- 23°
Birefringence- .117, very strong
Dispersion- strong
Transparent to opaque
Luster- adamantine to submetallic
Optically- biaxial positive
Name- for Henry J. Brooke, English mineralogist

Brookite crystals are nearly always a deep brilliant black. Recently, Brazil has produced small pinkish crystals that are transparent. These have been cut into very brilliant, tiny gems. Larger pieces would make superb gems.

BRUCITE

BROO-site

Magnesium hydroxide
$Mg(OH)_2$
Hexagonal
Habit- tabular, massive, fibrous
Hardness- 2.5
Specific gravity- 2.38 to 2.4
Cleavage- good, one direction
Fracture- sectile
Streak- white

Color- White to gray, (blue), (green)
RI- O-1.5617, E-1.5815
Critical angle- 40°
Birefringence- variable, medium
Transparent to translucent
Luster- pearly, waxy to vitreous
Optically- uniaxial positive
Name- for Archibald Bruce, American mineralogist

Massive material produces white cabochons of only small interest. After cutting, the gem may alter (to hydromagnesite), with the surface becoming cloudy. Good massive material has come from Pennsylvania.

BUERGERITE (see Tourmaline Group – dravite-schorl series)

BURR-ger-ite

BURNITE

BURN-ite

A mixture of azurite and impurities
Copper carbonate (see azurite)
Habit- massive
Hardness- about 4
Specific gravity- about 3
Fracture- rough conchoidal
Streak- bluish

Color- Brownish-blue
Opaque
Luster- earthy
Name- for Frank Burnham, American collector who discovered it in 1952

This material is found in Arizona copper mines. For many years the authors said that this was a mixture of azurite and mud. This is true in many cases, but the material is evidently variable enough that nice cabochons have recently been cut.

BUSTAMITE (Pyroxene Group)

BUST-ah-mite

Calcium manganese silicate
(Ca, Mn) Si_2O_6
Triclinic
Habit- prismatic
Hardness- 5.5 to 6.5
Specific gravity- 3.4 to 3.7
Cleavage- perfect, three directions
Fracture- conchoidal
Streak- uncolored
Inclusions- many fine needles

Color- Flesh pink
RI- X-1.662, Y-1.674, Z-1.676
Critical angle- 37°
Birefringence- .014, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 44°
Name- for Anastasio Bustamente, Mexican army General, discoverer.

Originally, bustamite was considered to be a variety of rhodonite, but it has been determined to be a separate species. The cleavages are very troublesome during cutting. Clear faceted gems are excellent. The fine needle-like inclusions give cabochons a silky look. Australia and South Africa are the best known sources.

BYTOWNITE (see Feldspar Group – plagioclase)

BY-ton-ite

CALAMINE (see hemimorphite and smithsonite)

CALCITE GROUP (see individual minerals)

CALCITE - MAGNESITE - RHODOCHROSITE - SIDERITE - SMITHSONITE

CALCITE (Calcite Group)

KAL-site

Calcium carbonate
$CaCO_3$
Hexagonal
Habit- rhombohedral, scalenohedral, massive, crystals highly varied
Hardness- 3
Specific gravity- 2.69 to 2.82 (2.71)
Cleavage- perfect, three directions
Fracture- conchoidal, seldom seen
Streak- white
Inclusions- many cleavage cracks, silver, copper, malachite, chalcotrichite, others

Colorless, almost all colors to black
RI- O-1.658, E-1.486
Critical angle- 42.5° and 37.5°
Birefringence- .172, very strong
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- *calyx* (L) - lime; or chalx (Gr) - burned lime

VARIETIES:
Fire marble, or lumachelle - brown with fire-like chatoyance, containing shells
Iceland spar - transparent optical calcite, usually as rhombohedrons
Limestone - very impure sedimentary deposits [lime is a general name for calcite]
Marble - finely crystalline, banded material of diverse patterns [*marmaros* (Gr)]
Shell or crinoid marble - calcite with enclosed sea shells or crinoid fossils

Some of the above have sub-varieties, usually based on color. One excellent variety of travertine is known as cobaltian calcite or sphaero-calcite, [sphaero (Gr) - ball]. It is pink to raspberry red, the color due to an impurity of cobaltocalcite ($CoCO_3$), and is an excellent cabochon material. Some has been faceted, but it is not completely clear. Travertine also has many other names, most incorrect; "onyx marble", "Mexican onyx", "Egyptian onyx", Egyptian alabaster", "Mexican jade", and "satin spar". The name onyx should be attached only to a form of cryptocrystalline quartz, but its use with travertine is so universal, that it will no doubt continue. The name alabaster should be used only for the massive form of gypsum; and satin spar should be used only with another form of gypsum. "Mexican jade" is a dyed travertine. Travertine is a product of precipitation from waters of hot springs. Marble is the result of metamorphosis of limestone. Some marbles are banded, but not with the regularity of travertine.

CALIFORNIATE (see idocrase)

CAMPBELLITE (see copper)

CANCRINITE (Cancrinite Group) CAN-crin-ite

Complex sodium calcium aluminum silicate
$(Na, Ca)_6Al_6Si6O_{24}(CO_3SO_4Cl)_2 \cdot nH_2O$
Hexagonal
Habit- massive, prismatic
Hardness- 5 to 6
Specific gravity- 2.42 to 2.52
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- white

Colorless, yellow, blue, green, reddish
RI- O-1.524, E-1.502
Critical angle- 40°
Transparent to opaque
Luster- vitreous to pearly
Optically- uniaxial negative
Name- for Count Cancrin; the Russian original discoverer

This complex silicate is usually massive. As such, it is sometimes cut as an unusual cabochon. Transparent crystals can conceivably be faceted. Brazil has produced cabochon material.

CARBONADO (see diamond)

CASSITERITE (Rutile Group) cah-SIT-er-ite

Tin oxide
SnO_2
Tetragonal
Habit- pyramidal, massive
Hardness- 6 to 7
Specific gravity- 6.8 to 7.1
Cleavage- imperfect, three directions
Fracture- subconchoidal to uneven
Streak- white to brownish
Inclusions- many veils

Colorless, yellow, red, gray, brown black
RI- O-2.003, E-2.101
Critical angle- 29.5°
Birefringence- .098, strong
Dichroism- distinct in some crystals
Dispersion- .071, strong
Transparent to opaque
Luster- adamantine
Optically- uniaxial positive
Name- *kassiteros* (Gr) - tin

VARIETY:
Tinstone and stream tin - are names for the massive, banded, mammilliary form. These sometimes can be cut into striking cabochons.

Transparent crystals that will yield clear faceted gems are uncommon. Lighter colored gems are excellent. Bolivia and a few locations in Africa have produced facetable pieces.

CAT'S EYE (see chrysoberyl)

CAT EYE SHELL (see pearl)

CATLINITE (pipestone) CAT-lin-ite

A metamorphosed clay
Habit- massive
Hardness- 4 (approx.)
Fracture- uneven
Streak- variable

Color- Yellow to bright red
Opaque
Luster- earthy
Name- for George Catlin; an artist who found the Indians using it

Catlinite was carved by the Indians into pipes. This activity antedates Caucasian experience in North America by centuries. It is now carved into trinkets and souvenirs. It makes lusterless cabochons, but can make interesting carvings. The main source is an area in Minnesota. Some adjoining states also have deposits, as does Arizona.

CELESTITE (Barite Group)

sell-EST-ite

Strontium sulfate
$SrSO_4$
Orthorhombic
Habit- tabular, prismatic, fibrous
Hardness- 3 to 3.5
Specific gravity- 3.95 to 3.97
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Inclusions- many cleavage cracks and veils

Colorless, blue, (reddish)
RI- X-1.622, Y-1.624, Z-1.631
Critical angle- 38°
Birefringence- .009, weak
Trichroic in blue crystals
Transparent to translucent
Luster- vitreous, somewhat pearly
Optically- biaxial positive
2V angle- 51°
Name- *caelestis* (L) - of the sky
Alternate name- celestine (coelestine)

This is a fairly common mineral, but crystals clear enough to facet are rare. The massive material is usually too cleaved to cut into cabochons. This closely resembles barite, but has a lower specific gravity. Madagascar presently produces a good blue faceting material. This is in unique crystal-lined geodes. Texas produces small amounts of colorless to light blue clear material, found in fossil beds.

CERULEITE

sir-OO-lee-ite

Basic copper aluminum arsenous oxide
$CuAl_4(AsO_4)_2(OH)_8\ 4H_2O$
Triclinic
Habit- massive (cryptocrystalline)
Hardness- 4 (approximately)
Specific gravity- 2.8
Cleavage- none ?
Fracture- uneven
Streak- white to bluish

Color- Bright blue with purplish tinge
RI- ?
Opaque
Luster- earthy
Name- *caeruleus* (L) - sky blue

Note: ceruleite has not been adequately described.

This is a fairly new material from a gold mine in Chile. It is fine compact material much resembling turquoise, but with a brilliant sky blue color. Cabochons are excellent. Much of the material on the market has been "stabilized" like turquoise.

CERUSSITE (Aragonite Group)

ser-OO-site

Lead carbonate
$PbCO_3$
Orthorhombic
Habit- prismatic, pyramidal
Hardness- 3 to 3.5
Specific gravity- 6.46 to 6.57
Cleavage- distinct, two directions
Fracture- conchoidal
Streak- white
Inclusions- rarely parallel needles

Colorless, smoky, yellow, greenish
RI- X-1.804, Y-2.076, Z-2.078
Critical angle- 31.5°
Birefringence- .274, very strong
Dispersion- very strong
Transparent to translucent
Luster- adamantine
Optically- biaxial negative
2V angle- 8°
Name- *cerussa* (L) - white-lead pigment; evidently derived from the mineral

Often appears as twins, some as six-rayed groups, and other repeated patterns. It can be cut into very brilliant faceted gems. Namibia furnishes clear faceting material. In the past, Arizona furnished clear to smoky material. The mine is closed. Sometimes large pieces are cut into very brilliant cabochons.

CHABAZITE & GMELINITE (Zeolite Group)

CAB-ah-zite, gum-ELL-in-ite

Sodium calcium aluminum silicates
$(Na,Ca)(Al_2Si_4)O_{12}\ 6H_2O$
Hexagonal
Habit- rhombohedral, hexagonal aspect
Hardness- 4 to 5
Specific gravity- 2.04 to 2.17
Cleavage- distinct, one direction
Fracture- uneven
Streak- white
Inclusions- numerous veils

Co.lor- White, flesh colored, yellowish, greenish
RI- 1.470 & 1.494 (means)
Critical angle- 43°
Birefringence- weak
Transparent to translucent
Luster- vitreous
Optically- uniaxial positive or negative
Names- *chabazie* (Fr) - hailstone; for the look of the crystal
for Christian H. Gmelin, botanist

VARIETY:
Phacolite (chabazite) - [*phacos* (Gr) - lentil; for the shape of the crystals].

These two minerals differ only in crystal angles, and apparent shape. Both have optical characteristics that are variable. Rarely, crystals are clear enough to facet. The variety phacolite forms somewhat rounded crystals that have small clear areas. A location in Victoria, British Columbia, Canada, produces this type of crystal.

CHALCOCITE

KAL-co-site

Copper sulfide
Cu_2S
Orthorhombic (pseudohexagonal)
Habit- massive, tabular
Hardness- 2.5 to 3
Specific gravity- 5.5 to 5.8
Cleavage- indistinct
Fracture- conchoidal
Streak- dark

Color- Black
Opaque
Luster- metallic
Name- *chalkos* (Gr) - copper, or bronze

In the massive form, without impurities, this material can be made into bright metallic cabochons. A high percentage of impurities makes it tend to undercut. Copper mines are likely sources of material with lapidary potential.

CHALCOPYRITE (Chalcopyrite Group)

KAL-co-pie-rite

Copper iron sulfide
$CuFeS_2$
Tetragonal
Habit- sphenoidal, massive
Hardness- 3.5 to 4
Specific gravity- 4.1 to 4.3
Cleavage- sometimes distinct, one direction
Fracture- uneven
Streak- greenish-black

Color- Brass-yellow tarnishing to iridescent
Opaque
Luster- metallic
Name- *chalkos* (Gr) - copper; plus pyrite

Occasionally, the massive material, with a nearly gold-color iridescence, can be cut into interesting cabochons.

CHALCOTRICHITE (see cuprite)

CHAMBERSITE

CHAIM-ber-site

Manganese chloro-borate
$Mn_3B_7O_{13}Cl$
Orthorhombic
Habit- tetrahedral crystals
Hardness- 7
Specific gravity- 3.49
Cleavage- none
Fracture- subconchoidal to uneven
Streak- colorless
Inclusions- numerous veils

Colorless to purple
RI- X-1.732, Y-1.737, Z-1.744
Critical angle- 35°
Birefringence- .012, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 83°
Name- for Chambers County, Texas, where first found

This mineral is found only in the brine returns from oil well salt domes in Texas and Louisiana. Crystals are seldom over one-half inch across. Few are free of inclusions. Some have been faceted and a fine gem is possible. This is the manganese analog of boracite (see page 14).

CHAROITE

CHAR-oh-ite

Complex potassium calcium silicate
$K(Ca,Na)_2Si_4O_{10}$ (OH,F) H_2O
Monoclinic
Habit- massive, cryptocrystalline
Hardness- 5 to 6
Specific gravity- 2.68 (approximately)
Cleavage- evidently none
Fracture- subconchoidal
Streak- white

Color- Light purple
RI- 1.55
Translucent to opaque
Luster- vitreous
Name- for the Charo River in Russia

This is a fairly new material imported from Russia. Cabochons, bookends, etc., cut from it are excellent. There is much doubt that facetable material will be possible. Impurities of a number of other minerals are common in the material presently on the market. Some of these inclusions impart an interesting pattern to the final product.

CHENEVIXITE

chen-eh-VIX-ite

Basic copper iron arsenate
$Cu_2Fe_2(AsO_4)_2(OH)_4$ H_2O
Orthorhombic
Habit- massive, compact, earthy
Hardness- 3.5 to 4.5
Specific gravity- 3.93
Cleavage- none (?)
Fracture- subconchoidal to uneven
Streak- greenish-yellow

Color- Dark green, olive-green, greenish-yellow
RI- mean 1.83 (unimportant)
Subtranslucent
Luster- greasy to dull
Name- for Richard Chenevix, Irish mineralogist

This material is found in a number of copper mines throughout the world. It can be cut into cabochons, but they are difficult to polish. This is probably due to various impurities. The cabochons have a unique color pattern, but are greasy looking rather than brilliant. The low hardness makes such gems relegated to a collection only. Chile is the best source of cutting material.

CHIASTOLITE (see andalusite)

CHILDRENITE (see eosphorite)

CHIOLITE (see cryolite)

CHLORASTROLITE

klor-AS-tro-lite

Calcium aluminum silicate
A mixture of minerals, thus a rock
Habit- fibrous, massive
Hardness- 5.5
Specific gravity- 3.2
Cleavage- none in massive material
Fracture- uneven
Streak- white
Color- Green with white banding
RI- 1.71 (approximately)
Translucent to opaque
Luster- vitreous
Name- *chlor* & *astro* (Gr) - green star

This material, a mixture of predominantly pumpellyite with traces of other minerals, is of interest for cabochon cutting only. The green and white banding produces very interesting gems. Michigan is the best source of material.

CHLORITE GROUP (see individual minerals)

CLINOCHLORE - KAMMERERITE - PENNINITE - PSEUDOPHITE

CHLORAPATITE (see apatite)

CHLOROSPINEL (see spinel)

CHONDRODITE

CON-drow-dite

Basic magnesium fluo-silicate
$(Mg, Fe)_3(SiO_4)(OH, F)_2$
Monoclinic
Habit- complex crystals, twins
Hardness- 6 to 6.5
Specific gravity- 3.1 to 3.2
Cleavage- distinct, one direction
Fracture- subconchoidal to uneven
Streak- white
Inclusions- numerous veils
Color- Yellow, orange, brown, red-brown
RI- X-1.592, Y-1.602, Z-1.621
Critical angle- 38.5°
Birefringence- .029, medium
Trichroism- sometimes distinct
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- approx. 80°
Name- *chondros* (Gr) - granular; from a common habit

This mineral is one of a series with norberite, humite, and clinohumite. Very frequently one of the others is mistaken for chondrodite as the characteristics of the four are remarkably similar. The red-brown material has been faceted, but gems are not spectacular. Good material comes from New York. Canada is also a source. Material is rare.

CHROME DIOPSIDE (see diopside)

CHROMITE (Spinel Group)

CROW-mite

Iron chromate
$FeCr_2O_4$
Isometric
Habit- octahedrons, massive
Hardness- 5.5
Specific gravity- 4.1 to 4.9 (4.45)
Cleavage- none
Fracture- uneven
Streak- brown
Color- Reddish, brownish-black, black
RI- n-2.08
Opaque, rarely translucent
Luster- submetallic
Name- for the chromium in its composition

This mineral has a small place in lapidary, but the translucent crystals are sometimes cut. It is remotely possible that nearly transparent, though deep colored, crystals may be found. California is a good source for cabochon material. A number of sources in Africa produce good crystals. Chromite is the important ore of the metal chromium.

CHRYSOBERYL

CHRIS-o-bear-ill

Beryllium aluminum oxide
$BeAl_2O_4$
Orthorhombic
Habit- tabular, twins common
Hardness- 8.5
Specific gravity- 3.5 to 3.84 (3.73)
Cleavage- distinct to imperfect, three directions
Fracture- conchoidal
Streak- uncolored
Inclusions- parallel needles, random needles, liquid filled cavities, rarely stepped twinning planes

Color- Yellow, green, brown, reddish-purple
RI- X-1.747, Y-1.748, Z-1.757
Critical angle- 35°
Birefringence- .01, medium
Trichroism- strong in alexandrite
Dispersion- .015, medium
Transparent to translucent
Photochroism- strong in alexandrite
Luster- vitreous to adamantine
Optically- biaxial positive
2V angle- highly variable
Names- *chrysos* & *beryllos* (Gr) - golden beryl; first thought to be beryl

VARIETIES:

Alexandrite- green in daylight (and some fluorescent lights) and reddish-purple in incandescent light (this behavior is called photochroism). Cat's-eye alexandrite is also a fine gem material. Other colors have been given the name alexandrite, but true alexandrite only has the green to purple change. Named for Alexander I, a Russian prince.

Cat's-eye - usually the color of cymophane, but containing parallel needle-like inclusions that make a chatoyant gem.

Cymophane - yellow, yellow-green, brownish, the usual faceting material. [*kymo* & *phainein* (Gr) - a wave & to appear]

This is a durable and popular gem. The cat's-eye and alexandrite varieties are valuable when of good quality. Cat's-eye has been imitated by a number of minerals, most notable is the tiger-eye form of cryptocrystalline quartz. One color of synthetic corundum has imitated alexandrite, but the colors do not match. A synthetic alexandrite is now on the market, see page 114. Sri Lanka and Brazil produce excellent faceting material. Both also produce good cat's-eye material. Alexandrite comes from Russia, Brazil, and Zimbabwe.

For many years the color change of alexandrite from natural to incandescent light has been called the "alexandrite effect". This color change has been seen in other minerals on rare occasions. With the introduction of the new man-made materials, this effect has become commonplace. As a result, the authors have introduced the term photochroism to cover this phenomenon. The term is from the Greek photo & chros- to color with light. It is hoped that this new term will better describe the unique behavior of a number of gem materials.

CHRYSOCOLLA

CHRIS-oh-coe-la

Basic copper silicate
$Cu_2H_2Si_2O_5(OH)_4$
Orthorhombic ?
Habit- massive, crystals very rare
Hardness- 2 to 4
Specific gravity- 2.0 to 2.4
Cleavage- none
Fracture- uneven to conchoidal, brittle
Streak- blue

Color- Blue, blue-green (green)
RI- 1.57 to 1.63 (unimportant)
Faintly translucent to opaque
Luster- earthy
Name- *chrysos* & *colla* (Gr) - golden glue; formerly used as gold flux

For many years the authors have considered this mineral to have no lapidary potential (except when in agate, page 82). This is because chrysocolla often fractures and crazes during and after cutting. Chrysocolla may also be too porous to produce a good polish without stabilization or surface treatment. When chrysocolla also contains malachite, it tends to have less crazing and porosity problems. Good cutting material has been marketed, which has been cut into fine cabochons. Arizona, Mexico, the Congo and Peru are probably the best sources for cabochon material. A mine in California reportedly produced good cutting material. The authors have not seen it.

CHRYSOLITE (see peridot)

CHRYSOTILE (see serpentine)

CINNABAR

SIN-ah-bar

Mercuric sulfide
HgS
Hexagonal
Habit- rhombohedral, massive
Hardness- 2 to 2.5
Specific gravity- 8.0 to 8.2
Cleavage- perfect, one direction
Fracture- uneven, very brittle
Streak- scarlet
Inclusions- possible veils, none observed

Color- Deep red, inclining to brownish gray
RI- O-2.905, E-3.256
Critical angle- 20°
Birefringence- .351, very strong
Dispersion- weak
Transparent to opaque
Luster- adamantine to metallic
Optically- uniaxial positive
Name- *kinnabari* (Gr) - vermillion; from *zinjafar* (Ar) - cinnabar

Clear pieces can be cut into spectacularly brilliant faceted gems. The massive material produces splendent cabochons. Nevada and China produce clear material. California has produced massive cabochon material.

CITRINE (see quartz - crystalline)

CLINOCHLORE (CLINOCLOR)

KLINE-o-klor

Ferrous magnesium, aluminum silicate
$(Mg,Fe_2-)_5 Al(Si_3Al)O_{10}(OH)_8$
Monoclinic
Habit- Tetragonal or pseudotetragonal, massive, layered structures
Hardness- 2 to 2.5
Specific gravity- 2.55 to 2.75
Cleavage- perfect, one direction
Fracture- uneven, very brittle
Streak- white
Inclusions- n/a

Color- Light green, blue green, yellowish to olive green, very dark green
RI- X-1.571, Y- 1.576, Z- 1.571
Critical angle- 39.6°
Birefringence- 0.005 - 0.011
Dispersion- ?
Transparent to opaque
Luster- Vitreous
Optically- biaxial positive
Name- *klino* (Gr) - oblique and *chloros* (Gr) green. Alternate spelling; clinoclor
Commercial name- Seraphinite from seriph - angel

Clinochlore is a a member of the chlorite group. It is a relatively new material that is marketed as seraphinite. Clinochlore is generally deep geen with light-green to white fan-like structures that display chatoyance. Clinochlore is found by Lake Baikal in Siberia.

CLINOHUMITE (Humite Group)

CLIN-O H-hume-ite

Basic magnesium fluo-silicate
$Mg_9Si_4O_{16}(F,OH)_2$
Monoclinic
Habit- crystals variable
Hardness-, 6 to 6.5
Specific gravity- 3.17 to 3.35
Cleavage- indistinct, one direction
Fracture- conchoidal to uneven, brittle
Streak- white
Inclusions- none observed

Color- White, yellow, brownish
RI- X-1.631, Y-1.64, Z-1.668
Critical angle- 38°
Birefringence- .037, strong
Pleochroism- strong; pale yellow to dark orange-yellow
Dispersion- ?
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 73°
Names- *clinein* (Gr) - to incline for Sir Abraham Hume, English mineralogist

In 1982 or 1983, the first gemmy clinohumite was offered for sale in Russia. The location is near Pamir, in the southern part of the country. A few gems have been cut in this country; it is not known how many gems have been cut in Russia. Prices for rough, offered in this country, are exceedingly high. Clinohumite can be cut into a beautiful orange gem resembling hessonite garnet.

CLINOZOISITE (Epidote Group)

clino-ZOE-iss-ite

Basic calcium aluminum silicate
$Ca_2Al_3Si_3O_{12}(OH)$
Orthorhombic
Habit- prismatic
Hardness- 6 to 7
Specific gravity- 3.25 to 3.58
Cleavage- perfect, one direction
Fracture- uneven
Streak- colorless
Dimorphous with zoisite
Inclusions- numerous veils and cleavage cracks

Colorless, yellow, green, pink, brown
RI- X-1.715, Y-1.729, Z-1.734
Critical angle- 35°
Birefringence- .019, medium
Dispersion- .030, medium
Trichroic- strong; green, yellow, brown
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 14° to 90°
Name- *clinein* (Gr) - to incline & for Baron Zois Von Edelstein [*edelstein* (Ger) - precious stone]

The color of clinozoisite is usually not dark and sometimes it is nearly colorless, but it is seldom free from flaws. If flawless material were available, it would be a popular faceting material. Well-formed clear, but flawed, crystals come from a number of scheelite mines in Baja California, Mexico. A European location has produced small crystals with a minimum of flaws, but these are very thin.

COBALTIAN CALCITE (see calcite)

COBALTITE

co-BALL-tite

Cobalt sulfarsenide
CoAsS
Isometric
Habit- cubes, pyritohedrons, massive
Hardness- 5.5
Specific gravity- 6 to 6.3 (6.15)
Cleavage- perfect, three directions (cubic)
Fracture- uneven
Streak- grayish black

Color- Silver-white, inclining to reddish
Opaque
Luster- metallic
Name- *cobald* (Ger) - goblin; from the difficult melting property

This mineral is sometimes cut into cabochons. Otherwise its prospects from the lapidary standpoint are small. California produces good cabochon material.

COLEMANITE

COAL-man-ite

Hydrous calcium borate
$Ca_2B_6O_{11} \cdot 5H_2O$
Monoclinic
Habit- prismatic, massive
Hardness- 4 to 4.5
Specific gravity- 2.42
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Inclusions- numerous veils and cleavage cracks

Colorless, gray, yellowish
RI- X-1.586, Y-1.592, Z-1.614
Critical angle- 39°
Birefringence- .028, medium
Dispersion- weak
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 55°
Name- for William Coleman, the owner of the first mine

The clear crystals can be faceted. The massive material is very cleavable and seldom is cut. California has produced the best facetable pieces.

COLOPHONITE (see Garnet Group – ugrandite subgroup – andradite)

COLUMBITE (and tantalite)

COL-um-bite, TAN-tal-ite

Iron-manganese, tantalo-niobate
$(Fe,Mn)(Nb,Ta)_2O_6$
Orthorhombic
Habit- flat crystals, massive
Hardness- 6
Specific gravity- 5.15
Cleavage- distinct, one direction
Fracture- uneven to sub-conchoidal, brittle
Streak- brownish-black to black

Color- Black to brownish-black
RI- about 2.5 (unimportant)
Opaque
Luster- sub-metallic
Name- from Columbia, an old name for America. Columbium is the old name for the element niobium
Name- *tantalus* (L) - tantalize; from its insolubility in acids

VARIETY:
Bismutotantalite - (containing bismuth) is a variety that is sometimes cut into dark brown to black gems. This differs very little from columbite or tantalite.

Columbite forms a series with tantalite. The only differences between the two is the amount of niobium or tantalum in the molecule and small differences in specific gravity and hardness. Under usual conditions, the lapidary could not discern the difference. This material can be cut into lustrous black to brownish cabochons. Brazil is an excellent source of material. Most of the production is in the form of crystals which are usually high priced. Broken crystals and the occasional massive material can be available as cutting material.

CONGLOMERATE (see breccia)

CONICHALCITE

cone-ih-KAL-site

Basic calcium copper arsenate
$CaCu(AsO_4)(OH)$
Orthorhombic
Habit- reniform, radiating massive
Hardness- 4.5
Specific gravity- 4.1
Cleavage- none
Fracture- uneven
Streak- greenish

Color- Green, yellow-green, blue-green
RI- approximately 1.8, variable
Subtranslucent to opaque
Luster- dull
Name- *conia* & *chalcos* (Gr) - powder and lime; the exact meaning is uncertain
Alternate name- higginsite; for a mine official

The massive material has been cut into interesting cabochons. It does not take a high polish. Copper mines in Arizona (and rarely Africa) have produced good cabochon material. Usually, other copper minerals are mixed with it.

COPAL (see amber)

COPPER & SILVER

COP-er, SIL-ver

Native metals with some impurities
Cu and Ag
Isometric
Habit- crystals, massive, wire-like
Hardness- 2.5 to 3
Specific gravity- 8.94 copper, 10.5 silver
Cleavage- none
Fracture- none, ductile
Streak- metallic

Color- Copper-red, and silver-white
Opaque
Luster- metallic
Name- *cupros* (Gr) - the isle of Cyprus, where the metal was found
Name- silber (Ger) - silver

Copper crystals have been cut into interesting cabochons. The "half-breed" nuggets, of silver and copper, will also make unique cabochons. Either type has a tendency to alter to the dark sulfides. Copper inclosed in other minerals such as datolite, epidote, etc., make better contrasty gems and do not seem to alter as readily. Kingstonite is copper in rhyolite. The copper district of Michigan has been the best producer. Mexico has produced a calcite (travertine?) containing arborescent silver that can be cut into interesting cabochons. The Campbell Mine in Arizona produces a mixture of native copper, cuprite, and chrysocolla in either agate or opal. This is known as "campbellite".

COPROLITE (see quartz, cryptocrystalline)

CORAL

CORE-ul

Calcium carbonate
$CaCO_3$
Produced by sea animals
Habit- branched, twig-like
Hardness- 3.5
Specific gravity- 2.6 to 2.7 (2.65)
Cleavage- none
Fracture- conchoidal
Streak- white

Color- Nearly white, pink, red
RI- 1.5 to 1.65 (unimportant)
Translucent to opaque
Luster- usually dull, sometimes vitreous
Name- *korallion* (Gr), also *corallium* (L); probably the first simultaneous usages

The above characteristics are for Mediterranean coral. In recent years, similar material has been introduced from Pacific waters. The characteristics of this material may vary. Coral will effervesce in hydrochloric acid, and thus can be distinguished from plastic imitations.

BLACK CORAL

Conchiolin, a leathery material
Produced by sea animals
Habit- branched, twig-like
Hardness- 4 (approximately)
Specific gravity- 1.34
Cleavage- none
Fracture- hackly
Streak- white

Color- Black
Opaque
Luster- dull on cut surfaces, vitreous on natural surfaces

This is a relative newcomer that has very few characteristics of true coral except habit. It is much tougher than true coral and may be sawed with metal cutting tools. It will not effervesce in acids. It can be cut into lustrous black cabochons.

CORDIERITE (see iolite)

CORUNDUM (Hematite Group)

core-UN-dum

Aluminum oxide
Al_2O_3
Hexagonal
Habit- rounded prismatic
Hardness- 9
Specific gravity- 3.95 to 4.1 (4.0)
Parting perfect on twins, one direction
Fracture- conchoidal
Streak- uncolored
Inclusions- rutile needles, spinel, zircon and garnet crystals, other blobs and color patches

Colors variable, see below
RI- O-1.765-1.777, E-1.757-1.767
Critical angle- 34°
Birefringence- .008, weak
Dichroic in most deep colors
Dispersion- .018, medium
Photochroism- rare in sapphire
Transparent to opaque
Luster- vitreous to adamantine
Optically- uniaxial negative
Name- *kauruntaka* & *korund*, East Indian names for the mineral

VARIETIES:
Emery - a non-gem type used for abrasives [*smyri* (Gr) to *emeril* (Fr)]
Padparadscha - the name for pinkish-orange to orange sapphire [padmaragaya (Singalese) - lotus flower color]
Ruby - red to purplish-red [*ruber* (L) - red]
Sapphire - colorless and all colors except red [*sappheiros* (Gr) - blue]
Star sapphire and star ruby - the colors of each above, with enclosed needles of rutile that make a six-rayed star, some are cat's eyes

Discerning natural corundum from the synthetic is sometimes very difficult. Natural corundum nearly always contains foreign inclusions, but never bubbles. The synthetic often contains bubbles. The mineral usually exhibits repeated twinning layers (poly-synthetic twinning) and these will sometimes show brightly in the polariscope. See further, synthetic corundum

Corundum continued on next page.

in the synthetic section (page 116). Some names for corundum contain the name of the area of origin. This is a widely accepted practice, but should be considered incorrect. Corundum contains many types of inclusions as well as the star-producing needles. Many of these are diagnostic of location of origin. Many crystals also exhibit a color zoning and bi-color pattern. On occasion a photochroic sapphire is seen; the colors are a blue to greenish-blue in daylight and a light red in incandescent light.

"Yogo" sapphire is a cornflower blue from Yogo Gulch, Montana. "Kashmir" blue sapphire is from the state of Kashmir, India. "Burma" ruby is very little different from any other ruby. Asia is an excellent source. East Africa, Sri Lanka and Australia are good sources.

COVELLITE

COVE-ell-ite

Cupric sulfide
CuS
Hexagonal
Habit- tabular, massive
Hardness- 1 to 2
Specific gravity- 4.6 to 4.76
Cleavage- perfect, one direction
Fracture- uneven
Streak- lead-gray to black
Color- Indigo-blue to nearly black
Opaque
Luster- metallic
Name- for N. Covelli, an Italian mineralogist
Alternate name- covelline

The massive material will produce brilliant blue cabochons. Montana is a good source of massive material.

CRANDALLITE (pseudowavellite)

CRAN-dall-ite, SUE-doe-wave-ell-ite

Hydrous calcium aluminum phosphate
$CaAl_3(PO_4)_2(OH)_5 \cdot H_2O$
Triclinic, hexagonal
Habit- commonly massive spherules
Hardness- 5
Specific gravity- 2.78 to 2.92
Cleavage- not important
Fracture- splintery
Streak- white to yellowish
Color- Yellow to yellowish-white
RI- 1.6 to 1.63 (unimportant)
Transparent to translucent
Luster- vitreous
Name- for M. L. Crandall, American mining engineer
Alternate name- pseudowavellite; for its resemblance to wavellite

This is a fairly rare material that can be cut into silky mottled cabochons. Sometimes it is dense enough to resemble agate. Utah has produced excellent cabochon material.

CREEDITE

CREED-ite

Basic calcium aluminum sulfate-fluoride
$Ca_3Al_2SO_4(F,OH)_{10} \cdot 2H_2O$
Monoclinic
Habit- prismatic, radiating masses
Hardness- 4
Specific gravity- 2.71
Cleavage- perfect, one direction
Fracture- conchoidal
Streak- white
Inclusions- numerous veils
Colorless, rarely purple
RI- X-1.461, Y-1.478, Z-1.485
Critical angle- 43°
Birefringence- .024, medium
Dispersion- medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 64°
Name- for the Creede area, Colorado

This is a very rare mineral. Transparent crystals are seldom large enough to facet. Mexico has produced clear pieces which make gems of low brilliance. Nevada is a recent new source of good facetable material.

CROCOITE

CROW-co-ite

Lead chromate
$PbCrO_4$
Monoclinic
Habit- long prisms
Hardness- 2.5 to 3
Specific gravity- 5.9 to 6.1
Cleavage- distinct, three directions
Fracture- conchoidal
Streak- orange-yellow
Inclusions- numerous tubes and needles the result of cavernous crystal growth

Color- Yellow, orange, orange-red, (red)
RI- X-2.29, Y-2.36, Z-2.66
Critical angle- 29.5°
Birefringence- .37, very strong
Trichroism- sometimes distinct
Dispersion- strong
Usually opaque, transparent in some
Luster- vitreous to adamantine
Optically- biaxial positive
2V angle- 57°
Name- *krokos* (Gr) - saffron; for the color

This is a very brittle and cleavable material that is seldom cut. Transparent crystals can be faceted into beautiful gems. The deep color masks the strong dispersion. Tasmania produces good clear facetable material.

CRYOLITE, CHIOLITE, CRYOLITHIONITE

CRY-oh-lite, KY-oh-lite, CRY-oh-lith-ee-on-ite

Sodium (& lithium) aluminum fluorides
Na_3AlF_6- cryolite; $Na_3Al_3F_{14}$- chiolite
$Li_3Na_3Al_2F_{12}$- cryolithionite
Monoclinic- cryolite; Tetragonal- chiolite
Isometric- cryolithionite
Habit- massive, crystals nearly equant
Hardness- 3.5 to 4- chiolite
2.5 to 3- cryolite and cryolithionite
Specific gravity- 2.77- cryolithionite
2.95 to 3.0- cryolite and chiolite
Cleavage- none- cryolite; distinct to perfect, two directions- chiolite; one direction- cryolithionite
Streak- white
Inclusions- numerous random veils in all three species

Colorless, white
RI- X-1.337, Y-1.337, Z-1.338- cryolite;
O-1.348, E-1.342- chiolite;
n- 1.3395- cryolithionite
Critical angle- 45°
Birefringence- .001, weak- cryolite. 006, weak- chiolite
Transparent to translucent
Luster- vitreous to greasy
Optically- biaxial positive- cryolite
uniaxial negative- chiolite
2V angle- 43° (cryolite)
Names- *kryos* (Gr) - icy cold, for the ice like look
chiori (Gr) - snow
kryos (Gr) - the lithium in its composition

These three minerals would be difficult to separate under normal conditions. Cryolithionite forms crystals about one-half inch across; the others form very small crystals. All have been faceted, but gems decidedly lack brilliance. The three minerals are found, in lapidary quality, only at single locations in Greenland and Russia. Clear facetable material is very rare.

CUBANITE

CUE-bun-ite

Copper iron sulfide
$CuFe_2S_3$
Orthorhombic
Habit- usually massive, tabular
Hardness- 3.5
Specific gravity- 4.03 to 4.18
Cleavage- none
Fracture- conchoidal
Streak- dark

Color- Bronze to brassy yellow
Opaque
Luster- metallic
Name- for Cuba where first found

This is an unusual mineral found in mines with high metal content. Most specimens are mixed with chalcopyrite, pyrite, magnetite, etc. A mine in Washington produces a nice brass-colored material with very little mixture of other minerals. This will make lustrous cabochons.

CUPRITE

COOP-rite, KEWP-rite

Copper oxide
Cu_2O
Isometric
Habit- cubic, octahedral, massive
Hardness- 3.5 to 4
Specific gravity- 5.85 to 6.15
Cleavage- interrupted, one direction
Fracture- uneven
Streak- brownish-red
Inclusions- rarely malachite crystals

Color- Deep red, altering to red-black
RI- n-2.849 (probably variable)
Critical angle- 21°
Transparent to opaque
Luster- submetallic to adamantine
Dispersion- very high (?)
Name- *cuprum* (L) - copper

VARIETY:
Chalcotrichite - red hair-like mats [*chalcos* & *trich* (Gr) - copper hair]

A very brittle material that is difficult to cut. It produces splendent cabochons and dark, but brilliant, faceted gems. The gem surface alters to blackish after nearly a year. Careful wiping with soft tissue will usually restore the original color. Namibia has produced excellent large clear facetable crystals.

CUPROSKLODOWSKITE

COOP-row-sklo-dow-skite

Basic, hydrous copper urano-silicate
$Cu(UO_2)_2(SiO_3)_2(OH)_2 \cdot 5H_2O$
Triclinic
Habit- acicular crystals, commonly in aggregates
Hardness- 4
Specific gravity- 3.85
Cleavage- one direction; not important in massive material
Fracture- uneven
Streak- light yellowish-green

Color- Pale green to olive-green
RI- 1.654 to 1.667 (unimportant)
Translucent- (transparent in small crystals)
Luster- subvitreous to dull to siky
Name- *cuprum* (L) - copper & for Maria Sklodowska Curie, the discoverer of uranium

Massive pieces of this material can be cut into interesting cabochons that are green with brown spots. Washington produces excellent material.

CYANITE (see kyanite)

CYPRINE (see idocrase)

DANBURITE

DAN-burr-ite

Calcium boro-silicate
$CaB_2Si_2O_8$
Orthorhombic
Habit- prismatic
Hardness- 7 to 7.25
Specific gravity- 2.97 to 3.02 (3.0)
Cleavage- poor
Fracture- conchoidal
Streak- uncolored
Inclusions- veils and random needles

Colorless, yellow, pink, brownish
RI- X-1.630, Y-1.633, Z-1.636
Critical angle- 38°
Birefringence- .006, weak
Dispersion- .017, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 88° to 90°
Name- for Danbury, Connecticut

Danburite produces an excellent brilliant gem, even though it has medium to weak optical properties. This is due in part to its excellent clarity. Mexico has produced excellent clear colorless to light pink crystals. Recently, Madagascar has produced nice yellowish crystals. A very recent find of bright yellow material was made in Canada. The supply is evidently not large.

DATOLITE

DATE-oh-lite, DAT-oh-lite

Basic calcium boro-orthosilicate
$HCaBSiO_5$
Monoclinic
Habit- prismatic, tabular, massive
Hardness- 5 to 5.5
Specific gravity- 2.9 to 3.0 (2.95)
Cleavage- none
Fracture- conchoidal
Streak- white
Inclusions- numerous veils; see below

Colorless, pink, green, yellow, (violet)
RI- X-1.626, Y-1.654, Z-1.670
Critical angle- 37.5°
Birefringence- .044, strong
Dispersion- .016, medium
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 74°
Name- *dateisthai* (Gr) - to divide; from its crumbling characteristic

Transparent crystals are cut into gems of moderate brilliance. The massive opaque material is cut into cabochons. Native copper is sometimes enclosed in the massive material, which can be cut into excellent cabochons.

DAVIDITE

DAVID-ite

A complex rare-earth oxide
$(Fe,Ce,U)_2(Ti,Fe,U,Cr)_5O_{12}$
Hexagonal
Habit- usually massive, sometimes in cube-like crystals
Hardness- 6
Specific gravity- 4.42 to 4.49
Cleavage- none (?)
Fracture- conchoidal to uneven
Streak- dark

Color- Black to grayish-black, brown
RI- about 2.3 (unimportant)
Opaque
Luster- dull
Name- for T. W. E. David, Australian geologist

This is a metamict mineral, undoubtedly due to the decomposition of the uranium in the molecule. Material from Norway can be cut into interesting brownish and black cabochons.

DEMANTOID (see Garnet Group – ugrandite subgroup – andradite)

DESCLOIZITE (Descloizite Group)

des-CLO-is-ite

Basic lead zinc vanadate
$PbZn(VO_4)(OH)$
Orthorhombic
Habit- pyramidal, prismatic
Hardness- 3 to 3.5
Specific gravity- 6.24 to 6.26
Cleavage- none
Fracture- uneven, brittle
Streak- dark

Color- Brown, orange-red, (greenish)
RI- X-2.185, Y-2.265, Z-2.35
Critical angle- 28°
Birefringence- .165, very strong
Transparent to opaque
Luster- greasy
Optically- biaxial positive
2V angle- 90°
Name- for Alfred Des Cloizeaux, a French mineralogist

Recently the mines in Namibia have produced virtually clear brownish crystals that are facetable. Orange-red pieces of facet quality have been very thin. The brown crystals do not produce very good gems.

DIAMOND

DYE-uh-mund

Pure carbon
Isometric
Habit- cubic, octrahedral, twins
Hardness- 10
Specific gravity- 3.5 to 3.53 (3.52)
Cleavage- perfect, four directions
Fracture- conchoidal
Streak- none
Inclusions- graphite, hematite, magnetite, enstatite, zircon, diamond, and others; most not visible to naked eye

Colorless, virtually all colors and black
RI- n-2.4175
Critical angle- 24.5°
Dispersion- .044, strong
Transparent to opaque
Luster- adamantine
Anomalous double refraction is often exhibited by diamond. However, few people will have the need to observe it.
Names- *adamas* (Gr) - unconquerable; then to *adiamentum* (L) - diamond

VARIETIES:
Black diamond - black; has recently been cut into gems
Carbonado - a dark tough cryptocrystalline type used industrially [*carbo* (L) - ember or charcoal; to *carbonada* (Sp)]
Fancy diamond - definite tints except black
Gem diamond - colorless or nearly so
Industrial diamond - all colors of opaque or non-gem types
Radiation treated - various intense greenish to golden shades

Diamond is the most unique of all gem minerals. Its extreme hardness coupled with the high RI and dispersion has always kept alive a search for a substitute. Evidently the combination is difficult to duplicate. The values of gem diamonds depend greatly on color. The so-called "blue-white" is in reality colorless. A slight blue color would increase the value. Slight yellow, brown, or green tends to lower values. Fancy diamonds of good clean color are becoming popular. Red and blue tops the list, with brown (coffee color), green, orange, and violet following. The best fancies are intense in color. It is sometimes very difficult to differentiate fancies from those that have been irradiated. Carbonado has a lower specific gravity, and greater toughness than single crystals. Many African countries are producers. Excellent gem crystals come from some South American countries. Russia has a producing mine (see section 2, page 116). Australia is a new producer.

DIASPORE

DYE-ah-spore

Hydrous aluminum oxide
$Al_2O_3 \cdot H_2O$
Orthorhombic
Habit- prismatic, foliated
Hardness- 6.5 to 7
Specific gravity- 3.3 to 3.5 (3.3)
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- white
Inclusions- numerous needles, some are parallel and could produce eye stones

Colorless, grayish, yellow, green, red
RI- X-1.702, Y-1.722, Z-1.750
Critical angle- 36°
Birefringence- .048, strong
Dichroic in some varieties
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 84°
Name- *diaspora* (Gr) - dispersion; it breaks up when heated

Manganodiaspore is a rose-red variety containing manganese. It is rarely faceted. A location in Africa has produced clear red material. A recent discovery in Turkey has produced excellent clear light yellow material that can be faceted into brilliant gems. The derivation of the name should be ample warning to faceters to not subject this material to heat.

DIATOMITE (see opal)

DICHROITE (see iolite)

DICKINSONITE

DICK-in-son-ite

Complex sodium manganese phosphate
$H_2Na_6(Mn,Fe,Ca,Mg)_{14}(PO_4)_{12} \cdot H_2O$
Monoclinic
Habit- tabular, pseudo-rhombohedral
Hardness- 3.5 to 4
Specific gravity- 3.38 to 3.42
Cleavage- perfect, one direction
Fracture- uneven
Streak- white
Inclusions- none observed

Color- Various shades of green
RI- X-1.648, Y-1.655, Z-1.662
Critical angle- 37°
Birefringence- .014, weak
Trichroism- pale to very pale green
Dispersion- strong
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 90°
Name- for William Dickinson, American mining engineer

This is a rare mineral that is cut for collectors of the unusual. It has little to offer except rarity. Connecticut and Maine are the only known sources.

DIGENITE

DIJ-en-ite

Copper sulfide
Cu_2S (variable amount of copper)
Isometric
Habit- massive, crystals rare
Hardness- 2.5 to 3
Specific gravity- 5.5 to 5.7
Cleavage- none (?)
Fracture- conchoidal, brittle
Streak- dark

Color- Deep blue to black
Opaque
Luster- metallic
Name- *digens* (Gr) - of two kinds; it supposedly contained both valences of copper

Copper mines in Montana have produced reasonably pure massive material that has been cut into quite lustrous dark cabochons.

DIOPSIDE (Pyroxene Group)

dye-OP-side

Calcium magnesium silicate
$CaMg(SiO_3)_2$
Monoclinic
Habit- prismatic, massive
Hardness- 5 to 6
Specific gravity- 3.2 to 3.38 (3.29)
Cleavage- perfect, interrupted one direction
Fracture- conchoidal
Streak- white to gray-green
Inclusions- numerous flaws and veils; sometimes has parallel needles

Colorless, yellow, green, blue, (brown), black
RI- X-1.664, Y-1.671, Z-1.694
Critical angle- 37°
Birefingence- .03, strong
Trichroic in deep colors
Dispersion- weak
Transparent to opaque
Luster- vitreous
Optically- biaxial positive
2V angle- 59°
Name- *di & opsis* (Gr) - two and view; for the birefringence

VARIETIES:
Alalite - colorless to green [Ala Valley, Italy]
Cat's-eye - opaque green due to needle inclusions
Chrome diopside - intense green due to a chromium impurity [*chroma* (Gr) - color]
Malacolite - translucent pale yellow [*malake* (Gr) - mallow]
Star - opaque black due to needle inclusions
Violane - a fine blue [for the violet-blue color]

Chrome diopside is the most desirable. Many locations produce light colors, but not usually pleasing. An excellent medium-deep green material comes from Russia. Finland, Brazil, and Madagascar produce a green diopside; most specimens are very flawed. The color is somewhat variable. New York produces a light greenish-yellow material, in nice crystals, that can be cut into cabochons or faceted gems.

DIOPTASE

dye-OP-tase

Basic copper silicate
$CuSiO_2(OH)_2$
Hexagonal
Habit- rhombohedral, prismatic, massive
Hardness- 5
Specific gravity- 3.28 to 3.35 (3.3)
Cleavage- perfect, three directions
Fracture- conchoidal
Streak- light green
Inclusions- numerous cleavage plane cracks that make transparent crystals appear translucent

Color- Emerald green
RI- O-1.644-1.658, E-1.697-1.709
Critical angle- 37°
Birefringence- .051-.053, strong
Dichroic- dark to light green
Dispersion- .022, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial positive
Name- *dia* & *optos* (Gr) - through and to look; the cleavages are easily seen in the crystal

Seldom is this material clear enough to facet, and when so, usually only the crystal tips are clear. Flawed material has been used as an emerald substitute. Namibia has produced small, but fine clear crystals.

DOLOMITE (Dolomite Group)

DOUGH-low-mite

Calcium magnesium carbonate
$CaMg(CO_3)_2$
Hexagonal
Habit- rhombohedral, massive
Hardness- 3.5 to 4
Specific gravity- 2.8 to 2.9
Cleavage- perfect, three directions
Fracture- subconchoidal
Streak- white
Inclusions- cleavage plane cracks

Colorless, pink, greenish, reddish, brown
RI- O-1.679, E-1.501
Critical angle- 42° and 37°
Birefringence- .177, very strong
Transparent to opaque
Luster- vitreous to pearly
Optically- uniaxial negative
Name- for Deodat de Dolomieu, French mineralogist

Occasionally, crystals are clear enough to facet. Colorless gems are very excellent. New Mexico and Switzerland have produced good sized colorless pieces. Massive dolomite can be cut into cabochons. A white, porcelain-looking material is found in California. A banded material, with brown, reddish, and greenish bands comes from Brazil and California. The banded material makes pleasing gems.

DOMEYKITE (see algodonite)

DRAVITE (see Tourmaline Group – dravite-schorl series)

DRAVE-ite

DUMORTIERITE

du-MORT-ee-er-ite

Aluminum borosilicate
$Al_7(BO_3)(SiO_4)_3O_3$
Orthorhombic
Habit- fibrous to massive, crystals rare
Hardness- 7
Specific gravity- 3.26 to 3.36
Cleavage- distinct, one direction
Fracture- splintery
Streak- white
Inclusions- none observed

Color- Blue to greenish-blue, violet
RI- X-1.686, Y-1.722, Z-1.723
Critical angle- 37°
Birefringence- .037, medium
Rarely transparent, opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 13°
Name- for Vincent Dumortier, a French paleontologist

Dumortierite of lapidary potential is rare. Massive dumortierite is usually very fibrous and seldom suitable for cutting cabochons. Good cabochon quality dumortierite comes from South Africa and Russia. This material is disseminated in quartz. Transparent crystals of dumortierite have been recently found in Brazil, and some faceted gems have been cut. These are very good gems.

DURANGITE

dur-ANG-ite

Sodium aluminum fluo-arsenate
$Na(Al,F)AsO_4$
Monoclinic
Habit- prismatic
Hardness- 5
Specific gravity- 3.97 to 4.07
Cleavage- distinct, two directions
Fracture- uneven
Streak- yellow
Inclusions- none observed

Color- Red-orange
RI- X-1.634, Y-1.673, Z-1.685
Critical angle- 37°
Birefringence- .051, strong
Trichroic- light to dark colors
Dispersion- weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 45°
Name- for Durango, Mexico, type locality

This is a very rare mineral, found at Durango, Mexico, and Nova Scotia, Canada. It is seldom cut, but makes good faceted gems.

EKANITE

EK-an-ite

Calcium sodium potassium thorium silicate
$(Ca,Na,K,Th)_2Si_4O_{10}$
Tetragonal
Habit- prismatic, pebbles, massive
Hardness- 5
Specific gravity- 3.3
Cleavage- none
Fracture- conchoidal
Streak- brownish
Inclusions- numerous needles, some producing asterism

Color- Green, dark brown
RI- O-1.582, E-1.670
Critical angle- 39.5°
Birefringence- .001, weak
Transparent to translucent
Luster- vitreous
Optically- uniaxial positive
Name- for F. L. D. Ekanyake, the Sri Lankan discoverer

This very rare mineral was known only as green material for many years, from Sri Lanka. Recently it has been found in Canada in small brown crystals. Both are facetable. The translucent material has been cut into cabochons. The thorium content in this mineral makes it highly radioactive, so extra precautions must be taken when cutting this material. Gems are mostly for collectors and rarely used in jewelry.

ELAEOLITE (see nepheline)

ELBAITE (see Tourmaline Group – elbaite-dravite series)

EL-buh-ite

EMERALD (see beryl)

ENSTATITE & HYPERSTHENE (Pyroxene Group)

EN-stah-tite, HIGH-pers-thene

Enstatite- magnesium silicate
$MgSiO_3$
Hypersthene- iron magnesium silicate
(Fe,Mg) SiO3
Orthorhombic
Habit- prismatic, massive
Hardness- 5 to 6
Specific gravity- 3.1 to 3.5 (3.25)
Cleavage- perfect, one direction
Fracture- uneven
Streak- white to brownish
Inclusions- numerous platelets and needles; some producing star gems

Color- Gray, orange, green, brown, black
RI- enstatite- X-1.650, Y-1.653, Z-1.658
hypersthene- 1.692 to 1.705
Critical angle- 36°
Birefringence- .008, weak & .013, med.
Trichroism- medium to strong
Dispersion- weak
Transparent to opaque
Luster- vitreous to pearly, submetallic
Optically- enstatite- biaxial positive
2V angle- large and variable
Names- *enstates* (Gr) - adversary; for its infusibility
hyper & stethanos (Gr) - very strong; for its strong pleochroism

Bronzite is a variety of hypersthene with bronze-like reflections from plate-like inclusions, which form a four-rayed star when cut as cabochons. Enstatite theoretically does not contain iron, but these two minerals form a series so that it is nearly impossible to find a specimen that is iron-free. Virtually all the material on the market is an intermediate form, best called enstatite-hypersthene, with an RI about midpoint of those above. Green to light brown enstatite from India is a good gem material. As it is very dark, hypersthene has no value for faceting. East African localities have produced excellent light-orange and green enstatite faceting material.

EOSPHORITE & CHILDRENITE

ee-OS-for-ite, CHILDREN-ite

Iron manganese aluminum phosphates
$(Mn,Fe)AlPO_4(OH)_2H_2O$
Monoclinic (eosphorite)
Orthorhombic (childrenite)
Habit- prismatic
Hardness- 4.5 to 5
Specificgravity- 3.06 to 3.25
Cleavage- imperfect, one direction
Fracture- uneven
Streak- white to yellowish
Inclusions- numerous veils or cracks; these do not make eosphorite appear to be translucent

Color- Pink (eosphorite), brownish (childrenite)
RI- X-1.638, Y-1.660, Z-1.668 (eosphorite)
X-1.63, Y-1.65, Z-1.66 (childrenite)
Critical angle- 37°
Birefringence- .03, medium
Trichroic- yellow, pink, colorless (eosphorite)
Dispersion- strong
Transparent to translucent
Luster- vitreous to resinous
Optically- biaxial negative
2V angle- 45° to 50°
Names- *eosphoros* (Gr) - dawn-bearing; in allusion to the pink color. Also - J. G. Children, English mineralogist

These two minerals, a series depending upon the iron vs. manganese content, are usually found only as crystals. Eosphorite, low in iron, is the only one known to be clear enough to facet, and makes excellent gems. Brazil is the only gem source.

EPIDOTE GROUP (see individual minerals)

ALLANITE - CLINOZOISITE - EPIDOTE - PIEMONTITE - ZOISITE

EPIDOTE (Epidote Group)

EP-ih-dote

Basic calcium aluminum iron silicate
$Ca_2(Al, Fe)_3Si_3O_{12}(OH)$
Monoclinic
Habit- prismatic
Hardness- 6 to 7
Specific gravity- 3.25 to 3.5 (3.4)
Cleavage- perfect, two directions
Fracture- uneven
Streak- uncolored
Inclusions- often filled with cracks, veils and cleavage plane cracks

Color- Green, yellowish, brown, black
RI- X-1.729, Y-1.754, Z-1.768
Critical angle- 35°
Birefringence- .039, medium
Trichroism- strong; green, brown, yellow
Dispersion- .030, medium
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 74°
Name- *epido* (Gr) - added; from one side of the base prism being longer
Alternate name- pistacite, for the green pistachio nut

Epidote is often transparent, but deep colored. Faceted gems are usually dark and the color density masks the fine optical properties. Epidote is considered to contain more than 10% iron in the molecule, which probably accounts for the depth of color. Clinozoisite (page 25) has less than 10% iron in the molecule, but never is without some. When the molecule contains no iron, it would be zoisite (page 112). California has produced good faceting epidote, but the supply now appears to be exhausted. In recent years, good faceting material has come from Kenya. Very recently, Brazil has produced medium greenish-yellow epidote of excellent clarity. Other locations on rare occasions have produced clear facetable material.

ETTRINGITE

ET-ring-ite

Basic hydrous calcium aluminum sulfate
$Ca_6Al_2(SO_4)_3(OH)_{12}{\cdot}24H_2O$
Hexagonal
Habit- prismatic, sometimes flattened
Hardness- 2 to 2.5
Specific gravity- 1.77
Cleavage- perfect, one direction
Streak- white
Inclusions- none observed

Colorless, white
RI- O-1.491, E-1.470
Critical angle- 42.5°
Transparent to translucent
Luster- vitreous
Name- for Ettringen, Germany where first found

This is a very rare mineral. Present specimens are coated with a layer of brown sturmanite. The junction between both minerals is very weak. The clear ettringite center will cut into colorless gems. The sturmanite portion will probably not facet.

EUCLASE

YOU-clase

Basic beryllium aluminum silicate
$BeAlSiO_4(OH)$
Monoclinic
Habit- prismatic
Hardness- 7.5
Specific gravity- 3.05 to 3.11 (3.1)
Cleavage- perfect, one direction
Fracture- uneven
Streak- uncolored
Inclusions- mud, feldspar, cleavage cracks, miscellaneous veils

Colorless, yellow, greenish, blue
RI- X-1.652, Y-1.655, Z-1.671
Critical angle- 36°
Birefringence- .019, medium
Dispersion- .016, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 50°
Name- *eu & klasis* (Gr) - good cleavage

Euclase makes brilliant faceted gems The one cleavage is very troublesome. Brazil has produced large colorless and blue faceting material. Very fine deep blue crystals have been found in Zimbabwe; the prices for these have been high.

EUDIALITE (eudialyte)

you-DIAL-ite

A complex sodium zirconium silicate
$Na_4(Ca,Fe, Ce,Mn)_2 ZrSi_6O_{17}(OH, Cl)_2$
Hexagonal
Habit- usually crystals
Hardness- 5 to 5.5
Specific Gravity- 2.7 to 3
Cleavage- indistinct
Fracture- uneven, very brittle
Streak- colorless
Inclusions- some flaws

Color- Red, pink, brownish red
RI- 1.593-1.634
Critical angle- 38.7°
Birefringence- .004, weak
Dispersion- weak
Transparent to opaque
Luster- vitreous to greasy of dull
Optically- uniaxial positive
Name- *eudialyst* (Gr) - easy to dissolve

This is very rare in facet quality. The brittleness can be a factor in faceting. Excellent medium red crystals are found in Canada. Pieces are small and rare. Cabochon material is found in Russia.

EUXENITE, FERGUSONITE, SAMARSKITE

YOUX-en-ite, FUR gus-on-ite, SAM-are-skite

Complex niobate tantalates + rare earths
(Nb,Ta)xOx+Ce,Er,Y,U, & others
Isometric (euxenite)
Tetragonal (fergusonite)
Orthorhombic (samarskite)
Habit- prismatic, pyramidal, massive
Hardness- 5 to 6.5
Specific gravity- 4.3 to 5.8
Cleavage- imperfect to none
Fracture- subconchoidal to conchoidal
Streak- reddish-brown to brown

Color- Brownish to black
RI- 2.06 to 2.26
Subtranslucent to opaque
Luster- dull to brilliant, to sub-metallic
Optically-
fergusonite, uniaxial negative
samarskite, biaxial negative
Names- *euxenos* (Gr) - hospitable; for the rare elements it contains
for Robert Ferguson, Scotch physician
for Col. Samarski, a Russian

Pegmatites in Madagascar have produced massive euxenite that makes very brilliant jet black cabochons. Norway has produced a similar fergusonite. Madagascar has also produced samarskite that has a lapidary potential, but it is not very brilliant.

FAIRFIELDITE

FAIR-field-ite

Calcium manganese iron phosphate
$Ca_2(Mn,Fe) (PO_4)_2 \cdot 2(H_2O)$
Triclinic
Habit- prismatic, lamellar, to fibrous
Hardness- 3.5
Specific gravity- 3.08
Cleaveage- distinct, two directions
Fracture- uneven
Streak- white

Colorless, pale-yellow, greenish
RI- X-1.636, Y-1.644, Z-1.654 (variable)
Critical angle- 38°
Birefringence- .018, medium
Dispersion- weak
Transparent to translucent
Luster- pearly to sub-adamantine
Optically- biaxial positive
Name- for Fairfield County, Connecticut

A rare mineral that is usually fibrous and seldom cut. With crystals, one of the cleaveages is a problem. Connecticut is the best producer of lapidary material.

FELDSPAR GROUP

FELLED-spar

[Name- feldspat (Ger) - field spar; spar (Anglo-Saxon) - easily cleaved]

ORTHOCLASE (Feldspar Group)

OR-tho-clase

Potassium aluminum silicate
$KAlSi_3O_8$
Monoclinic
Habit- prismatic, twinned, massive
Hardness- 6
Specific gravity- 2.56 to 2.58
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Inclusions- other feldspars, stress cracks, and numerous needles

Colorless, yellow, gray, pink, bluish
RI- X-1.519, Y-1.523, Z-1.525
Critical angle- 41°
Birefringence- .006, weak
Dispersion- .012, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial negative
2V angle- variable, 33° to 103°
Name- *orthos* & *klasis* (Gr) - straight cleavage

VARIETIES:
Moonstone or adularia - bluish, greenish, reddish, showing an internal reflection.
Sanidine - glassy, colorless

Adularia crystals are usually opaque white. Sri Lanka produces a fine white moon stone. Madagascar has produced excellent colorless and yellow faceting material.

MICROCLINE (Feldspar Group)

MY-crow-cline

Potassium aluminum silicate
$KAlSi_3O_8$
Triclinic
Habit- prismatic twinned, massive
Hardness- 6 to 6.5
Specific gravity- 2.54 to 2.59 (2.56)
Cleavage- perfect to indistinct, three directions
Fracture- uneven
Streak- white
Inclusions- other feldspars; some needles

Colorless, pale yellow, green, reddish
RI- X-1.518, Y-1.522, Z-1.525
Critical angle- 41°
Birefringence- .007, weak
Dispersion- weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- variable, 66° to 103°
Name- *micro* & *klinein* (Gr) - small inclined; for the small triclinic angle

VARIETY:
Amazonstone, (amazonite) - green, [named for the Amazon River, but it is not found there]. "Colorado jade" is a misnomer for amazonstone. Colorado, Russia, Canada, and an African country have produced good amazonstone.

Microcline is the feldspar of pegmatites. It is seldom transparent. Some opaque types make nice cabochons. Perthite is microcline or orthoclase with albite. A most unique aventurine type microcline is found in the Harts Range in central Australia. The feldspar is a clear slight reddish, containing hexagonal hematite plates oriented in two directions about 90° apart. The hematite crystals are not smooth and thus act as diffraction gratings, producing flashes of a number of colors. This material is truly spectacular.

FELDSPAR GROUP - PLAGIOCLASE

PLADG-ee-oh-clase

Name- plagios & kiasis (Gr) - [oblique cleavage]

The plagioclase feldspars are an interesting group. Each contains a certain percentage of the albite and anorthite molecules. Actually, this is the percentages of sodium versus calcium. Albite, the first end-member of the group should have sodium to the exclusion of calcium in the molecule. Anorthite is vice versa. Mineralogists have found that the other four members of the group contain these two elements in 20% increments. The end-members each have only 10% increments. This gives a total of six possible members. In actual findings, there is no sharp delineation between members of the group; each grades into the adjacent member. To give an example of this near intergradation, a type of labradorite (from Oregon) has been named calcic labradorite on the basis of its calcium ratio being at or near the 60% maximum. This is an excellent sunstone material.

FELDSPAR GROUP - PLAGIOCLASE Cont.

ALBITE (Feldspar Group – Plagioclase) AL-bite

Sodium aluminum silicate
$NaAlSi_3O_6$
Triclinic
Habit- tabular, massive
Hardness- 6 to 6.5
Specific gravity- 2.60 to 2.62
Cleavage- perfect to imperfect three directions
Fracture- conchoidal
Streak- white
Inclusions- other feldspars, and platelets

Colorless, white, gray, blue, green, red
RI- X-1.527, Y-1.529, Z-1.538
Critical angle- 41°
Birefringence- .011, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 70°
Name- *albus* (L) - white; for the usual color

VARIETIES:
Cleavelandite - white plate-like crystals common in pegmatites [for Parker Cleaveland, American mineralogist]
Moonstone - above colors (except colorless) showing internal reflection [moonlike]
Peristerite - reddish, greenish, bluish, sometimes with internal reflections [peristellein (Gr) - to wrap around]
Perthite - a mixture of albite with orthoclase or microcline [for Perth, Canada]

Localities are numerous. Albite in any form as clear facetable material is very rare.

OLIGOCLASE (Feldspar Group – Plagioclase) OH-li-go-clase
(approx. 80% albite and 20% anorthite)

Triclinic
Habit- usually massive
Hardness- 5 to 6
Specific gravity- 2.62 to 2.65
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Inclusions- platelets of goethite or hematite; white blobs

Color- Various light tints
RI- X-1.539, Y-1.544, Z-1.547
Critical angle- 41°
Birefringence- .008, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 85°, (approximately)
Name- *oligos* & *kiasis* (Gr) - little cleavage

Oligoclase also appears as a moonstone and aventurine. The moonstone is due to internal reflections from intersecting twinning planes. A good facetable oligoclase comes from South Carolina. It usually contains white inclusions.

ANDESINE (Feldspar Group – Plagioclase) AN-des-ine
(approx. 60% albite and 40% anorthite)

Triclinic
Habit- usually massive; crystals tabular, rare
Hardness- 6 to 6.5
Specific gravity- 2.66 to 2.68
Cleavage- perfect, one direction; less so, two directions
Fracture- uneven to conchoidal, brittle
Streak- white
Inclusions- none observed
America, where first found

Colorless, white, gray
RI- X-1.550, Y-1.554, Z-1.558
Critical angle- 41°
Birefringence- .008, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 76° to 80°
Name- for the Andes Mountains, South

This is a fairly common mineral, but usually locked in igneous rocks as very small particles. Free visible crystals are very rare. As material with lapidary potential it is very rare. A greenish form has been cut into cabochons. The authors know of clear andesine at an Indian reservation. Permission is very difficult.

FELDSPAR GROUP - PLAGIOCLASE Cont.

LABRADORITE (Feldsapr Group – Plagioclase)

LAB-ruh-door-ite

(approx. 40% albite and 60% anorthite)

Triclinic
Habit- massive
Hardness- 6 to 6.5
Specific gravity- 2.67 to 2.71
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Inclusions- hematite platelets, numerous needles and twinning planes

Colorless, yellow, bluish, red, black
RI- X-1.560, Y-1.563, Z-1.568
Critical angle- 41°
Birefringence- .008, weak
Transparent to opaque
Luster- vitreous
Optically- biaxial positive
2V angle- approximately 78°
Name- for the island of Labrador

Labradorite is the most common of the plagioclase feldspars and is best known as the nearly opaque material with a play of color (labradorescence). "Black moonstone" is an incorrect name for this variety. The usual clear facetable labradorite is a light yellow to colorless. It is found in many locations. A very good labradorite moonstone is found in Kenya; this resembles the Sri Lanka orthoclase type. The best nearly clear material with labradorescence is from Madagascar. Finnish material has a black base and fine labradorescence. It is often referred to as spectrolite. Oregon produces an excellent sunstone type (poorly named "heliolite"). This shows a nice red schiller and a green. The red is claimed to be due to colloidal copper; the green due to lead in a trivalent metallic form. Surprsingly, however, the green is dichroic.

BYTOWNITE (Feldspar Group – Plagioclase)

BY-ton-ite

(approx. 20% albite and 80% anorthite)

Triclinic
Habit- usually massive, crystals tabular, very rare
Hardness- 6 to 6.5
Specific gravity- 2.72 to 2.74
Cleavage- perfect, one direction; less so, two directions
Fracture- uneven to conchoidal, brittle
Streak- white
Inclusions- none observed

Colorless, white, gray, yellowish
RI- X-1.568, Y-1.573, Z-1 576
Critical angle- 41°
Birefringence- .008, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 81°
Name- for Bytown, Canada (which is now Ottawa), where first described. Actually the material first found there has been shown to be a different feldspar.

This is a rare feldspar, usually found only as small particles in igneous rocks. The list of localities is small. The authors have long doubted the existence of clear facetable material. Many specimens sent to them proved to be labradorite. Recently, they were sent specimens from a locality in New Mexico that may be bytownite.

ANORTHITE (Feldspar Group – Plagioclase)

AN-or-thite

Calcium aluminum silicate
$CaAl_2 Si_2O_8$
Triclinic
Habit- prismatic, massive
Hardness- 6 to 6.5
Specific gravity- 2.74 to 2.76
Cleavage- perfect, two directions
Fracture- conchoidal to uneven
Streak- white
Inclusions- probably usual for plagioclase

Color- White, gray, yellow, reddish
RI- X-1.574, Y-1.581, Z-1.585
Critical angle- 41°
Birefringence- .011, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 78°
Name- an & orthos (Gr) - not straight

Some stones have been cut for collectors. It is very rare as a gem material. Recently, a material offered as anorthite has been found to be labradorite. Thus, the faceter is cautioned to be very careful buying feldspars.

FERGUSONITE (see euxenite)

FUR-gus-on-ite

FERROAXINITE (see axinite)

FLUORAPATITE (see apatite)

FLUORITE

FLUE-oh-rite

Calcium fluorite
CaF_2
Isometric
Habit- cubic, octahedral, massive
Hardness- 4
Specific gravity- 3.01 to 3.25 (3.15)
Cleavage- perfect, four directions
Fracture- flat conchoidal
Streak- white
Inclusions- veils, cleavages, minerals

Colorless, nearly all colors
RI- n-1.4339
Critical angle- 44°
Dispersion- .007, weak
Transparent to translucent
Luster- vitreous
Name- *fluere* (L) - to flow; from its easy melting
Alternate names- fluor, fluorspar; Blue John is blue to purple, massive

Most specimens contain many inclusions and cleavage cracks. The massive material sometimes appears columnar because of interference in crystal growth. The low optical properties give faceted gems a unique "empty" look which is enhanced by the clarity. The wide range of colors and their many hues make this an interesting gem material in spite of the low optical properties. The famous Blue John is from England.

FOGGITE

FOG-ite

Hydrous calcium aluminum phosphate
$CaAl(PO_4)(OH)_2 \cdot H2O$
Orthorhombic
Habit- very small crystals; massive?
Hardness- 4.5
Specific gravity- 2. 53 approximately
Cleavage- none
Fracture- sub-conchoidal
Streak- white

Color- Green
Opaque
Luster- earthy
Name- for Forrest M. Fogg, American mineralogist

In the second edition it was stated that this mineral appeared as massive material in Australia and much resembled variscite. The authors had previously purchased and cut material that was sold as foggite. The experience was that it was different from the usual variscite and all information given them was considered correct. During a trip to Australia in 1984 it was found that no one in that country knew of foggite, and many collectors had material they considered to be variscite that had originated in Australia. A further careful search of the literature revealed no indication that foggite had been found in Australia in a massive form. Thus, the only conclusion that can be drawn is that information to that effect was erroneous. However, there is a good possibility that dealers are still offering the same material under the name foggite. There is also the possibility, however remote, that the material from Australia is in fact a form of foggite, but further investigation is needed before this can in any way be assumed to be correct.

FORSTERITE (see peridot)

FRIEDELITE

free-DELL-ite

Hydrous basic manganese chloro-silicate
$Mn_8Si_6O_{18}(OH, Cl)_4 \cdot 4(H_2O)$
Hexagonal
Habit- usually massive, crystals rare
Hardness- 4 to 5
Specific gravity- 3.06 to 3.19
Cleavage- perfect in crystals, one direction
Fracture- conchoidal to uneven
Streak- white

Color- Rose-red, orange-red
RI- O-1.66, E-1.63 (variable)
Critical angle- 37°
Birefringence- .03, medium
Translucent, very rarely transparent
Luster- vitreous
Optically- uniaxial negative
Name- for Charles Friedel, French mineralogist

This rare material is sometimes available in cabochon quality. Seldom is clear facetable material available. New Jersey has produced some material of lapidary potential. In 1980, a deposit of excellent massive material was found in South Africa. Some of the material is nearly clear enough to facet.

GADOLINITE

gah-DOLE-in-ite

Beryllium iron yttrium silicate
$Be_2FeY_2Si_2O_{10}$
Monoclinic
Habit- rough prismatic, massive
Hardness- 6.5 to 7
Specific gravity- 4.0 to 4.65
Cleavage- none
Fracture- conchoidal or splintery
Streak- dark

Color- Brown, greenish-black, black
RI- X-1.77, Z-1.82
Critical angle- 34°
Birefringence- .05, strong
Transparent to opaque
Luster- vitreous to greasy
Optically- biaxial positive
2V angle- 85°
Usually metamict with only two RI's
Name- for Johan Gadolin, Finnish chemist

Gadolinite has been cut into cabochons of interest to collectors only. Originally found at a worked-out location in Texas. Sweden and Norway produce small amounts.

GAHNITE (Spinel Group)

GAH-nite

Zinc aluminate
$ZnAl_2O_4$
Isometric
Habit- octahedral, massive
Hardness- 7.5 to 8
Specific gravity- 4.0 to 4.6
Cleavage- indistinct
Fracture- conchoidal to uneven
Streak- grayish
Inclusions- numerous veils and cracks

Color- Yellow, green, brown, greenish-black
RI- n-1.79 to 1.82
Critical angle- 33°
Transparent to opaque
Luster- vitreous to greasy
Name- for J. G. Gahn, Swedish mineralogist
Alternate name- zinc spinel, as it is a member of the spinel group

A few faceted gems were reported in the 1960's, but the locality of origin was not certain. It was probably Brazil. In the 1970's, rough material came from Brazil. The recent material is a nice peridot green, which makes good, but dark gems. Gem material is presently very scarce, because the mine has been closed for a number of years. It is understood that the mine is being reopened.

GAHNOSPINEL (see spinel)

GARNET GROUP [granatus (L) - seed-like]

GAR-net

The garnets are highly variable, with many intermediate forms. Some contain much iron, while others normally contain none. However, it is common for nearly all species to contain at least a small amount. This can upset some tests. All gem garnets are isometric, none have true cleavage, though some do show a parting that resembles cleavage. All exhibit conchoidal fracture and a white or uncolored streak. They cannot be pleochroic, or doubly refractive; but some species show anomalous double refraction in the polariscope, due to internal strain. The above characteristics are deleted in the descriptive portions that follow.

The gem garnets have been divided into two sub-groups based upon the metals of the first and second radicals. These sub-groups are: PYRALSPITE- pyrope, almandine, and spessartine, (aluminum as the second radical); and UGRANDITE- uvarovite, grossular, and andradite, (calcium as the first radical). Members of each sub-group may mix in almost any amount, but mixture between members of the two groups is evidently limited to no more than ten percent. Recent investigations have shown the garnet group to be more varied than was thought. New species of rare occurrence have been found. The massive jade-like material from South Africa that for many years was classified as a variety of grossular is now the species hydrogrossular.

Following are other members of the garnet group not described in the following pages. Most are very rare, but these may some-day have gem significance. The information as to how they might fit into either sub- group is incomplete.

VARIETIES:

Calderite (CALL.der-ite) - Manganese calcium iron aluminum silicate; crystals dark reddish brown. No gem significance.
Goldmanite (GOLD-man-ite) - Calcium vanadium silicate; crystals .02 mm, dark green. Recorded only from near Albuquerque, New Mexico; no gem significance.
Henritermeirite (henry-TER-me-er-ite) - Calcium manganese silicate; is sometimes classed as a garnet. It is tetragonal and is really only closely related. Recorded only from Morocco.
Hydrougrandite (high-dro-oo-GRAND-ite) - Basic calcium magnesium iron aluminum silicate; small green grains. Recorded only from China; no gem significance.

Garnet Group continued on next page.

Kimseyite (KIM-see-ite) - Calcium zirconium titanium aluminum silicate; crystals 1 mm, dark brown. Recorded only from Magnet Cove, Arkansas; no gem significance.
Knorringite (NOR-in-jite) - Magnesium chromium silicate; minute grains; forms a series with pyrope. Recorded only from a Lesthoso (Africa) kimberlite; no gem significance.
Majorite (MAJOR-ite) - Magnesium iron aluminum silicate; minute purple grains. Recorded only from an Australian meteorite; no gem significance.
Schorlomite (SHORE-low-mite) - Calcium iron titanium silicate; black masses; forms a series with andradite Recorded from Magnet Cove, Arkansas and British Columbia, Canada It is possible that schorlomite gems exist, thought to be melanite.

GARNET GROUP, PYRALSPITE (sub-group)

pie- RALL-spite

PYROPE (Garnet Group – Pyralspite Subgroup)

PIE-rope

Magnesium aluminum silicate
$Mg3Al_2 (SiO_4)_3$
Habit- usually massive
Hardness- 7.25
Specific gravity- 3.65 to 3.80
Inclusions- seldom included; then with small needles, making a star gem

Color- Intense red, purplish-red, brownish-red
RI- n-1.714 to 1.73 sometimes higher
Critical angle- 35°
Dispersion- .023, medium
Transparent to translucent
Luster- vitreous
Name- *pyr* & *ops* (Gr)- fire & eye

Pyrope is normally an intense red, and rarely appears in lighter shades The intense color precludes against gems much larger than two carats in weight. The usual size of the rough pieces will ordinarily not allow a gem much larger. Pyrope contains needle inclusions and is rarely starred. The color of pyrope is attributed to an impurity of chromium. Pure pyrope (if it existed) would be colorless. Arizona has been a good source of small deep colored rounded pebbles. East Africa has begun to produce medium deep colored material.

ALMANDINE (Garnet Group – Pyralspite Subgroup)

AL-man-dean

Iron aluminum silicate
$Fe_3Al_2 (SiO_4)_3$
Habit- dodecahedral, trapezohedral
Hardness- 7 to 7.5
Specific gravity- 3.95 to 4.25
Inclusions- zircon, hornblende, rutile, regularly diseminated small crystals, lumps of unknown material

Color- Red, purplish-red, brownish-red
RI- n-1.78 to 1.83
Critical angle- 34.5°
Dispersion- .024, medium
Transparent to opaque
Luster- vitreous to sub-adamantine
Name- from Alabanda, a town in Asia Minor, probably the first source
Alternate name- almandite

VARIETIES:
Carbuncle - a name given to any cabochon-cut deep red garnet; these are usually almandine
"***Kandy spinel***" - is an incorrect name for Sri Lanka almandine

This is the commonest of the garnets. It often contains rutile needles oriented in two planes and produces a four-rayed star. Rarely, the star may be six-rayed. Almandine occurances are widespread. Excellent faceting material comes from India, Brazil, and East Africa. A fine star material comes from Idaho.

RHODOLITE (Garnet Group – Pyralspite Subgroup)

ROAD-oh-lite

Two parts pyrope and one part almandine (variable)
Habit- usually massive
Hardness- 7.25
Specific gravity- 3.74 to 3.94 (3.84)
Inclusions- often many short needles

Color- Red, rose-red to violet
RI- n-1.75 to 1.77
Critical angle- 34.5°
Transparent to translucent
Luster- vitreous
Name- *rhodo* (Gr) - pink

The mixture is not always constant, and variations are reflected in differences in color, specific gravity, and RI. When the color is a medium-hue violet, it produces spectacular gems. This variety may also contain needle inclusions. Rhodolite is not part of the pyralspite sub-group acronym, but the fact that it is predominantly a mixture of pyrope and almandine places it there. East Africa has produced excellent red to violet material. North Carolina and other localities have produced small amounts.

GARNET GROUP, PYRALSPITE Cont.

SPESSARTINE (Garnet Group – Pyralspite Subgroup) SPESS-are-tine

Manganese aluminum silicate
$Mn_3Al_2(SiO_4)_3$
Habit- dodecahedrons
Hardness- 7.25
Specific gravity- 3.8 to 4.25
Inclusions- random veils

Color- Orange, red, brownish-red, brown
RI- n-1.79 to 1.81
Critical angle- 33.5
Dispersion- .027, medium
Transparent to opaque
Name- for Spessart, Bavaria; probably the first location
Alternate name- spessartite

Spessartine is not a common garnet. The finest faceting material is usually of pegmatite origin. When the material is clear and has excellent optical properties, it produces fine gems. Brazil and Nigeria are the largest suppliers, but fine material also comes from Namibia. East African countries are also producers. California and Virginia have produced excellent material in the past.

GARNET GROUP

MALAYA (Garnet Group) ma-LIE-ah

45% pyrope, 45% spessartine, & 10% grossular
Habit- usually water worn pebbles
Hardness- 7.25
Specific gravity- 3.84 to 3.88
Inclusions- random veils and cracks

Color- Orange to red-orange
RI- n-1.75 to 1.77
Critical angle- 34.5°
Transparent to translucent
Luster- vitreous
Name- from a Swahili (Tanzania) word for "out of the family"

Presently there is much controversy about this garnet variety. The name arose from the practice of setting these aside when sorting the Umba River gravels for rhodolite. The orange pieces were thought of no value and thus discarded. A colloquialism of the word is its use for reference to a prostitute. The Tanzanian government has voiced an objection to the use of the name. The name is not the only source of controversy. Specific gravity and refractive index evidently vary somewhat more than the figures given above. However, these extreme variations may, at least in part, be due to material that really is not a true malaya. On the other hand, it is doubtful that the true malaya characteristics have been determined.

Another reason for some of the confusion is that this variety bridges the Pyralspite-Ugrandite groupings. At one time this was thought to be impossible. To add even more confusion, a photochroic garnet (with a color change very close to alexandrite) with almost the exact percentages given above, plus .05 to 1% chromium oxide and .3 to 2% vanadium oxide, has also been found in Tanzania. In spite of all the controversy, and the resultant confusion, this is an excellent gem material, with a color range that has been difficult to find in other materials. This garnet, actually a variety, is not included in the pyralspite acronym, but as its makeup is 90% of two members of the group, it is included here. As stated above, this can be considered as a bridge between this group and the one following. All inconsistencies strongly point out that the garnet group is highly variable in many ways, and, for the present at least, they defy any rigid and orderly classification.

Probably, the simplest solution to this portion of the garnet group is to call the unknown specimens pyralspite garnet. This is already being done by some of the gem dealers. Some specimens are part of a pyrope-almandine series, others are in a pyrope-spessartine series. Only a chemical or spectroscopic examination (or both) would give a positive determination. It then appears that using pyralspite would not only simplify the problem, but it might be the most accurate term.

GARNET GROUP, UGRANDITE (sub-group) oo-GRAND-ite

UVAROVITE (Garnet Group – Ugrandite Subgroup) oo-VAHR-oh-vite

Calcium chromium silicate
$Ca_3Cr_2(SiO_4)3$
Habit- dodecahedral
Hardness- 7.5
Specific gravity- 3.40 to 3.8
Inclusions- numerous veils and cracks which make crystals opaque

Color- Emerald green
RI- n-1.87
Critical angle- 32°
Opaque, transparent in small crystals
Luster- vitreous to adamantine
Name- for S. S. Uvarov, a Russion collector

This is the rarest of all garnets, crystals are usually very small. Chromium, as part of the molecule, is given credit for the fine green color. This is a very different situation from pyrope, which is colored red from chromium. Uvarovite gems are virtually unknown. A chromium grossular (Canada) has been mistaken for uvarovite. Finland produces excellent uvarovite crystals, but very few (if any) have clear areas. Some chromium mines in the Mother Lode district of California produce clear crystals, but these measure less than a millimeter.

GARNET GROUP, UGRANDITE Cont.

GROSSULAR (Garnet Group – Ugrandite Subgroup) GRAHS-you-lar

Calcium aluminum silicate
$Ca_3Al_2(SiO_4)_3$
Habit- dodecahedral, massive
Hardness- 7.25
Specific gravity- 3.5 to 3.75 (3.6)
Inclusions- numerous cracks, some small crystals such as diopside

Colorless, green, pink, orange, brown
RI- n-1.734 to 1.75
Critical angle- 35°
Dispersion- .027, medium
Transparent to translucent
Luster- vitreous
Name- *grossularia* (L) - gooseberry
Alternate name- grossularite

VARIETIES:

Hessonite (essonite) - orange-red to orange-brown, pinkish-orange. Also called "cinnamon stone". [*hesson* (Gr) - low hardness). The first good gem material came from Sri Lanka and shows a swirl pattern under low magnification. It also may show anomalous double refraction. Hessonite from other locations seldom shows the swirl pattern.

"***Succinite***" - amber colored; this is an incorrect name [*succinum* (L) - amber]

Tsavorite - light to deep green; colored by vanadium impurities. [for the Tsavor National Park in Kenya, near which it appears). Tsavorite, a green grossular (vanadium colored), is very popular.

Xalostocite - pink crystals in marble [for Xalostos, Mexico, where it is found]

The first crystals found (in Siberia) were greenish, resembling gooseberries, thus the species name. East African material has made fine gems. An Afghanistan material is fairly new on the market, but is not as nice as the African material. East Africa also produces a golden to yellowish, to nearly colorless material. A Canadian material is colored green by chromium, but has not been of gem significance. Canada also produces good pink-orange and rarely a colorless grossular.

Grossular has a tendency to not mix with other garnet molecules and usually is a reasonably pure molecule. This allows for substitution of other ions (such as vanadium and chromium) that tend to produce the many color varieties. Grossular, however, does mix with idocrase; then called californite. This mixing is somewhat variable, and some californite may not contain grossular.

HYDROGROSSULAR (Garnet Group – Ugrandite Subgroup) HYDRO-gross-you-lar

Hydrous calcium aluminum silicate
$Ca_3Al_2(SiO_4)_3\text{-}x(OH)_{4x}$
Isometric
Habit- massive, crystals octahedral, usually minute
Specific gravity- 3.0 to 3.3
Fracture- uneven conchoidal
Inclusions- magnetite blobs, idocrase crystals, opacity due to many veils

Colorless, white, pink, green, brown
RI- n-1.675 to 1.734
Critical angle- 37°
Translucent to opaque (transparent?)
Luster- vitreous to greasy
Name- from the hydroxyl radical (OH) and its resemblance to grossular
Incorrect name- Transvaal Jade

This species has long been assumed to be grossular. Undoubtedly some gems of this material are in collections listed as grossular. The best known example of this mineral is the jade-like massive material from South Africa. This massive material is an excellent cabochon material, but the supply is. presently very limited. Crystals, in sizes up to three-quarters of an inch, and massive material have been found at Crestmore, Riverside County, California. This mineral also appears with the jadeite in San Benito County, California. Some of the material from South Africa may be mixed with idocrase, and perhaps better called californite (see idocrase).

GARNET GROUP, UGRANDITE Cont.

ANDRADITE (Garnet Group – Ugrandite Subgroup)

AND-ruh-dite

Calcium iron silicate
$Ca_3Fe_2(SiO_4)_3$
Habit- dodecahedral, trapezohedral
Hardness- 6.5
Specific gravity- 3.70 to 4.1
Inclusions- byssolite fibers in demantoid, veils in all types

Color- Yellow, green, brown, black
RI- n-1.85 to 1.89
Critical angle- 32°
Dispersion- .057, (demantoid) strong
Transparent to opaque
Luster- vitreous to adamantine
Name- for J. B. DeAndrade, Portuguese mineralogist

VARIETIES:

Colophonite - coarse, resinous, massive sometimes iridescent [*kolophonia* (Gr) - resin; for Colophon, a town in Asia Minor that produced resin]

Demantoid - yellowish-green to intense green [*demant* (Dutch) - diamond]. Demantoid is a very excellent gem with strong dispersion. It always contains "horsetails" of byssolite, a form of actinolite. Russia and Italy have produced excellent demantoid. In 1985, a discovery of demantoid was made in a remote area of Mexico. At the time of this writing, only a few very small gems had been cut. Crystals viewed by the authors indicate that the deposit has real promise for good gems.

Melanite - black [*melanos* (Gr) - black]

Topazolite - a fine yellow, resembling topaz. This is really a poor name. Topazolite makes a good gem, but lacks the high dispersion of demantoid.

Andradite is a highly variable garnet for nearly all characteristics, and is not commonly encountered. Many localities produce andradite, but very few gem pieces are found. Recently, a unique massive form of andradite has been discovered in San Benito County, California. This is a pseudomorph after asbestos that can be cut into nice yellow cabochons that closely resemble tigereye in texture.

GASPEITE

GAS-pee-ite

Nickel magnesium iron carbonate
$(Ni\ Mg\ Fe)\ CO_3$
Trigonal
Habit- hexagonal scalenohedral, massive
Hardness- 4 to 5
Specific gravity- 3.71
Cleavage- subconchoidal to conchoidal
Fracture- uneven
Streak- yellow-green

Color- Chartreuse to yellow-green
RI- 1.61-1.83
Critical angle- 36°
Birefringence- .220
Pleochroism- weak
Translucent to opaque
Luster- Vitreous, Dull
Optically- uniaxial negative
Name- for locality Gaspe Penninsula, Quebec, Canada

Transparent material large enough to facet is unknown to the authors. It is commonly cut into cabochons and beads. Gaspeite may be somewhat porous and can contain small vugs. Therefore some material is put through a stabilizing treatment similar to what is often done with turquoise. Nearly all gaspeite on the market comes from western Australia.

GEYSERITE (see opal)

GILSONITE (uintaite)

GILL-son-ite, YOU-in-tah-ite

A variety of asphalt
A hydrocarbon
Habit- massive
Hardness- 2 to 2.5
Specific gravity- 1.065 to 1.07
Cleavage- none
Fracture- uneven, brittle
Streak- black

Color- Black
Opaque
Luster- dull
Name- for S. H. Gilson

The name gilsonite is actually a trade name for the asphalt uintaite [for Utah]. Utah produces chunks of this material. It produces lusterless cabochons, but evidently has a potential for carving. This material is used to make paint, varnish, and ink.

GMELINITE (see chabazite)

GOETHITE & LIMONITE

GUR-tite, LIME-on-ite

Hydrous iron oxide
$Fe_2O_3 \cdot H_2O$
Orthorhombic
Amorphous colloid- limonite
Habit- prismatic, pseudomorphous
Hardness- 5 to 5.5
Specific gravity- 3.6 to 4.28
Cleavage- perfect (goethite), one direction
Fracture- uneven
Streak- yellowish-brown

Color- Yellowish, reddish, brown
RI- X-2.260, Y-2.393, Z-2.398
Birefringence- .13, strong
Pleochroism- weak
Translucent to opaque, goethite is often blood-red by transmitted light
Luster- earthy, goethite may be sub-adamantine
Optically- biaxial negative (goethite)
Names- for Goethe, a German poet; *leimon* (Gr) - meadow

Goethite in the fibrous form makes interesting, nearly chatoyant cabochons. Many of the pseudomorphs, usually after pyrite, that were thought to be limonite, have been shown to be goethite. Limonite has been removed from species status, and is the name for a group. Massive and pseudomorphic materials are widespread. Colorado produces a nice fibrous material.

GOLDMANITE (see Garnet Group)

GOSHENITE (see beryl)

GRANDIDIERITE

gran-DID-ee-er-ite

Magnesium iron aluminum boro-silicate
$(Mg, Fe)Al_3BSiO_9$
Orthorhombic
Habit- usually massive
Hardness- 7.25
Specific gravity- 2.97 to 3.0
Cleavage- distinct, one direction
Fracture- uneven, brittle
Streak- white ?

Color- Bluish-green
RI- X-1.602, Y-1.636, Z-1.639
Critical angle- 38°
Translucent
Luster- vitreous
Trichroic- blue-green, colorless, dark green

This material is known only from Madagascar. Cabochons are dark and not spectacular.

GRANITE & GRAPHIC GRANITE

GRAF-ick GRAN-it

Granite has been polished into building stone and headstones for many years. Sometimes it is mixed with other colorful minerals such as chrysocolla, and has been cut into interesting cabochons. [Name- granum (L) - seed or grain]

Graphic granite is common in pegmatites. It is basically a feldspar (usually microcline) with enclosed quartz crystals. The feldspar crystalization interfered with the growth of the quartz crystals to the point that they have been distorted to resemble cuneiform letters. This material is often made into book ends, and on occasion into striking cabochons. The lapidary potential appears to have been mostly neglected. [Name- graphe (Gr) - writing] Neither of these materials takes a high polish because of the differential in hardness between the component materials.

GROSSULAR (see Garnet Group – ugrandite subgroup)

GRAHS-you-lar

GYPSUM

GYP-sum

Hydrous calcium sulfate
$CaSO_4 \cdot 2H_2O$
Monoclinic
Habit- prismatic, twins, massive
Hardness- 2
Specific gravity- 2.31 to 2.33
Cleavage- perfect, one direction
Fracture- conchoidal, fibrous
Streak- white
Inclusions- mud, veils, cleavage cracks

Colorless and various pastel shades
RI- X-1.520, Y-1.523, Z-1.530
Critical angle- 41°
Birefringence- .01, medium
Dispersion- may be strong
Transparent to opaque
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 58°
Name- *jibs* (Ar) - plaster; to *gypsos* (Gr) - chalk

VARIETIES:

Alabaster - various shades, granular [*alabastros* (Gr) - a town in Egypt]. A popular carving medium. Alabaster is best known from Egypt, but is found in Colorado & Utah as well as other locations.

Common gypsum - white, earthy

Satin spar - silky, fibrous, usually white or colorless. It is sometimes carved or made into cabochons; and can also be found dyed.

Selenite - pure crystalized gypsum, usually colorless [*selenites* (Gr) - moon]. the faceting of clear selenite has been attempted; any success has not been reported. Found in may locations.

Gypsum differs from anhydrite (page 7) in that it contains water in its molecule; anhydrite has no water and can be termed anhydrous.

HACKMANITE (see sodalite)

HALITE

HAY-lite

Sodium chloride (common salt)
NaCl
Isometric
Habit- cubic, rarely octahedral
Hardness- 2
Specific gravity- 2.16
Cleavage- perfect, three directions
Fracture- conchoidal
Inclusions- water in negative crystals

Colorless, (blue), (purple), (pink)
RI- n-1.5443
Critical angle- 40°
Transparent to translucent
Luster- vitreous
Name- *halos* (Gr) - salt. Halite is the mineral name for ordinary table salt.

In spite of its solubility in water, halite has been faceted. Gems are not very stable or interesting, but the simple fact that it has been faceted is interesting. Colorless material is found worldwide. Germany has produced a fine purple material, and New Mexico and Arizona have produced a fine blue.

HAMBERGITE

HAM-berg-ite

Beryllium borate
$Be_2BO_3(OH)$
Orthorhombic
Habit- prismatic
Hardness- 7.5
Specific gravity- 2.347
Cleavage- perfect, two directions
Fracture- conchoidal to uneven
Streak- uncolored
Inclusions- many cleavage plane cracks

Colorless, yellowish, grayish
RI- X-1.554, Y-1.558. Z-1.628
Critical angle- 39.5°
Birefringence- .074, strong
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 87°
Name- for Alex Hamberg, Swedish mineralogist

Hambergite is usually flawed due to the perfect cleavage, thus flawless gems are unusual. The cleavages are also a problem during cutting. Madagascar has been the only source of facetable material. Hambergite gems are not very brilliant.

HAUYNE (Sodalite Group)

how-AIN

Sodium aluminum calcium sulfo-silicate
$(Na, Ca)_{4\text{-}8}Al_6Si_6O_{24}(SO4)_{1\text{-}2}$
Isometric
Habit- dodecahedral, octahedral, grains
Hardness- 5.5 to 6
Specific gravity- 2.44 to 2.5
Cleavage- distinct, six directions
Fracture- conchoidal
Streak- white to bluish
Inclusions- usually filed with veils

Color- Yellow, blue, greenish-blue, (red)
RI- n-1.496 to 1.505
Critical angle- 42°
Transparent to translucent
Luster- vitreous
Name- for Rene Just Hauy, French mineralogist
Alternate name- hauynite

This is an extremely rare mineral, but makes a good gem when clear. Blue is the most desired color. It is one of the minerals that compose lapis lazuli. Germany has produced very small clear pieces. Recently, fine deep azure blue material has been cut into small gems.

HEDYPHANE (Apatite Group)

HEADY-fane

Calcium lead chloro-arsenate
$(Ca,Pb)_5(AsO_4)_3Cl$
Hexagonal
Habit- prismatic crystals, massive
Hardness- 4.5
Specific gravity- 5.82
Cleavage- one direction, not troublesome
Fracture- subconchoidal, brittle
Streak- white

Color- White, brownish, yellowish, bluish
RI- 1.948 to 1.958 (unimportant)
Translucent
Luster- bright, to greasy to resinous
Name- *hedys* & *phainesthai* (Gr) - sweet and bright; in reference to the luster

Mexico has produced a marbled white material that can be cut into bright cabochons.

HELIODOR (see beryl)

HENRITERMEIRITE (see Garnet Group)

HEMATITE GROUP (see individual minerals)

CORUNDUM - HEMATITE

HEMATITE (Hematite Group)

HEM-ah-tite

Iron oxide
Fe_2O_3
Hexagonal
Habit- rhombohedral, botryoidal
Hardness- 5.5 to 6.5
Specific gravity- 4.9 to 5.3 (5.1)
Cleavage- poor
Fracture- conchoidal
Streak- red, reddish-brown

Color- Iron black, steel gray
RI- 2.94 to 3.22
Opaque
Luster- metallic
Name- *haimatites* (Gr) - bloodlike, from the red streak
Incorrect name- "black diamond"

VARIETY:
Turgite - from the Turginisk Mine in Russia, where it was first found. It is a fibrous variety found in Connecticut. It can be cut into cabochons that show chatoyance.

This opaque material is cut as tablets, intaglios, and cabochons. Gems are very splendent. Red cuttings cover hands and clothing during grinding.

HEMIMORPHITE

hem-th-MORE-fite

Zinc silicate
$Zn_4Si_2O_7(OH)_2 \cdot H2O$
Orthorhombic, hemimorphic
Habit- prismatic, tabular
Hardness- 4.5 to 5
Specific gravity- 3.4 to 3.5
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Inclusions- hematite powder, veils, etc.

Colorless, yellow, blue-green, (red)
RI- X-1.614, Y-1.617, Z-1.636
Critical angle- 38°
Birefringence- .022, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 46°
Name- *hemi* & *morphe* (Gr) - half & form; in reference to the single termination
Alternate name- calamine, [*kadmeia* (Gr) - earth]

Recently, colorless crystals large enough to facet have been found in Mexico. The gems are not spectacular, and have been cut only for collectors. An excellent blue-green massive material comes from Mexico. It makes excellent cabochons that closely resemble smithsonite. Compare smithsonite, page 92. The close resemblance of hemimorphite and smithsonite in the massive form led early day miners to confuse them, resulting in the name calamine being given to both of them. Where the reference to earth comes from is not clear.

HERDERITE (hydroxyl-herderite)

HER-der-ite

Beryllium calcium fluophosphate
$CaBePO_4(F, OH)$
Monoclinic
Habit- prismatic, massive
Hardness- 5 to 5.5
Specific gravity- 3.0
Cleavage- interrupted, one direction
Fracture- subconchoidal
Streak- white
Inclusions- numerous cracks and veils, seldom clear

Color- Yellowish, greenish, blue, purple
RI- X-1.592, Y-1.612, Z-1.621
Critical angle- 38°
Birefringence- .029, medium
Dispersion- weak
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 74° approximately
Name- for S. A. W. von Herder, German mining official

Herderite forms a series with hydroxyl-herderite. The difference between the two is the amount of fluorine (F) versus the hydroxyl (OH) radical. That with an excess of fluorine is herderite; that with a hydroxyl excess is hydroxyl-herderite. This appears to be splitting hairs, but it has been found that herderite is extremely rare and virtually all known specimens are hydroxyl-herderite. The name herderite is used here because of precedent. Brazil has produced excellent specimens in recent years. Some of these have contained clear areas that have been cut into faceted gems.

HIDDENITE (see spodumene)

HODGKINSONITE

HODGE-kin-son-ite

Hydrous zinc manganese silicate
$MnZn_2SiO_5 \cdot H_2O$
Monoclinic
Habit- pyramidal, prismatic
Hardness- 4.5 to 5
Specific gravity- 3.91
Cleavage- perfect, one direction
Fracture- conchoidal
Streak- white
Inclusions- veils and cracks

Color- Pink, reddish-brown
RI- X-1.724, Y-1.742, Z-1.746
Critical angle- 35°
Birefringence- .022, medium
Dispersion- weak
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 50° to 60°
Name- for H. H. Hodgkinson, American mineralogist

A very rare mineral, cut on occasion for collectors. New Jersey has produced a small amount of cabochon material.

HOLTITE

HOLT-ite

Aluminum tin tantalum boron silicate
$Al_6(Ta,Sb,Li)\ [(Si,As)O_4]_3(BO_3)(O,OH)_3$
Orthorhombic
Habit- pseudohexagonal, massive
Hardness- 8.5
Specific gravity- 3.9
Cleavage- distinct, one direction
Fracture- uneven
Color- Greenish, brownish to brown
RI- X-1.743, Y-1.758, Z-1.761
Opaque
Luster- vitreous to resinous to dull
Name- for Harold Holt, former Prime Minister of Australia

This is a one-location mineral that is found in alluvial deposits in Australia. It has been cut into cabochons.

HORNBLENDE (Amphibole Group)

HORN-blend

A complex iron aluminum silicate
$(Ca, Na)_{2-3}(Mg, Fe)_5Al_6Si_8O_{22}(OH)_2$
Monoclinic
Habit- long prismatic, pseudohexagonal
Hardness- 5 to 6
Specific gravity- 3.02 to 3.47
Cleavage- perfect, one direction; parting, two directions
Fracture- uneven to subconchoidal
Streak- dark
Inclusions- evidently only cracks in the clear material
Color- Green, bluish-green, yellow, black
RI- X-1.615, Y-1.618, Z-1.632
Critical angle- 38°
Birefringence- .017, medium
Translucent to opaque
Luster- vitreous to silky
Optically- biaxial positive
Name- *horn* (Gr) - horn is the same as in English. Also - *blende* (Gr) - dazzle; evidently from the brilliant cleavage faces

On occasion, crystals are solid enough to be cut into dark green or black cabochons. They do not have an exciting potential. Occurances are widespread. A fine clear golden to brown facetable hornblende has recently been found in Canada as very small pieces. If these were larger, it could become a popular gem material. The Canadian material is evidently very low in iron. The cleavage (or parting plane?) can be very troublesome during cutting.

HOWLITE

HOW-lite

Calcium silico-borate
$Ca_2B_5SiO_9(OH)_5$
Monoclinic
Habit- rounded nodules
Hardness- 3.5
Specific gravity- 2.58
Fracture- subconchoidal
Streak- white
Color- White with black veining
RI- 1.596 (mean)
Opaque
Luster- dull
Name- for H. How, Canadian professor

This massive material is suitable for carvings and cabochons. The cabochons are lusterless, but the black veining imparts an interesting pattern. California has produced excellent massive material. Howlite is often dyed to simulate turquoise.

HUEBNERITE (also hubnerite)

HUEB-ner-ite

Manganese tungstate
$MnWO_4$
Monoclinic
Habit- prismatic to tabular
Hardness- 4 to 4.5
Specific gravity- 7.18
Cleavage- perfect, one direction
Fracture- uneven, brittle
Streak- yellow to reddish-brown
Inclusions- none (?)
Color- Black, reddish-brown, yellowish-brown
RI- X-2.17, Y-2.22, Z-2.3
Critical angle- 28°
Transparent to opaque
Luster- metallic
Optically- biaxial positive
2V angle- 73°
Name- for Adolph Hubner, German metallurgist

In recent years a deposit of transparent deep red huebnerite was found in one of the Peruvian mines. This was the first known occurance of the mineral in gemmy transparent crystals. The color is very deep and faceted gems are nearly opaque unless they are well under 5 mm in depth. The largest crystals seen by the authors were .25 inch or less in width. The small size is usually within the limitations for a clear gem. These crystals should have potential for cabochons also, but none have been observed to date. The brittleness of the material might make cabochon cutting somewhat difficult.

HUMITE GROUP (see individual minerals)

CHONDRODITE - CLINOHUMITE - LEUCOPHOENICITE

HUREAULITE

who-ree-ALL-ite

Hydrous manganese iron phosphate
$H_2(Mn,Fe)_5(PO_4)_4 \cdot 4H_2O$
Monoclinic
Habit- long prismatic groups
Hardness- 3.5
Specific gravity- 3.19
Cleavage- good, one direction
Fracture- uneven, brittle
Streak- nearly white
Inclusions- lines from crystal growth interference
Color- Rose, yellow, orange, brown
RI- X-1.657, Y-1.667, Z-1.671
Critical angle- 38.5°
Birefringence- .014, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 75°
Name- for Hureaux, France; the type location

This is a very rare mineral. Brazil has recently produced small crystal groups that are very clear and are facetable. The junctions between crystals in the groups appear to be well bonded. The rose color is interesting.

HYDROGROSSULAR (see Garnet Group – ugrandite subgroup)

HYDRO-gross-you-lar

HYDROUGRANDITE (see Garnet Group)

HYDROXYLAPATITE (see apatite)

HYDROXYLHERDERITE (see herderite)

HYDROZINCITE

high-dro-ZINC-ite

Basic zinc carbonate
$Zn_5(CO_3)_2(OH)_6$
Monoclinic
Habit- massive, fibrous, earthy
Hardness- 2 to 2.5
Specific gravity- 3.58 to 3.8
Cleavage- none
Fracture- uneven, very brittle
Streak- white
Color- White, grayish, yellowish
RI- X-1.635, Y-1.736, Z-1.750
Translucent to opaque
Luster- silky to pearly
Name- *hydor* (Gr) - water; for the hydroxyl (OH) radical, and the zinc in its molecule

The massive material can be cut into white or off-white cabochons that are uninteresting. The mineral is found world-wide, but Nevada is the best source.

HYPERSTHENE (see enstatite)

HY-pers-thene

IDOCRASE

EYE-doe-crase

Calcium magnesium aluminum silicate
$Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$
Tetragonal
Habit- prismatic, massive
Hardness- 6.5
Specific gravity- 3.35 to 3.45 (3.4)
Cleavage- distinct, three directions
Fracture- subconchoidal
Streak- white
Inclusions- numerous veils and cracks in transparent material
Color- Yellow, green, brown, (blue)
RI- O-1.703 to 1.752, E-1.700 to 1.746
Critical angle- 35.5°
Birefringence- .005, weak
Dichroism- weak to distinct
Dispersion- .019, medium
Transparent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- *eidos* & *krasis* (Gr) - form & mixture; it resembles other minerals
Alternate name- vesuvianite; for the Mt. Vesuvius volcano

VARIETIES:
Californite, " California jade"- mottled greenish, massive jade-like material
Cyprine- light blue (very rare) [for the isle of Cyprus]
Xanthite- transparent yellow-green [*xantho* (Gr) - yellow]

This mineral is best known as the jade substitute. It is not common in faceting quality, but faceted gems are very good. East Africa and Canada have produced good faceting material. Californite is from California, Pakistan, and South Africa.

INDERITE & KURNAKOVITE

IN-derr-ite, curr-nah-KOFF-ite

Hydrous magnesium borates
$Mg_2B_6O_{11}•15H_2O$
Inderite- monoclinic
Kurnakovite- triclinic
Habit- prismatic
Hardness- 2.5
Specific gravity- 1.78 and 1.86
Cleavage- perfect, two directions
Fracture- conchoidal to uneven
Streak- white
Inclusions- mud and water-filled cavities

Colorless
RI- X-1.488, Y-1.491, Z-1.505 (both)
Critical angle- 42°
Transparent to translucent
Luster- vitreous
Optically- biaxial positive, inderite; biaxial negative, kurnakovite
2V angle- approximately 35°
Names- Inder, a Russian provence & a Russian named Kurnakov

These two similar materials have been cut by some lapidaries. Unless carefully dried and protected after cutting, the surface will become cloudy. A borax mine in California has produced clear pieces of both minerals.

INDICOLITE (see Tourmaline Group – elbaite-dravite series)

IOLITE (cordierite) (dichroite)

EYE-oh-lite, CORD-ee-air-ite, DIE-crow-ite

Magnesium aluminum silicate
$Mg_2Al_4Si_5O_{18}$
Orthorhombic
Habit- usually massive, crystals rare
Hardness- 7 to 7.5
Specific gravity- 2.55 to 2.75 (2.63)
Cleavage- distinct to indistinct, three directions
Fracture- subconchoidal
Streak- colored
Inclusions- numerous veils of bubbles, hematite platelets, others

Color- Light to dark blue, yellowish, colorless
RI- X-1.544, Y-1.548, Z-1.550 (approx.)
Critical angle- 40°
Birefringence- .006 (approx.),weak
Trichroism strong; colorless, yellow, blue
Transparent to translucent
Luster- vitreous
Optically- biaxial positive or negative
2V angle- 40° to 84°
Names- *ion* (Gr) - violet, for the color; for P.L.A. Cordier, French geologist; *dichros* (Gr) - two colors
Alternate names- cordierite, dichroite

The strong trichroism is striking. The fine blue color is its only real attribute. "Bloodshot" iolite is a variety that contains parallel platelets of hematite. Madagascar, India, and East Africa have produced good clear material. Cordierite is the name for the mineral; iolite is a gem name.

IVORY

EYE-vory

Organic substances
Hardness- approx. 2.5
Specific gravity- 1.7 to 1.98 (dentine)
1.38 to 1.42 (vegetable)
Fracture- subconchoidal
Streak- white

Color- White to yellowish-white
Opaque
Luster- waxy
Name- *eboreus* (L) to *ivor* (Fr) - ivory

VARIETIES:

Dentine ivory - teeth, tusks, or horn, a form of hydroxylapatite $Ca_3OH_2\ (PO_4)_6$. Dentine is the most popular carving medium, but horn is used fairly frequently.

Horn - is used commonly by many artists in countries frequented by tourists. The horns of cattle are the most common. The horn of some birds and other mammals are also used; resulting in the near extinction of some of these species.

Vegetable ivory - a carbohydrate, $C_6H_{10}O_5$, is the seed of palm trees. The corozo or tagua nut is from a South American palm. Another source is the doom (doum) palm of Africa. These nuts can be made into nice carvings.

JACOBSITE (Spinel Group)

JAY-cob-site

Manganese iron magnesium oxide
$(Mn, Fe, Mg) (Fe,Mn)_2O_4$
Isometric
Habit- usually massive, octahedral
Hardness- 5.5 to 6.5
Specific gravity- 4.76
Cleavage- none, suspected parting
Fracture- uneven to subconchoidal
Streak- brown

Color- Black
RI- n-2.3 (unimportant)
Opaque
Luster- metallic
Weakly magnetic
Name- for Jacobsberg, Sweden; the type locality

Jacobsite is a rare mineral, closely related to magnetite. It is found in very few localities. A recent find is in the state of Washington. This material can be cut into splendent black cabochons.

JADEITE (jade in part) (see nephrite) (Pyroxene Group)

JADE-ite

Sodium aluminum silicate
$NaAlSi_2O_8$
Monoclinic
Habit- massive crystaline aggregate
Hardness- 6.5 to 7
Specific gravity- 3.2 to 3.5 (3.3)
Cleavage- none
Fracture- splintery
Streak- uncolored
Inclusions- some dark minerals such as magnetite

Color- White, gray, green, blue, purple, reddish, black
RI- 1.654 to 1.667
Critical angle- 37°, (unimportant)
Almost transparent to opaque
Luster- greasy to vitreous
Optically- biaxial positive
Name- *fade* (Sp) - pronounced HA-day - from Piedra de yjade- stone of the side; used for cure of pain in the side

VARIETY:
Chloromelanite - very dark green to black

This material is characterized by a slippery feel, a lack of cleavage, and extreme toughness. The toughness helps to make it wear well in jewelry. The polish is usually irregular (known as orange peel) due to many included impurities. It is a popular carving and cabochon medium. Burma is the best known source of jadeite. Other worldwide localities produce small amounts. California is a good source.

JET

A fossil coal, remains of plant life
Amorphous
Hardness- 2.5 to 4
Specific gravity- 1.3 to 1.35 (1.33)
Fracture- conchoidal, tough
Streak- black

Color- Black
Opaque
Luster- vitreous when polished, often brilliant on broken surface
Name- *gagates* (Gr) - from Gagat, a town in Asia Minor; to *jaeit* (Fr)

VARIETY:
Anthracite (hard coal) - [*anthrax* (Gr) - a burning coal]. Sometimes similar to jet, but usually brittle.

This material, a type of brown coal (lignite), is excellent for carving. It takes a high polish, and is surprisingly tough. Utah and New Mexico produce small amounts. Russian material is poor. Other world-wide locations produce small amounts.

JEREMEJEVITE

yehr-ah-MAY-yev-ite

Basic aluminum borate
$Al_6B_5O_{15}(OH)_3$
Hexagonal
Habit- long prismatic
Hardness- 6.5
Specific gravity- 3.28
Cleavage- none
Fracture- conchoidal
Streak- white
Inclusions- veils

Colorless, blue, greenish, (yellowish)
RI- O-1.653, E-1.640
Critical angle- 37.5°
Birefringence- .013, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative, sometimes biaxial negative
Name- for Pavel V. Jeremejev, a Russian mineralogist

This mineral is known from only two locations, Siberia and Namibia. The Namibia location has produced many fine clear, though small crystals. The blue material makes excellent gems. Only a few crystals were discovered in Siberia. The unusual optical behavior has been attributed to jeremejevite being of two parts; a core of normal material and a shell of another (once called eichwaldite). This, in spite of the fact that both are hexagonal, appears to give a third RI. It is possible that this mineral is not adequately described. Very recently, another find at the Namibia site produced very excellent crystals.

KAKORTOKITE

ka-COURT-toe-kite

A rock
Essentially a nepheline syenite
Habit- massive
Hardness- 5 to 6
Specific gravity- 2.7 to 2.8
Cleavage- none
Fracture- uneven
Streak- grayish

Color- Mottled black, white, red, green
Opaque
Luster- earthy
Name- from the Eskimo name for sea gull

This is a one-location material from the southern portion of Greenland. Here it is made into carvings and cabochons for tourists. The material is a unique mixture of nepheline- whitish; feldspar- whitish; sodalite-greenish; aegerine- dark green; arfvedsonite- green; and red crystals of eudailite. The combination makes an exceptionally colored gem material. It is better used for carvings, as the surface does not take a high polish. The color pattern, however, more than makes up for the lack of polish.

KAMMERERITE (kaemmererite) (Chlorite Group)

CAM-er-er-ite

Magnesium chromium aluminum silicate
$(Mg, Cr)_6AlSi_3O_{10}(OH)_8$
Triclinic
Habit- pseudohexagonal pyramids, massive
Hardness- 2 to 2.5
Specific gravity- 2.64
Cleavage- perfect, one direction
Fracture- flexible
Streak- purple
Inclusions- usually none in clear crystals

Color- Red to purplish-red
RI- X-1.597, Y-1.598, Z-1.599
Critical angle- 39°
Birefringence- .002, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
Name- for A. A. Kammerer, Russian scientist
Alternate name- chromian clinochlor

Kammererite displays very poor lapidary characteristics. Crystals of facetable size have been found in a chromium mine in Turkey. A few of these have been faceted. The massive material has been cut into very interesting cabochons. Good cabochon material has come from Maryland.

KIMSEYITE (see Garnet Group)

KINOITE

KEEN-oh-ite

Copper calcium silicate
$Cu_2Ca_2Si_3O_{10}{\cdot}2H_2O$
Monoclinic
Habit- elongated, tabular
Hardness- 5
Specific gravity- 3.16
Cleavage- good, two directions
Fracture- splintery in massive material
Streak- bluish

Color- Light to deep azure blue
RI- X-1.638, Y-1.665, Z-1.676
Critical angle- 37.5°
Birefringence- .038, strong
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
Name- for an early Southwestern Catholic missionary, Fr. Kino

This mineral is a fairly recent find in the Arizona copper mines. Virtually all specimens are crystalline and of interest only to mineral collectors. The crystals are usually very small. On occasion, the crystals have formed in tight masses that may be cut into deep blue cabochons. Such material should be considered very fragile and extra precautions should be taken during cutting. If larger crystals are found, they might be facetable, but the depth of color might preclude against brilliant gems.

KNORINGITE (see Garnet Group)

KORNERUPINE

corner-OO-peen

Magnesium aluminum boro-silicate
$Mg_3Al_{11}Si_5O_{11}B_5O_9(OH)$
Orthorhombic
Habit- massive, seldom as crystals
Hardness- 6.5
Specific gravity- 3.27 to 3.45 (3.3)
Cleavage- distinct, two directions
Fracture- conchoidal
Streak- uncolored
Inclusions- often has many veils and cracks, rarely has oriented needles

Colorless, yellow, green, purple, brown
RI- X-1.668, Y-1.68, Z-1.68 (Sri Lanka)
X-1.665, Y-1.676, Z-1.677 (others)
Critical angle- 37°
Birefringence- .012, medium
Trichroism- very distinct, light to dark
Dispersion- .018, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 20°
Name- for A. N. Kornerup, Danish geologist

Kornerupine is a rare material. Most faceted gems usually show only fair brilliance, due to the deep color. A star kornerupine is known. Madagascar has produced a good green, but it is dark. East Africa produces a nice light green to purple dichroic material, but pieces have been very small. Sri Lanka material is often light colored, making good faceted gems. Green cat's eye is found in Kenya.

KUNZITE (see spodumene)

KURNAKOVITE (see inderite)

KYANITE

KY-an-ite

Aluminum silicate
Al_2SiO_5
Triclinic
Habit- bladed, prismatic
Hardness- 4, 5, and 7
Specific gravity- 3.53 to 3.67
Cleavage- perfect, two directions
Fracture- splintery
Streak- white
Trimorphous with andalusite and sillimanite
Inclusions- many cleavage plane cracks, some veils

Colorless, blue, green, gray, also bi-colored
RI- X-1.715, Y-1.726, Z-1.732
Critical angle- 35.5°
Birefringence- .017, medium
Trichroism- distinct, light to dark
Dispersion- .011, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial negative
2V angle- 82°
Name- *kyanos* (Gr) - dark blue, for the usual color
Alternate names- cyanite, disthene, [*di* & *sthenos* (Gr) - double strength; from the assumed two hardnesses]

Kyanite is unique in that it has three hardnesses, one for each crystal axis. That of the end of the crystal is difficult to determine, thus it is often thought to have only two hardnesses. Hardness across a face is different than along the length. Transparent material produces good faceted gems, but is very rare. Some are bi-colored. Brazil and East Africa have produced nice clear material.

LABRADORITE (see Feldspar Group - plagioclase) LAB-ruh-door-ite

LAPIS LAZULI (see lazulite)

"LAPIS NEVADA" (see zoisite)

LARIMAR (see pectolite)

LAWSONITE

LAW-son-ite

Hydrous calcium aluminum silicate
$CaAl_2Si_2O_7(OH)_2 \cdot H_2O$
Orthorhombic
Habit- prismatic, tabular, massive
Hardness- 6
Specific gravity- 3.05 to 3.12
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- white
Inclusions- many veils and cracks

Colorless, pink, (blue)
RI- X-1.665, Y-1.674, Z-1.684
Critical angle- 37°
Birefringence- .019, medium
Transparent to translucent
Luster- vitreous to greasy
Optically- biaxial positive
2V angle- 76° to 87°
Name- for Andrew C. Lawson, American geologist

Facetable pieces of this mineral are very rare, and usually not flawless. In spite of the flaws, the gems can be interesting. The Coast Range Mountains of northern California are the most likely source of cutting material.

LAZULITE & SCORZALITE

LAZ-you-lite, SCORE-zah-lite

Iron and magnesium aluminum phosphates
Lazulite- $MgAl_2(PO_4)_2(OH)_2$
Scorzalite- $(Fe,Mg)Al_2(PO_4)(OH)$
Monoclinic
Habit- pyramidal, massive
Hardness- 5.5 to 6
Specific gravity- 3.05 to 3.39
Cleavage- indistinct, two directions
Fracture- uneven
Streak- white
Inclusions- many cracks, making gemmy pieces very small

Color- Blue, greenish
RI- X-1.612, Y-1.634, Z-1.643
scorzalite- X-1.633, Y-1.663, Z-1.673
Critical angle- 38°
Birefringence- .031 and .04, medium
Trichroism- distinct, blue to colorless
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 69°
Names- *lazuli* & *azul* (Ar) - heaven; also Evaristo Scorza, Brazilian mineralogist
Incorrect name- "false lapis"

These two minerals are end members of a series and are usually opaque. Lazulite is the best known and has appeared as transparent faceting material in the past. Only recently has scorzalite been found in clear facetable pieces. Each has the potential of producing excellent gems. Brazil is the only known source for facetable pieces.

LAZURITE (lapis lazuli) (Lazurite Group)

LAZ-your-ite, LAP-iss LAZ-you-lie

Sodium calcium aluminum silicate
$(Na, Ca)_8(Al, Si)_{12}O_{24}(S, SO_4)$
Isometric
Habit- crystal rare, usually massive
Hardness- 5 to 5.5
Specific gravity- 2.38 to 2.95 (2.65)
Cleavage- none
Fracture- uneven
Streak- bluish
Inclusions- see below

Color- Light to intense blue, rarely greenish
RI- n-1.5
Opaque, sometimes translucent
Luster- vitreous
Names- *lazaward* (Ar) - blue; *lapis* (L) stone, & *lazuli* (Ar) - heaven
Alternate name- lapis

This mineral is the largest component of lapis lazuli. The others are hauynite, sodalite, noselite, pyrite, calcite, and sometimes lapis lazuli contains small quantities of mica, scapolite, diopside, or apatite. The calcite shows as white veins. The amount of pyrite is variable. Afghanistan material is nearly pure lazurite. Chile also produces a good lapis lazuli.

LEGRANDITE

leh-GRAND-ite

Basic zinc arsenate
$Zn_2ASO_4(OH) \cdot H_2O$
Monoclinic
Habit- radiating prisms
Hardness- 5
Specific gravity- 3.98 to 4.01
Cleavage- distinct, one direction
Fracture- uneven, very brittle
Streak- white
Inclusions- veils, cracks, crystal growth interference planes

Colorless to bright yellow
RI- X-1.675, Y-1.690, Z-1.735
Critical angle- 36°
Birefringence- .06, strong
Trichroism- colorless to yellow
Dispersion- medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 36°
Name- for a Mr. Le Grand, Belgian engineer

This very rare material usually forms in crystal groups that make cutting nearly impossible. On occasion, single crystals are large enough to facet into small gems, which are very good. Mexico is the only known source of facetable material.

LEPIDOLITE (muscovite) (Mica Group)

lep-ID-oh-lite, MUSS-coe-vite

Potassium lithium aluminum silicate
$KLi_3Al_7Si_4O_{10}(F,OH)_2$
Monoclinic
Habit- tabular, massive
Hardness- 2.5 to 4
Specific gravity- 2.8 to 3.3
Cleavage- perfect, one direction
Fracture- uneven
Streak- white
Inclusions- metallic inclusions, dendrites, sometimes garnets and tourmalines

Colorless, rose-red, violet, yellow
RI- X-1.530, Y-1.553, Z-1.556
Critical angle- 40°
Birefringence- .026, medium
Translucent, sometimes transparent
Luster- vitreous to pearly
Optically- biaxial negative
2V angle- highly variable
Name- *lepidos* (L) - scale, from the usual very small crystals
Name- for Muscovy, an old name for Russia
Alternate name- lithia mica (lepidolite)

Massive lepidolite, sometimes containing pink tourmaline, is used for carvings and cabochons. Occasionally, muscovite mica appears in a massive form (it is sometimes also rose-red) and is given the same treatment. Usually muscovite mica is colorless to light yellowish. The colorless or yellowish colors of either micas do not make interesting gems. Pegmatites in California, Zimbabwe and Brazil have produced good cabochon lepidolite. A deposit of cabochon-quality lepidolite has recently been found in Wyoming, but it is often stained with an unattractive yellow coloration from iron. Brazil has produced good potential faceting lepidolite, and a few gems have been cut. Brazil produces excellent lepidolite ash trays.

LEUCITE

LEW-site

Potassium aluminum silicate
$KAlSi_2O_6$
Tetragonal
Habit- trapezohedra
Hardness- 5.5 to 6
Specific gravity- 2.45 to 2.50
Cleavage- poor
Fracture- conchoidal
Streak- white
Inclusions- numerous veils

Colorless, white, grayish
RI- 1.508 to 1.509
Critical angle- 42°
Birefringence- .001, very weak
Transparent to opaque
Luster- vitreous
Optically- uniaxial positive
Name- *leuko* (Gr) - white; for the color
Alternate name- amphigene, [*amphi* & *genos* (Gr) - on all sides; for the many faced crystals]

Not a rare mineral, but facetable crystals are very rare. Italy has produced good clear facetable crystals. Leucite was formerly considered to be isometric. The very small birefringence was thought to be anomalous double refraction.

LEUCOPHOENICITE (Humite Group) — loo-co-FEEN-ih-cite

Basic manganese silicate
$Mn_7Si_3O_{12}(OH)_2$
Monoclinic
Habit- usually massive, crystals small
Hardness- 5.5 to 6
Specific gravity- 3.6
Cleavage- none, brittle
Fracture- subconchoidal
Streak- white
Inclusions- not observed

Color- Pink, purplish-red, white, brown
RI- X-1.751, Y-1.771, Z-1.782
Critical angle- 34.5°
Birefringence- .031, strong
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
Name- *leuco & phoinix* (Gr) - white and purple; for the colors

This is a one-location mineral, found only at Franklin, New Jersey. The cabochon material can be cut into interesting gems. There are listings of transparent material that is assumed to be facetable, but is unknown to the authors.

LIDDICOATITE (Tourmaline Group – elbaite-dravite series) — LID-ih-coat-ite

LIMONITE (see goethite) — LIME-on-ite

LINARITE — LIN-are-ite

Basic lead copper sulfate
$PbCuSO_4(OH)_2$
Monoclinic
Habit- prismatic
Hardness- 2.5
Specific gravity- 5.35
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- blue
Inclusions- none observed

Color- Deep blue
RI- X-1.809, Y-1.838, Z-1.859
Critical angle- 33°
Birefringence- .050, strong
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 80°
Name- for Linares, Spain; type location

Rarely, very small crystals are transparent enough to allow a limited amount of light to travel through a faceted gem. They are best suited for the cutting of tablets. This is especially true as the crystals are very thin. New Mexico and Arizona have produced clear crystals.

LITHIOPHILITE (triphylite) — lith-ee-AH-fee-lite, TRIH-fee-lite

Lithium iron manganese phosphates
$Li(Fe,Mn)PO_4$
Orthorhombic
Habit- usually massive
Hardness- 4 to 5
Specific gravity- 3.34 and 3.42
Cleavage- nearly perfect, one direction; imperfect, two directions (triphylite)
Fracture- subconchoidal to uneven
Streak- colorless to dirty white
Inclusions- none observed

Color- Yellowish to reddish-brown (lithiophilite)
Greenish to bluish-gray (triphylite)
RI- X-1.669, Y-1.673, Z-1.682
Critical angle- 36°
Birefringence- .013, medium
Transparent to translucent
Luster- resinous to vitreous
Optically- biaxial positive
2V angle- 65°
Names- from the lithium in the molecule, *and philos* (Gr) - loving
trois & phile (Gr) - three and a clan; for the three metals in the molecule

These two minerals can be differentiated only by the color and specific gravity. They are nearly the same chemically. Either can be cut into interesting cabochons. There is the possibility of clear faceting material, but the authors have not seen it. This is a pegmatite mineral and is found in a number of American mines.

LLANITE

LAN-ite

A rock, composed of feldspars and small blue quartz crystals; a porphyry
Habit- chunks
Hardness- 5 or greater, depending upon the material being tested
Specific gravity- 2.5 (approx.)
Cleavage- none
Fracture- uneven to splintery
Streak- brownish
Color- Brownish, with blue flecks
Opaque
Luster- earthy
Name- for Llano County, Texas [*ilano* (Sp) - a plain]

Llanite appears in only two places in the world, Texas and Norway. The Texas location is quite extensive; the material appears in large dikes in a number of places in Llano County. This material is very unique as it is the only definite occurrence of blue quartz in crystal form. These crystals are hexagonal double pyramids much resembling beta quartz. The color is a bright blue with an internal "opalescence" due evidently to small needle inclusions. This material can be cut into bookends, slabs and cabochons. Such gems do not have a good luster, but the blue spangles of the quartz in the brown feldspar background make a striking pattern. Most material contains mica flakes that add to the spangled look.

LUDLAMITE

LUD-lum-ite

Iron phosphate
$Fe_3(PO_4)_2 \cdot 4H_2O$
Monoclinic
Habit- tabular
Hardness- 3.5
Specific gravity- 3.19
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Inclusions- numerous veils
Color- Green
RI- X-1.653, Y-1.675, Z-1.697
Critical angle- 37.5°
Birefringence- .044, strong
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- large
Name- for Henry Ludlam, English mineralogist

A mineral that sometimes appears in facet quality. Crystals are usually small and badly included. Some good facetable pieces come from Idaho. Mexico recently produced some nice clear crystals.

MACUSANITE (see obsidian)

MAGNESITE (Calcite Group)

MAG-ness-ite

Magnesium carbonate
$MgCO_3$
Hexagonal
Habit- rhombohedral, massive
Hardness- 3.5 to 4.5
Specific gravity- 3.0 to 3.2
Cleavage- perfect, three directions, none in massive material
Fracture- conchoidal
Streak- white
Inclusions- many cleavage plane cracks
Colorless, white, yellow, gray, green, brown
RI- O-1.717, E-1.515
Critical angle- 36° and 42°, depending on axis
Birefringence- .202, very strong
Transparent to opaque
Luster- vitreous to silky
Optically- uniaxial negative
Name- for the magnesium in its composition
Alternate name- pristine; for the pure white variety

Transparent crystals are very rare. Brazil has produced excellent clear pieces which make excellent, colorless gems. Massive material is often cut into cabochons, but these are usually without much color. A cream colored material, mottled with red, has been found in California; it makes very interesting cabochons. A nice chartreuse-green magnesite comes from Australia.

MAGNETITE (Spinel Group)

MAG-net-ite

Iron sesquioxide
Fe_3O_4
Isometric
Habit- octahedral, massive
Hardness- 5.5 to 6.5
Specific gravity- 5.175
Cleavage- none; parting one direction
Fracture- uneven to subconchoidal, brittle
Streak- black

Color- Black, splendent metallic
RI- 2.4 (unimportant)
Opaque
Luster- metallic
Name- for its magnetic properties

Magnetite crystals are often large enough to produce a good sized splendent cabochon. The brittleness can be a problem in cutting. Brazil has produced potential cabochon material in the form of large crystals.

MAJORITE (see garnet group)

MALACOLITE (see diopside)

MALACHITE

MAL-ah-kite

Basic copper carbonate
$Cu_2CO_3(OH)_2$
Monoclinic
Habit- botryoidal, pseudomorphous
Hardness- 3.5 to 4
Specific gravity- 3.5 to 4.03 (3.9)
Cleavage- perfect, not troublesome
Fracture- subconchoidal, uneven
Streak- green, paler than the mineral

Color- Light to deep green
RI- 1.655 to 1.909
Opaque
Luster- silky to adamantine, vitreous
Name- *malache* (Gr) - mallow; from the color of the leaves

Malachite is of interest to the lapidary for cabochons and carving. It can be cut into very excellent gems. Excellent banded massive pieces have been produced in Zaire. The copper mines of Arizona, and other locations, have produced some nice cabochon material. Malachite is often pseudomorphous after azurite. Stalactites can cut interesting "bulls-eye" cabochons. Acicular material often displays chatoyance.

MALAYA (see Garnet Group – pyralspite subgroup)

ma-LIE-ah

MANGANITE

MAN-gan-ite

Basic manganese oxide
MnO(OH)
Monoclinic
Habit- prismatic, massive
Hardness- 4
Specific gravity- 4.33
Cleavage- perfect, one direction
Fracture- uneven, brittle
Streak- reddish-brown to black

Color- Black to dark steel gray
Opaque
Luster- submetallic
Name- from the manganese component

The massive material can be cut into splendent jet black cabochons, South Africa produces good cutting material.

MANGANODIASPORE (see diaspore)

MANGANOTANTALITE (a variety of tantalite)

man-gan-oh-TAN-tall-ite

Manganese tantalate
$MnTa_2O_6$
Orthorhombic
Habit- prismatic
Hardness- 6 to 6.5
Specific gravity- 8.0 to 8.2
Cleavage- perfect, one direction
Fracture- subconchoidal, brittle
Streak- reddish-brown
Inclusions- many cleavage plane cracks, some metallic blobs

Color- Red
RI- X-2.19, Y-2.25, Z-2.34
Critical angle- 27°
Birefringence- .015, medium
Transparent to opaque
Luster- submetallic to vitreous
Optically- biaxial positive
2V angle- large, variable
Name- for the manganese and tantalum in its composition (see columbite)

Tantalite is a manganese iron tantalate. When it forms with little or no iron, it is the variety manganotantalite and is a deep red. As such, it is a very good gem material. Gems are very brillliant. The cleavage is very troublesome during cutting. Facetable pieces are usually small. Brazil produces excellent faceting material. A location in Africa (Zimbabwe?) has also produced good material.

MARCASITE (Marcasite Group)

MARK-ah-site

Iron sulfide
FeS_2
Orthorhombic
Habit- varied, massive
Hardness- 6 to 6.5
Specific gravity- 4.85 to 4.95
Cleavage- poor
Fracture- uneven
Streak- gray to brown

Color- Light brownish-yellow, rarely green
Opaque
Luster- metallic
Name- *marcasita* (L) - from Markhashi, a region probably in northern Iran

Marcasite, as a mineral, is of interest to the lapidary only in the massive form. It is found as an inclusion in agate, and this is an excellent lapidary material. The "marcasite" of the jewelry trade is pyrite. The agate enclosed form is from California. Mexico has produced lumps of the mineral in cabochon quality.

MARIPOSITE

mare-ih-PO-site

Correctly, mariposite is a form of one of the micas (alurgite). The material that is popularly known as mariposite is a variable rock containing alurgite as a coloring matter. The most common color is green. Most pieces resemble a micaceous type of schist, which they probably are. It is seldom of cabochon quality, but is made into bookends and other like objects. It seldom takes a good polish. The material is found in mountainous central California. Name- for the Mariposa region in California.

MAUCHERITE

MAU-sher-ite

Nickel arsenide
$Ni_{11}As_8$
Tetragonal
Habit- square tabular, massive
Hardness- 5
Specific gravity- 7.83 to 7.95
Cleavage- none
Fracture- uneven
Streak- dark gray

Color- Reddish silver-white; tarnishing to grayish copper-red
Opaque
Luster- metallic
Name- for Wilhelm Maucher, a German mineral dealer

The massive material can be cut into cabochons, and can be very spectacular. Pieces are usually impure, giving gem surfaces a "spiderweb" appearance. A good material comes from Washington.

MAW SIT SIT

MAW-sit-sit

A combination of minerals, with chrome-jadeite and chromite being the major constiutents
Habit- massive
Hardness- 6 to 7
Specific gravity- 2.5 - 3.5
Cleavage-none
Fracture- conchoidal to irregular
Streak- ?

Color- Light to dark green, often with black inclusions
RI- 1.52 - 1.74
Opaque to sub-translucent
Luster- vitreous, oily, porcelaneous
Name- for the village, Taw Maw, near locality in Myanmar

This massive material is cut into cabochons and made into carvings. Maw Sit Sit also contains kosmochlor, symplektite, chrome amphibole, and other minerals. It was originally thought to be a type of jade, but identified as a distinct mineral by gemologist, Eduard Gübelin.

MEERSCHAUM (see sepiolite)

MELIPHANITE

mel-IF-an-ite

Calcium sodium beryllium fluo-silicate
$(Ca, Na)_2Be(Si, Al)_2(O,F)_7$
Tetragonal
Habit- square pyramidal, massive
Hardness- 5 to 5.5
Specific gravity- 3.0
Cleavage- distinct, one direction
Streak- white

Color- Yellow
RI- O-1.612, E-1.593
Critical angle- 38°
Birefringence- .019, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- *meli* (L) - honey & *phanein* (Gr) - to appear; for the honey-like look
Alternate name- melinophane

Meliphanite is sometimes cut into cabochons that are of interest only to collectors. Norway is the only known source of lapidary material.

MELANITE (see Garnet Group – ugrandite subgroup)

MELLITE

MEL-lite

Hydrous aluminum mellate (organic)
$Al_2C_6(CO_2)_6{\cdot}18H_2O$
Tetragonal
Habit- pyramidal, massive
Hardness- 2 to 2.5
Specific gravity- 1.64
Cleavage- indistinct
Fracture- conchoidal, sectile
Streak- whitish
Inclusions- organic materials

Color- Yellow, reddish, brown
RI- O-1.539, E-1.511
Critical angle- 41°
Birefringence- .028, medium
Transparent to translucent
Luster- resinous to vitreous
Optically- uniaxial negative
Name- *meli* (L) - honey; in reference to the color

This unique mineral is found only in lignite coal beds in Europe. Faceted gems are unique, but lack brilliance.

MESOLITE (Zeolite Group)

MEZ-oh-lite

Hydrous sodium calcium aluminum silicate
$Na_2Ca_2Al_6Si_9O_{30}{\cdot}8H_2O$
Monoclinic
Habit- acicular, massive
Hardness- 5
Specific gravity- 2.29
Cleavage- perfect, two directions
Fracture- subconchoidal
Streak- white
Inclusions- crystal growth interferences

Colorless, white
RI- X-1.504, Z-1.506
Critical angle- 40°
Birefringence- .002, weak
Dispersion- strong
Transparent to opaque
Luster- silky
Optically- biaxial positive
Name- *mesos* (Gr) - middle; refers to ?

The opaque massive material produces silky cabochons. Transparent crystals are found on rare occasions, these may be faceted. Oregon is the best known source.

METEORITE (metallic) — ME-tee-or-ite

Predominantly iron and nickel, plus inclusions of various minerals
Habit- irregular chunks
Hardness- 4 to 5
Specific gravity- 7 to 8 (variable)
Cleavage- none
Fracture- splintery
Streak- shining

Color- Rust-red on surfaces, bright silvery metal when cut
Opaque
Luster- metallic
Name- meteorum (L) - meteor

Metallic meteorites have been cut into cabochons. After polishing, the surface is etched with nitric acid to reveal the crystal pattern (Widmanstaetten figures). Some meteorites contain minerals such as diamond, olivene, and others. Other metals may also be included. Meteorites are found worldwide. They are of extra-terrestrial origin.

MICA GROUP (see individual minerals)

LEPIDOLITE - MUSCOVITE - PINNITE - SERICITE - VERDITE

MICROCLINE (see Feldspar Group) — MY-crow-cline

MICROLITE (Pyrochlore Group) — MY-crow-lite

Sodium calcium tantalate
$(Na, Ca)_2Ta_2O_6(O, OH, F)$
Isometric
Habit- octahedral
Hardness- 5.5
Specific gravity- 5.5
Cleavage- poor
Fracture- conchoidal
Streak- white
Inclusions- veils and cracks

Color- Pale yellow, orange-red, brown
RI- n-1.93 to 2.02
Critical angle- 30°
Transparent to opaque
Luster- vitreous
Name- *micron* (Gr) - very small; for the very small crystals first discovered

A rare mineral in any form. Facetable crystals are unusual. Gems of the orange-red color are excellent. The name comes from the very small crystals first found. Subsequently, very large crystals have been found. Virginia has produced most of the facetable material, but the mine is closed. Brazil has produced a small amount. Microlite is found in pegmatites; it is usually not recognized by the miners.

MILARITE — mill-ARE-ite

Complex beryllium aluminum silicate
$K_2Ca_4Al_2Be_4Si_{24}O_{60}\cdot H_2O$
Hexagonal
Habit- prismatic
Hardness- 5.5 to 6
Specific gravity- 2.55 to 2.59
Cleavage- poor
Fracture- conchoidal
Streak- white
Inclusions- veils and cracks

Colorless, yellow, (pale green)
RI- O-1.532-1.551, E-1.529-1.548
Critical angle- 41°
Birefringence- .003, weak
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- for Milar Valley, Switzerland

Namibia produces very small yellowish crystals clear enough to facet. Gems are uninteresting. Recently, Brazil has produced nearly colorless crystals; these have a potential to be fairly good gems.

MILLERITE

MILL-er-ite

Nickel sulfide
NiS
Hexagonal
Habit- elongated crystals, massive
Hardness- 3 to 3.5
Specific gravity- 5.41 to 5.42
Cleavage- perfect, two directions
Fracture- uneven, brittle
Streak- greenish black

Color- Brass yellow to bronze yellow
Opaque
Luster- metallic
Name- for W. H. Miller, English mineralogist

This mineral usually is found as very slender crystals lining cavities. These are in sprays that are very popular with mineral collectors. A location in Ontario, Canada, produces large bright colored cleavable masses that can be cut into brilliant cabochons. These have a tendency to tarnish to a greenish gray color. A plastic spray will reduce the tendency to tarnish.

MIMETITE (Apatite Group)

MIM-eh-tite

Lead chloro-arsenate
$Pb_5(AsO_4)_3C_1$
Monoclinic
Habit- prismatic, massive
Hardness- 3.5 to 4
Specific gravity- 7.28
Cleavage- none (?)
Fracture- subconchoidal to uneven
Streak- white
Inclusions- veils

Colorless, yellowish, brownish, orange
RI- O-2.147, E-2.128 (highly variable)
Critical angle- 28°
Birefringence- .019, medium
Transparent to translucent
Luster- subadamantine to resinous
Optically- biaxial negative
2V angle- about 42°
Name- *mimetis* (Gr) - imitator, for its resemblance to pyromorphite

In recent years fine clear facetable crystals have come from Namibia. The supply seems to have been exhausted. The mines at Chihuahua, Mexico, have produced good botryoidal material that can be cut into nice cabochons.

MISERITE

MIS-er-ite

Basic potassium calcium silicate
$K(Ca, Ce)_4Si_5O_{13}(OH)_3$
Triclinic
Habit- massive, cleavable
Hardness- 5.5 to 6
Specific gravity- 2.84 to 2.96
Cleavage- perfect, one direction
Fracture- irregular
Streak- white

Color- Pinkish, lavender, red-brown
RI- 1.587 to 1.594
Translucent
Luster- vitreous to pearly
Name- for Hugh D. Miser, geologist

Material from Arkansas can be cut into interesting cabochons with a random pattern.

MOLDAVITE (see tektite)

MONAZITE (Monazite Group)

MOAN-ah-zite

Cerium lanthanum yttrium thorium phosphate
$(Ce, La, Y, Th)PO_4$
Monoclinic
Habit- tabular or elongated, massive
Hardness- 5 to 5.5
Specific gravity- 4.6 to 5.4
Cleavage- distinct, one direction distinct parting often present
Fracture- conchoidal to uneven
Streak- white
Inclusions- many cracks that break transparent crystals into small pieces

Color- Brownish, pink, yellow, greenish
RI- X-1.785, Y-1.787, Z-1.84
Critical angle- 34.5°
Birefringence- .055, medium
Pleochroism- light to medium colors
Dispersion- ?
Transparent to translucent
Luster- resinous, waxy, lusterous to subadamantine
Optically- biaxial positive
2V angle- 12°
Name- from *monasely* (Gr) - solitary; for its rarity in the first known deposits

Recently, fine transparent golden-brown crystals have been found in Brazil. Most crystals are very flawed. The largest possible gem, from crystals seen by the authors, might be one-fourth carat. Such gems, though small, should be very brilliant.

MONTEBRASITE (see amblygonite)

MONTICELLITE

MONT-ih-sell-ite

Magnesium calcium silicate
$MgCaSiO_4$
Orthorhombic
Habit- prismatic, usually massive
Hardness- 5.5
Specific gravity- 3.08 to 3.27
Cleavage- poor, brittle
Fracture- subconchoidal
Streak- light yellow

Colorless, gray, greenish, brownish
RI- X-1.64, Y-1.65, Z-1.66
Critical angle- 37.5°
Birefringence- .002, weak
Transparent, usually translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 72° to 82°
Name- for T. Monticelli, Italian chemist

California material can be cut into brown cabochons with a satin-like luster. Any possibility of faceting material is not known to the authors.

MOOKAITE

MOO-ka-ite

A rock
Habit- lumps
Hardness- 6 to 7
Specific gravity- 2.62 to 2.66
Cleavage- none
Fracture- conchoidal
Streak- whitish

Color- White, yellowish, gray, red, brownish
Opaque
Luster- dull
Name- for Mooka Station, Gascoyne Range, Australia

Mookaite has been considered to be a jasper, but recent investigations have shown it to be a very unique material. It basically is a fossil made of radiolarians (one-cell ocean dwelling organisms) cemented with an opaline material. It also contains silica replaced fossil shell, plus foraminifera, pelecepods, ostracods, small ammonites and belemnites. It should be classed as silicious fossil material, or perhaps a form of chert. Regardless of how it might be classified, it was formed under oceanic conditions. It is known only from Mooka Station. Material is quite variable in color, ranging from nearly translucent to opaque, with the above colors randomly distributed.

MORDENITE

MORE-den-ite

Hydrous calcium sodium potassium aluminum silicate
$(Ca, Na_2,K_2)Al_2Si_{10}O_{24}•7H_2O$
Orthorhombic
Habit- acicular, silky porcelaneous
Hardness- 4 to 5
Specific gravity- 2.12 to 2.15
Cleavage- perfect, one direction
Fracture- uneven
Streak- white to pinkish

Colorless, white, (yellowish), (pinkish)
RI- X-1.472, Y-1.475, Z-1.477
Critical angle- 42°
Birefringence- .005, weak
Transparent to translucent
Luster- vitreous to silky
Optically- biaxial negative
2V angle- 76°
Name- for Morden, Nova Scotia, Canada

The only form of this mineral that has lapidary potential is the porcelaneous chunks which are rarely found. Cabochons are interesting because of a silky luster. Nova Scotia has produced lapidary material.

MORGANITE (see beryl)

MORION (see quartz, crystalline)

MUSCOVITE (see lepidolite)

MYRICKITE (see opal; and quartz, cryptocrystalline)

NAMBULITE

NAM-boo-lite

Basic sodium lithium manganese silicate
$LiNaMn_8Si_{10}O_{28}(OH)_2$
Triclinic
Habit- prismatic
Hardness- 6.5
Specific gravity- 3.5
Cleavage- distinct, two directions
Fracture- conchoidal
Streak- pale yellow
Inclusions- none observed

Color- Orange, reddish-brown
RI- X-1.707, Y-1.710, Z-1.730
Critical angle- 36°
Birefringence- .023, medium
Dispersion- weak
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 30°
Name- for Matsuo Nambu, Japanese mineralogist

This mineral is found only in Japan and Namibia. The Namibian material is excellent. Less than 75 specimens are presently known from Namibia, but if a supply becomes available, this has the potential of being an excellent gem material. Present prices are exceedingly high.

NATROLITE (Zeolite Group)

NAY-tro-lite

Hydrous sodium aluminum silicate
$Na_2Al_2Si_3O_{10}\ 2H_2O$
Orthorhombic
Habit- slender prismatic, massive
Hardness- 5 to 5.5
Specific gravity- 2.21 to 2.26
Cleavage- perfect, two directions
Fracture- uneven to conchoidal
Streak- white
Inclusions- dirt, phantoms, many veils

Colorless, white, gray, yellowish, red
RI- X-1.480, Y-1.482, Z-1.493
Critical angle- 42.5°
Birefringence- .013, medium
Transparent to opaque
Luster- vitreous to dull
Optically- biaxial positive
2V angle- 63°
Name- *natron* (Fr) - soda; referring to the sodium in its composition

Facetable crystals are rare. The massive material can be cut into mottled cabochons. New Jersey has produced nice-sized excellent faceting material.

NEPHELINE (elaeolite)

NEFF-uh-leen, el-LEE-oh-lite

Sodium aluminum silicate
$NaAlSiO_4$
Hexagonal
Habit- prismatic, massive
Hardness- 5.5 to 6
Specific gravity- 2.55 to 2.65 (2.6)
Cleavage- distinct to imperfect two directions
Fracture- subconchoidal
Streak- white
Inclusions- various mineral blobs

Colorless, green, orange, red
RI- O-1.529 to 1.549, E-1.526 to 1.542
Critical angle- 40°
Birefringence- .005, weak
Translucent to opaque, rarely transparent
Luster- vitreous to greasy
Optically- uniaxial negative
Name- *nephele* (Gr) - a cloud & *elaion* (Gr) - oil, for the greasy look
Alternate name- nephelite

VARIETY:
Elaeolite - green, orange, red. The massive variety, elaeolite, may be cut into cabochons or carvings.

Colorless nepheline may be faceted, but gems are not spectacular. Norway produces the best material.

NEPHRITE (Amphibole Group) (jade in part, see jadeite)

NEFF-rite

Hydrous calcium magnesium iron silicate
$Ca(Mg, Fe)_5(Si_4O_{11})_2H_2O$
Monoclinic
Habit- massive, never crystalline
Hardness- 6 to 6.5
Specific gravity- 2.90 to 3.02 (2.95)
Cleavage- none
Fracture- splintery
Streak- uncolored
Inclusions- various dark blobs

Color- White, shades of green, reddish, black
RI- 1.60 to 1.641 (shadow at 1.61)
Translucent to opaque
Luster- dull to glistening
Name- *nephros* (Gr) - kidney; was used as a cure for kidney ailments
Alternate names- jade, greenstone

Nephrite is an exceedingly tough massive form of actinolite. Nephrite is the most common of the jade-like minerals, but is second in popularity to jadeite (see page 54). The cat's-eye nephrite (cat's-eye jade) is composed of long slender parallel actinolite needles. This lack of intergrown crystals makes the material much more brittle than the usual nephrite. Wyoming has produced excellent nephrite, some of it a fine apple green. An excellent type presently comes from British Columbia and Alaska. The greenstone from New Zealand is a nephrite.

NOSEAN (Sodalite Group)

NO-see-en

Sodium aluminum sulfo-silicate
$Na_8Al_6Si_6O_{24}SO_4$
Isometric
Habit- octahedral, usually massive
Hardness- 5.5
Specific gravity- 2.3 to 2.4
Cleavage- indistinct
Fracture- irregular
Streak- variable

Colorless, white, blue, gray, brown, reddish, black
RI- n-1.495
Critical angle- 41.5°
Transparent to translucent
Luster- vitreous
Name- for Karl W. Nose, German geologist

Material from Germany can be cut into unique tan and black spotted cabochons. Any material that can be considered as transparent is very rare.

NICCOLITE

NICK-oh-lite

Nickel arsenide
NiAs
Hexagonal
Habit- crystals rare, massive
Hardness- 5 to 5.5
Specific gravity- 7.78
Cleavage- none
Fracture- uneven, brittle
Streak- brownish black

Color- Pale copper-red, tarnishes to dark color
RI- (unimportant)
Opaque
Luster- metallic
Name- *nicolum* (L) - nickel

This material is usually found in heavy metal mines. It can be cut into beautiful reddish cabochons. The tarnish can be controlled by a layer of spray-on acrylic. Material has come from Ontario, Canada.

OBSIDIAN

ahb-SID-ee-un

Natural volcanic glass
SiO_2 + various minerals
An amorphous rock
Habit- massive
Hardness- 5 to 5.5
Specific gravity- 2.3 to 2.6 (2.45)
Cleavage- none
Fracture- conchoidal
Streak- white
Inclusions- see below

Color- Yellowish, gray to black, (red)
RI- n-1.48 to 1.57
Critical angle- 42°
Transparent to opaque
Luster- vitreous
Name- *obsidianus* (L) - for a Roman citizen, Obsius; Pliney's obsidianus

VARIETIES:
Apache tears - nearly spherical dark nodules found in pitchstone ("perlite"). Some may be transparent enough to facet; most are too dark. [for Apache Indians]
Macusanite - nearly colorless material from near Macusani in the Peruvian Andes.
Sheen obsidian - containing small needles lying parallel so that light is refracted and reflected off, giving an iridescent look. The types are referred to as rainbow, gold sheen and silver sheen. From Oregon, California, Utah and Mexico.
Snowflake - containing ball-like groups of cristobalite. When cut these resemble snowflakes. From Utah.
Tachylite - a translucent basaltic glass found in lava cavities. [tachy & lytos (Gr) - to dissolve; for its rapid decomposition in acids]

Obsidian always contains inclusions. These are usually in the form of plates, crystal needles, bubbles, or spheres of the mineral crystobalite. The needles sometimes create a sheen. Some pieces are clear enough to facet (inclusions are present even then), but gems are not greatly interesting. The best use of obsidian is for cabochons or carvings. A location in the Peruvian Andes produces a unique nearly colorless material (macusanite) in which most of the inclusions are clear rod-like crystals of andalusite. This makes unique faceted gems. An area in Montgomery Pass, on the California-Nevada border, produces excellent banded obsidian. The bands are often very narrow (less that one millimeter) and closely spaced. When this material is cut into cabochons, the effect runs from what might be called a "venetian blind" pattern to a variegated banding pattern. Excellent cabochons can be cut from this material, which is plentiful at the site.

The authors strongly feel that there is no clear green, brown, or blue obsidian. All that they have examined have been found to be glass, or in a few instances, hyalite opal. About three years ago, the authors were shown green obsidian as knives made by ancient people in Central America. At least, now there is green.

ODONTOLITE

oh-DON-toe-lite

Fossil bone or ivory
Colored by iron phosphate (vivianite)
Habit- massive
Hardness- 5
Specific gravity- 3.0 to 3.5
Fracture- irregular
Streak- color of the material.

Color- Blue, greenish-blue, rarely green
RI- 1.57 to 1.63
Translucent to opaque
Luster- vitreous to dull, earthy
Name- *odonto* (Gr) - tooth; from the altering of teeth
Incorrect name- "bone turquoise"

This is often mistaken for turquoise, but can easily be identified by the fact that it is a replacement. It is often found in caves replacing bones and teeth. This gives a test reaction for iron, whereas turquoise gives a test reaction for copper. Sometimes these replacements can be cut into cabochons.

OLIGOCLASE (see Feldspar Group – plagioclase) OH-li-go-clase

OLIVENE (see peridot)

OOLITE (see breccia)

OPAL

OH-puhl

Silicon dioxide (quartz) plus water
SiO_2 nH_2O (water content is variable)
Amorphous
Habit- massive, pseudomorphous
Hardness- 5 to 6.5
Specific gravity- 1.9 to 2.3 (2.2)
Cleavage- none
Fracture- conchoidal, very brittle
Streak- white
Inclusions- cracks, mud in some, some needles (zeolites?) in Mexican opals

Colorless to black, nearly all colors
RI- n-1.43 to 1.47
Critical angle- 43.5°
Transparent to opaque
Luster- vitreous
Anomalous double refraction is often exhibited by the transparent forms
Name- *upala* (Sanskrit) - a jewel; to *opalus* (L) - opal

VARIETIES WITH PLAY OF COLOR:
Black opal- dark body color (also called precious opal)
Fire opal - red, orange, or yellow body color (opal of these colors, without play of color should be classified in the section below)
Hydrophane opal (HIGH-drow-fane) - opal that shows a play of color only when immersed in water [hydros & phanos (L) - water & clear]
Jelly opal - transparent yellowish body color (also precious opal)
Precious opal - white to light, or yellow body color
Solari opal (so-LAHR-ee) - play of color seen only in transmitted light [*solaris* (L) - sun. Mexicans call this *contra luz* (Sp) - against the light]

VARIETIES WITHOUT PLAY OF COLOR:
Cherry opal - transparent red, orange, or yellow, is often called fire opal
Girasol opal (JEER-uh-sahl) - bluish-white, with an inner red glow seeming to move within the stone [*gyrare* & *sol* (L) - to turn & sun]
Hyalite opal ("muller's glass") (HIGH-uh-lite) - transparent bluish, colorless to smoky; water-drop shapes, may contain bubbles [*hyalos* (Gr) - glass]
Moss opal - containing a moss-like dendritic pattern
Prase opal (PRAISE) - dark green, nearly opaque [*prason* (Gr) - leek]

VARIETIES OF COMMON OPAL:
Cachalong opal (CASH-uh-long) - porous, porcelain-like; will stick to tongue [Cach, a river in Asia Minor, & cholon (Turkish) - to remain]
Diatomite (diatomaceous earth) (DIE-at-oh-mite) - a soft rock composed of the opal cell walls of microscopic plants called diatoms (DIE-uh-tome)
Geyserite (GUY-zir-ite) - botryoidal; produced by geysers (one is "Lee opal")
Matrix opal (MAY-tricks) - opal that must be cut so that the gem will contain some of the rock matrix
Milk or semi opal - dull shades of light colors
Myrickite (MY-rick-ite) - white with cinnabar inclusions [for "Shady" Myrick, early American prospector]
Opalite - impure opal containing various patterns of inclusions
Tabasheer opal (TAB-uh-sheer) - opal found in bamboo joints [*tabashir* (Ar)]
Wood opal - opalized wood (petrified wood)

Specimens of opal may have a tendency to dry out and crack, become cachalong, or disintegrate. Some localities produce opal that is nearly free of this problem, while others produce material that shows it often. Heat can dry out nearly any opal. Storing opal in water or glycerine seldom helps this problem. Australia and Brazil produce the best precious opal. Pseudomorphs of opal after seashells found in Australia make excellent specimens. Virgin Valley, Nevada has an excellent precious opal that is pseudomorphous after wood; which has a very bad tendency to dry out. Idaho produces a good precious opal that is usually made into doublets; and a good clear yellow opal that can be faceted into excellent gems. The finest cherry and fire opal come from Mexico. A geyserite type opal ("Lee opal") comes from Utah. This makes excellent highly reflective cabochons. The yellow Idaho opal and Mexican cherry opal are the best for faceting. Some jelly opal from Australia is also good faceting opal. Much of the clear facetable opal has a slight haziness.

ORANGEITE (see thorite)

ORPIMENT

OR-pih-ment

Arsenic sulfide
As_2S_3
Monoclinic
Habit- prismatic, massive
Hardness- 1.5 to 2
Specific gravity- 3.49
Cleavage- perfect, one direction
Fracture- uneven
Streak- pale yellow
Inclusions- cleavage plane cracks

Color- Yellow-orange, lemon-yellow
RI- X-2.4, Y-2.81, Z-3.02
Critical angle- 24°
Birefringence- .62, very strong
Luster- resinous, adamantine on cleavage
Optically- biaxial negative
2V angle- 76°
Name- a corruption of *auropigmentum* (L) - golden paint

Orpiment has a very small lapidary potential, but it has been faceted. The cleavage plates are very flexible rather than brittle, and can be controlled during the cutting process. Excellent transparent crystals have recently come from Peru. Massive material has been cut into interesting orange cabochons. This material is light-sensitive and will change color and decompose on long exposure.

ORTHITE (see allanite)

ORTHOCLASE (see Feldspar Group)

OR-tho-clase

OSUMILITE GROUP (see individual mineral)

MILARITE - SUGILITE

PACHNOLITE

PACK-no-lite

Hydrous sodium calcium aluminum fluoride
$NaCaAlF_6 \cdot H_2O$
Monoclinic
Habit- slender prismatic, massive, chalcedony-like
Hardness- 3
Specific gravity- 2.98
Cleavage- indistinct
Streak- white
Inclusions- none observed

Colorless to white
RI- X-1.411, Y-1.420, Z-1.413
Critical angle- 45°
Birefringence- .002, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 76°
Name- *pachne* (Gr) - hoarfrost; in reference to the usual color

The massive material can be cut into white cabochons with a poor luster. Transparent pieces can be faceted, but gems will have poor brilliance. Colorado is a good source of material that may be cut.

PADPARADSCHA (see corundum)

PAINITE

PAIN-ite

Calcium zirconium boro-aluminate
$CaZrBAl_9O_{18}$
Hexagonal
Habit- tabular
Hardness- 8+
Specific gravity- 4.01
Fracture- ?
Streak- ?
Inclusions- veils and tabular crystals

Color- Deep red
RI- O-1.816, E-1.787
Critical angle- 33.5°
Birefringence- .029, medium
Dichroism- red to brownish orange
Transparent
Luster- vitreous
Optically- uniaxial negative
Name- for A. C. D. Pain, British gemologist, discoverer

A single crystal was found in Burma in 1951. Subsequently two others have been found. There is the possibility that unidentified gems may exist, thought to be either spinel or garnet.

PARISITE

PARIS-ite

Calcium cerium lanthanum fluo-carbonate
$(Ce,La)_2Ca(CO_3)_3F_2$
Hexagonal
Habit- pyramidal, prismatic
Hardness- 4.5
Specific gravity- 4.3
Cleavage- distinct, one direction
Fracture- subconchoidal to splintery
Streak- brownish
Inclusions- many veils, foreign particles

Color- Brown to yellow
RI- O-1.676, E-1.757
Critical angle- 36°
Birefringence- .081, strong
Transparent to opaque
Luster- vitreous to resinous
Optically- uniaxial positive
Name- for J. J. Paris, lessee of the Muzo (emerald) mine where the mineral was discovered

This is a very rare mineral. A recent find in Montana has produced small clear crystals that have been cut into dark brown gems.

PATRICIANITE

pat-REE-sea-an-ite

Prehnite plus chlorite, with variable amounts of native copper
Habit- massive
Hardness- 6 to 6.5, portions may be softer
Specific gravity- 2.9 may be higher with larger amounts of copper
Cleavage- none
Fracture- uneven
Streak- white to pinkish

Color- White, greenish, pinkish, reddish
Translucent to opaque
Luster- vitreous to metallic

This material is included here under this name because it has recently been offered as such. It really is a variety of prehnite. Regardless, it can be cut into excellent pink and green cabochons that can be spangled with native copper. Keweenaw County, Michigan is the only known source.

PARAVAUXITE

para-VAUZ-ite

Basic hydrous iron aluminum phosphate
$FeAl(PO_4)_2 \cdot 10H_2O$
Triclinic
Habit- prismatic to tabular, groups
Hardness- 3
Specific gravity- 2.36
Cleavage- perfect, one direction
Fracture- conchoidal, brittle
Streak- white
Inclusions- many veils

Color- Pale green
RI- X-1.552, Y-1.559, Z-1.572
Critical angle- 43°
Birefringence- .02, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 72°
Name- for George Vaux, American mineral collector

The tin mines at Llallagua, Bolivia, produce small groups of crystals. Some of these contain small transparent areas that can be faceted. The cleavage can be troublesome during cutting. There is a true vauxite, which was originally named for Mr. Vaux. Paravauxite is very similar to vauxite and thus carries the prefix para from the Greek meaning akin to.

PEARL, PEARL SHELL, & SHELL

Calcium carbonate plus conchiolin
Produced by marine animals of the order Mollusca
Hardness- 2.5 to 4.5
Specific gravity- 2.66 to 2.77
Fracture- conchoidal to uneven
Streak- white

Colors variable
Opaque
Luster- pearly to dull
Name- *perula* (L) - pearl

Pearls are the result of a mollusc depositing layers of shell and conchiolin around an irritant (usually a very small animal rather than a grain of sand). Cultured pearls are layers of the same material around a sphere of mother-of-pearl that was inserted into the animal's flesh. Conchiolin is a leathery substance (see black coral, page 27).

Pearl continued on next page.

VARIETIES:
Cultured pearl - identical in outward appearance to natural pearl
Mother-of-pearl - sections of shell from various molluscs, including pearl oyster, abalone, and the Indian Ocean pearl shell; with a decided pearly luster and a play of colors that are sometimes chatoyant
Operculum or cat-eye shell - the trap door of a South Sea Island snail, in discs much resembling cabochons, of deep green turning to brown on the edges. The operculum shell is very dull when found, and must be polished before setting into jewelry. Operculum is popularly known as cat-eye shell, "Chinese cat-eye" or " G. I. cat-eye".
Pearl - a nearly spherical to spherical gem with pearly luster

Pearl shell imitations can easily be differentiated from pearl as the layering of the shell, used to make the imitation, is very evident. The outer layer of pearl is composed of minute crystals. Natural and cultured pearl can easily be distinguished from imitations. When rubbed across the teeth, the imitation will feel smooth, whereas true and cultured pearl will have a roughness much like a file. Against a strong light, the banding of the nucleus of cultured pearl may be seen, thus differentiating it from natural pearl.

PECTOLITE

PECK-toe-lite

Basic sodium calcium silicate
$NaCa_2Si_3O_8(OH)$
Monoclinic
Habit- acicular masses
Hardness- 5
Specific gravity- 2.74 to 2.88
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Color- White, gray, blue to blue-green
RI- 1.595 to 1.633
Translucent to opaque
Luster- silky
Name- *pectos* (Gr) - compacted; from the tight masses it forms
Commericial name for blue variety is larimar

This material can be cut into silky appearing cabochons. It lapidary potential is very limited. The island of Santo Domingo has produced nice cabochon material.

PENNINITE (Chlorite Group)

PEN-in-ite

Basic magnesium iron aluminum silicate
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$
Monoclinic
Habit- tabular, rhombohedral, tapering pyramids, massive
Hardness- 2 to 2.5
Specific gravity- 2.6 to 2.85
Cleavage- perfect, one direction
Fracture- laminae are flexible
Streak- white
Color- Green to olive-green (yellowish)
RI- 1.56 to 1.59
Transparent to translucent
Luster- vitreous to pearly
Name- for the Pennine Alps

This mineral is a member of the chlorite group; which is well known for its easy cleavage and softness. In spite of its occasional transparency, it is doubtful if it could ever be faceted. The massive material can be cut into cabochons with a silky appearance. The Alps Region (Italy, Switzerland, and Austria) is the best source for cutting material.

PENTLANDITE

PENT-land-ite

Iron nickel sulfide
$(Fe,Ni)_9S_8$
Isometric
Habit- massive, granular
Hardness- 3.5 to 4
Specific gravity- 4.6 to 5.0
Cleavage- none, exhibits parting
Fracture- conchoidal, brittle
Streak- bronze brown
Color- Light bronze yellow
Opaque
Luster- metallic
Name- for J. B. Pentland, Irish scientist

This mineral is the major nickel ore at a mine in Ontario. It appears in large masses, some of which infrequently reaches the amateur market. These can be cut into bright cabochons.

PERIDOT (Olivene Group)

PAIR-ih-doe, PAIR-ih-dot

Magnesium iron silicate
$(Mg,Fe)_2SiO_4$
Orthorhombic
Habit- prismatic, usually massive
Hardness- 6.5 to 7
Specific gravity- 3.25 to 3.45 (3.3)
Cleavage- imperfect, two
Fracture- conchoidal
Streak- uncolored
Inclusions- black spinel and chromite crystals (both octahedrons), veils, circular cleavage cracks ("lily pads"), glass blobs, mica flakes, diopside, negative crystals

Color- Green, yellow-green, brownish, orange
RI- X-1.654, Y-1.671, Z-1.689
Critical angle- 37°
Birefringence- .035, medium
Pleochroism- weak
Dispersion- .02, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 72° to 90°
Names- *peritot* (Fr) - meaning unclear; [*chrysos* (Gr) - gold or yellow]; [*oliva* (L) - olive; for the color]; [for John Forster, German traveler]

One of the finest of gem materials. Facetable crystals are known from Egypt and Pakistan. Material from other locations (usually Arizona) is in irregular pieces. "Hawaiite" and "olivene" are incorrect names for Hawaiian material which is found only in very small pieces. Specimens or gems offered in Hawaii are usually from Arizona. The gem material is also found in Ethiopia, China, Mexico, and Norway. Recent finds in the latter two may become important sources. Australia produces a small amount. At one time, peridot was considered to be a gem variety of olivene. Olivene is now a group name. The authors consider peridot a variety of chrysolite; some others say it is a variety of forsterite. Regardless of the name, it is a beautiful gem.

PERISTERITE (see Feldspar Group – plagioclase subgroup – albaite)

PERLITE (pitchstone)

PEARL-ite

A type of obsidian
Habit- massive, with small included spheres
Hardness- 5 to 6.5
Specific gravity- about 2.4
cleavage- none
Fracture- conchoidal
Streak- white

Color- Black to gray
Opaque
Luster- vitreous to resinous
Name- from the pearl-like spheres
Name- Pitchstone is from the pitchy luster spheres

True perlite really has no lapidary potential. The small spheres are not of a different color or texture than the massive, and they will easily fall out during lapidary treatment. "Peanut stone" (from Mexico) is an obsidian with brown spheres of a zeolite. It is poor; the spheres also fall out during lapidary treatment. What is usually called perlite is another obsidian type correctly called pitchstone. This could have lapidary potential, but is usually somewhat fractured and extremely brittle. Pitchstone is best known as the material, from a number of Western U.S. localities, that contains nodules of obsidian that are known as Apache tears.

PERTHITE (see Feldspar Group – plagioclase subgroup – albaite)

PETALITE

PETAL-ite

Lithium aluminum silicate
$LiAlSi_4O_{10}$
Monoclinic
Habit- massive
Hardness- 6 to 6.5
Specific gravity- 2.30 to 2.50
Cleavage- perfect to imperfect three directions
Fracture- subconchoidal
Streak- uncolored
Inclusions- cleavage plane cracks

Colorless, greenish-white, gray, pink
RI- X-1.504, Y-1.510, Z-1.516
Critical angle- 42°
Birefringence- .012, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 83.5°
Name- *petalon* (Gr) - leaf, from the cleavage
Alternate name- castorite (for crystals)

Facetable crystals are extremely rare. Clear pieces make good gems. Facetable material is known only from two mines in Brazil, and a single location in Australia. Massive material is sometimes suitable for cabochons. A nice pink material comes from Australia. A nearly colorless material comes from Sweden. Castorite is an obsolete name for petalite. It was derived from the mythical twins Castor and Pollux. The latter is the derivation of the name for pollucite.

PEZZOTTAITE

PEZ-oh-tite

Cesium, beryllium, lithium aluminum silicate
$Cs(Be_2 Li)Al_2 Si_6 O_{18}$
Trigonal
Habit- hexagonal tabular crystals, small flat to equant crystals
Hardness- 8
Specific gravity- 2.97 to 3.06
Cleavage Fair, imperfect
Fracture- irregular/uneven, conchoidal
Streak- colorless to white
Inclusions- usually only a few cracks

Color- Pink to raspberry
RI- O- 1.612 - 1.620 E- 1.601 - 1.611
Critical angle- 38.4°
Birefringence- 0.011, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- for Dr. Federico Pezzotta of the Museo Civico, Milano, Italy

Pezzottaite is a brittle material. It has only recently been found at one locality in Madagascar. Flawless material is very rare.

PHACOLITE (see chabazite)

PHENAKITE

FEN-ah-kite

Beryllium silicate
Be_2SiO_4
Hexagonal
Habit- rhombohedral, prismatic
Hardness- 7.5 to 8
Specific gravity- 2.97 to 3.0
Cleavage distinct to imperfect, two directions
Fracture- conchoidal
Streak- uncolored
Inclusions- usually only a few cracks

Colorless, light yellow
RI- O-1.654, E-1.670
Critical angle- 37°
Birefringence- .016, medium
Transparent
Luster- vitreous
Optically- uniaxial positive
Name- *phenakos* (Gr) - deceiver; the crystals resemble quartz
Alternate spelling- phenacite

In spite of the low optical properties, phenakite produces a brilliant gem. This is partly due to its extreme clarity. Brazil produces the finest faceting material. Colorado, Russia, and other locations produce crystals that may be facetable.

PHOSGENITE

FOZ-gen-ite

Lead chlorocarbonate
$Pb_2CO_3Cl_2$
Tetragonal
Habit- prismatic, tabular, massive
Hardness- 2.5 to 3
Specific gravity- 6.0 to 6.3
Cleavage- distinct, three directions
Fracture- conchoidal
Streak- white
Inclusions- cleavage plane cracks

Colorless, yellow, smoky
RI- O-2.118, E-2.144
Critical angle- 28.5°
Birefringence- .026, medium
Dispersion- strong
Transparent to translucent
Luster- adamantine
Optically- uniaxial positive
Name- from phosgene, (carbonyl chloride $COCl_2$) This mineral also contains carbon, oxygen, and chlorine.

A rare gem material in facet quality, but it makes excellent gems. It is very difficult to cut into cabochons because of the cleavages. Such gems would not be spectacular, however. Sardinia, Italy produces fine clear faceting material.

PHOSPHOPHYLLITE

FOS-fof-fee-lite

Hydrous zinc iron manganese phosphate
$Zn_2(Fe,Mn)(PO_4)_2 \cdot 4H_2O$
Monoclinic
Habit- prismatic, twins common
Hardness- 3 to 4
Specific gravity- 3.08
Cleavage- perfect, three directions
Fracture- splintery
Streak- white
Inclusions- veils; usually very clear

Colorless to blue-green
RI- X-1.595, Y-1.614, Z-1.616
Critical angle- 39°
Birefringence- .021, medium
Transparent
Luster- vitreous
Optically- biaxial negative
2V angle- 50°
Name- from *phosphorus phylon* (Gr) - leaf, for the very easy cleavage

A very rare mineral in facet quality. It produces a beautiful gem. Bolivia is the only known source of clear material. Phosphophyllite was originally considered to be very difficult to facet. New cutting and polishing laps and new techniques have reduced it to only moderately difficult.

PHOSPHOSIDERITE

FOS-foe-SIDER-ite

Hydrous iron potassium oxide
$Fe(PO_4) \cdot 2H_2O$
Monoclinic
Habit- crusty aggregates, massive
Hardness- 3.5 to 4; 4.5 (stabilized)
Specific gravity- 2.76
Cleavage- perfect
Fracture- uneven
Streak- white

Color- Purple, pink
RI- X- 1.692, Y- 1.725, Z- 1.738
Critical angle- 36°
Transparent, translucent to opaque
Luster- vitreous
Optically- biaxial negative
Name- for the constituents; phosphorus, and *sideros* (Gr) - iron

Phosphosiderite is rarely found in massive habit. However, a deposit recently discovered in Chile has good lapidary potential when stabilized. This stabilized material produces fine purple cabochons and carvings, often with ochre colored veins running through it.

PIEMONTITE (see zoisite)

PICOTITE (see spinel)

PINITE (Mica Group)

PIN-ite

Massive muscovite mica
Habit- massive
Hardness- 2.5 to 3
Specific gravity- 2.7 to 2.8
Cleavage- none
Fracture- uneven
Streak- white

Color- White, light to dark brown, greenish
RI- 1.57 (unimportant)
Translucent to opaque
Luster- waxy to granular
Name- for the Pini Mine in Saxony
Alternate name- pagodite from the use for carvings

Pinite is evidently derived from a number of sources; it can be an alteration product of cordierite (iolite), feldspar, scapolite, spodumene, and others. It may have a greenish color due to the admixture of chlorite. This material has been used for carvings and other related art forms for many centuries. Many Chinese carvings are of pinite. It would obviously, due to the low hardness, not be suitable for cabochons, or other wear prone articles.

PIPESTONE (see catlinite)

PITCHSTONE (see perlite)

PLAGIOCLASE (see Feldspar Group)

PLANCHEITE

plan-CHEE-ite

Hydrous copper silicate
$Cu_8Si_8O_{22}(OH)_4 \cdot H_2O$
Habit- fibrous radial aggregates
Hardness- 5.5
Specific gravity- 3.65 to 3.8
Cleavage- none
Fracture- uneven
Streak- blue

Color- Pale to dark blue
RI- 1.7 (approx.)
Translucent
Luster- satiny
Name- for Planche; proper French name

This is a fairly unusual copper mineral that appears in mines in Africa and Arizona. It can be cut into interesting silky cabochons. See bisbeeite, (page 14).

PLEONASTE (see spinel)

POLLUCITE (Zeolite Group)

poe-LOO-site

Hydrous cesium aluminum silicate
$(Cs,Na)_2(Al_2Si_4)O_{12} \cdot H_2O$
Isometric
Habit- cubic, usually massive
Hardness- 6.5
Specific gravity- 2.85 to 2.94 (2.86)
Cleavage- none
Fracture- conchoidal
Streak- uncolored
Inclusions- white sphere-like balls

Colorless, pinkish, yellowish
RI- n-1.517 to 1.525
Critical angle- 41°
Dispersion- .014, medium
Transparent
Luster- vitreous
Name- *pollux* (L) - for one twin of Castor & Pollux

Petalite was once called castorite. The two minerals were thought to be inseparable. Anomalous double refraction is sometimes exhibited by pollucite. A rare gem material, usually contains white sphere-like inclusions. Maine is the only known source of facetable material.

PORPHYRY

PORE-fer-ee

A volcanic rock, containing small phenocrysts of feldspar
Habit- massive
Hardness- about 6
Specific gravity- 2.5 to 2.6
Cleavage- none
Fracture- uneven
Streak- brownish

Color- Various shades of brown to blackish
Opaque
Luster- earthy
Names- *porphyros* (Gr) - purple
phainein & cryste (Gr) - to show crystals

Porphyries are highly variable. Basically, they are a medium to dark background color with lighter colored phenocrysts. Sometimes these phenocrysts are in the form of sprays. This type is known as chrysanthemum stone. [phenocryst-phainein & krystallos (Gr) - to show & crystal] All the porphries can be cut into interesting cabochons. Some do not take a good polish, but the pattern of the phenocrysts compensates for it. See Llanite, which is also a porphyry.

PREHNITE

PREE-nite, PRAY-nite

Basic calcium aluminum silicate
$Ca_2Al_2Si_3O_{10}(OH)_2$
Orthorhombic
Habit- reniform aggregates, prismatic
Hardness- 6 to 6.5
Specific gravity- 2.8 to 2.95 (2.9)
Cleavage- distinct, one direction
Fracture- uneven
Streak- uncolored
Inclusions- crystal growth interferences

Color- Shades of light green, yellowish
RI- X-1.616, Y-1.626, Z-1.649
Critical angle- 38°
Birefringence- .033, medium
Transparent to translucent and opaque
Luster- vitreous
Optically- biaxial positive
Name- for Col. von Prehn, Dutch discoverer

This material is seldom found in transparent pieces large enough to facet. The translucent material makes silky cabochons. Australia has produced nearly transparent massive material that is conceivably facetable. A location in Canada has produced single clear crystals of facetable size.

PRICEITE

PRICE-ite

Hydrous calcium borate
$Ca_4B_{10}O_{19}\cdot 7H_2O$
Triclinic
Habit- massive nodules
Hardness- 3 to 3.5
Specific gravity- 2.42
Fracture- earthy to conchoidal
Streak- white
Color- White
RI- approximately 1.59
Translucent
Luster- earthy
Name- for Thomas Price, American mineralogist

The nodules can be cut into white cabochons with a satiny texture.

PROUSTITE

PROO-stite

Silver arsenic sulfide
$Ag_3A_5S_3$
Hexagonal
Habit- prismatic (rhombohedral), massive
Hardness- 2 to 2.5
Specific gravity- 5.57 to 5.64
Cleavage- distinct, three directions
Fracture- conchoidal to uneven
Streak- red
Inclusions- cracks are rarely noted
Color- Deep red
RI- O-3.087, E-2.792
Critical angle- 21°
Birefringence- .295, very strong
Dichroism- strong, red to red-orange
Dispersion- weak
Transparent to opaque
Luster- adamantine
Optically- uniaxial negative
Name- for J. L. Proust, French chemist

Proustite is often a very clear bright deep red and can be faceted into spectacular gems. Germany and Chile are the best sources of clear material.

PSEUDOBOLEITE (see boleite)

PSEUDOPHITE (Chlorite Group)

SOO-doe-fight

Magnesium aluminum silicate
Monoclinic (?)
Habit- massive
Hardness- 2.5
Specific gravity- 2.69
Cleavage- none
Fracture- uneven
Streak- greenish to colorless
Color- Gray, green
RI- 1.57 (approximately)
Translucent
Luster- vitreous to pearly
Name- *pseudes* (Gr) - false (false stone)
Incorrect name- "Styrian Jade"

This material is of interest to the lapidary only as a massive material suitable for carving. It greatly resembles serpentine, and is classed as such by some authors. It evidently is a form of penninite, a member of the chlorite group. Suitable lapidary material comes from Austria (Styria) and other central European localities.

PSEUDOWAVELITE (see crandallite)

PSILOMELANE

sill-AH-mel-ane

Manganese dioxide
MnO_2
Amorphous, colloidal
Habit- botryoidal
Hardness- 5 to 7
Specific gravity- 3.3 to 4.7
Fracture- conchoidal
Streak- brownish-black, shining
Color- Black to steel-gray
Opaque
Luster- submetallic, dull
Name- *psilo & melas* (Gr) - bare black

A black banded material (from Mexico) known as gem psilomelane is often on the market. This is agate with finely divided particles presumed to be psilomelane. This can resemble the pure mineral, but the extra hardness (7) and areas of clear agate will separate the two. The specific gravity of the agate material is lower. Some of the mines in southwestern United States have produced a dense massive psilomelane that has been cut into nice cabochons.

PURPURITE

PURR-purr-ite

Manganese phosphate
$MnPO_4$
Orthorhombic
Habit- massive
Hardness- 4 to 4.5
Specific gravity- 3.4
Cleavage- perfect, one direction
Fracture- uneven
Streak- dark colored

Color- Purple to reddish-purple
RI- X-1.85, Y-1.86, Z-1.92
Pleochroism- strong
Dispersion- very strong
Translucent to opaque, transparent (?)
Luster- submetallic
Optically- biaxial positive
2V angle- 38°
Name- *purpura* (L) - purple

The massive material produces a delightful purple cabochon. It alters after a period of time to a dark color, but the purple can be restored by an immersion for a few moments in a weak hydrochloric acid solution. If transparent, it is presumably facetable, but it will undoubtedly also darken.
Namibia presently produces the material with the best lapidary potential.

PYRARGYRITE

PYRE-are-jur-ite

Silver antimony sulfide
Ag_3SbS_3
Hexagonal
Habit- prismatic (hemimorphic), massive
Hardness- 2.5
Specific gravity- 5.77 to 5.86
Cleavage- distinct, one direction
Fracture- conchoidal to uneven
Streak- reddish-purple
Inclusions- cracks are rarely noted

Color- Deep red
RI- O-3.084, E-2.881
Critical angle- 21°
Birefringence- .2+, very strong
Dichroism- strong, red to red-orange
Dispersion- strong
Faintly transparent to opaque
Luster- adamantine
Optically- uniaxial negative
Name- *pyros* & *argyros* (Gr) - fire silver, in reference to the color and the metal

Pyrargyrite closely resembles proustite (see page 78), but is a darker red and seldom is transparent enough to facet. Germany and Chile are potential sources of faceting material.
A cabochon material has been found in Mexico.

PYRITE (Pyrite Group)

PIE-rite

Iron sulfide
FeS_2
Isometric
Habit- cubic, pyritohedral, octahedral
Hardness- 6 to 6.5
Specific gravity- 4.95 to 5.10 (5.0)
Cleavage- none
Fracture- conchoidal to uneven
Streak- green to brownish-black

Color- Light brass-yellow
Opaque
Luster- metallic, splendent
Name- *pyro* & *lithos* (Gr) - stone that strikes fire
Alternate names- iron pyrite, fool's gold, also the "marcasite" of the jewelry trade

Brilliant opaque faceted gems and cabochons have been cut from this material. A lusterous polish is difficult to obtain on flat facets. The facets of jewelry stones are usually rounded as a result. This is a widespread mineral, but very few areas have been known to produce material with lapidary potential.

PYROMORPHITE (Apatite Group)

pie-roe-MORE-fight

Lead chloro-phosphate
$Pb_5(PO_4)_3Cl$
Hexagonal
Habit- prismatic
Hardness- 3.5 to 4
Specific gravity- 7.04
Cleavage- a trace, one direction
Fracture- uneven to subconchoidal, brittle
Streak- white
Inclusions- numerous veils

Colorless, green, yellow, orange, gray
RI- O-2.058, E-2.048
Critical angle- 30°
Birefringence- .010, medium
Transparent to translucent
Luster- subadamantine to resinous
Optically- uniaxial negative
Name- *pyro* & *morph* (Gr) - fire form; from the crystal that forms from a cooling melt

It is possible that crystal tips of this mineral will be clear enough to facet. This would be true mostly in the lighter colors or colorless (which is rare). Some of the larger crystals, of the deeper colors, could be cut into small, bright cabochons.

PYROPE (see Garnet Group – pyralspite subgroup)

PIE-rope

PYROXENE GROUP (see individual minerals)

pie-ROX-ene

Name- pyr & xene (Gr) - fire and rock; a mistaken idea that they were igneous

ACMITE - AUGITE - DIOPSIDE - ENSTATITE - HYPERSTHENE - JADEITE
PYROXMANGITE - SPODUMENE

PYROXMANGITE (Pyroxene Group)

pie-ROX-man-jite

Manganese iron silicate
$(Mn,Fe)SiO_3$
Triclinic
Habit- tabular, massive
Hardness- 5.5 to 6
Specific gravity- 3.61 to 3.8
Cleavage- perfect, two directions
Fracture- subconchoidal, brittle
Streak- white
Inclusions- veils, cleavage plane cracks

Color- Pink to rose-red, (yellowish), (brown)
RI- X-1.726, Y-1.728, Z-1.744
Critical angle- 35°
Birefringence- .018, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 35° to 46°
Name- *pyro* (Gr) - fire; with the manganese element

This is a one-location material (Japan) which has produced some excellent faceting material. The authors have seen a cabochon from the same area that closely resembles rhodonite, thus there is a possible cabochon potential also. At the time of publication of the first edition this was considered as a variety of rhodonite, but subsequently it was elevated to species status.

PYRRHOTITE

PEER-oh-tite

Iron sulfide
FeS
Hexagonal, monoclinic
Habit- tabular, massive
Hardness- 3.5 to 4.5
Specific gravity- 4.53 to 4.77
Cleavage- basal parting
Fracture- subconchoidal to uneven
Streak- grayish-black

Color- Bronze-yellow to bronze-red
Opaque
Luster- metallic
Name- *pyrrhotes* (Gr) - redness; probably resulting from a flame test

This close relative of pyrite can be cut into excellent golden-colored cabochons. The surface of a cabochon may tarnish with time. Fine large crystals have been offered recently. These and the massive material, if pure and unflawed, are the best lapidary material.

QUARTZ (crystalline)

QUART-z, CHRIS-tull-in

Silicon dioxide
SiO_2
Hexagonal
Habit- prismatic, massive
Hardness- 7
Specific gravity- 2.65 to 2.66
Cleavage- rhombohedral, seldom distinct
Fracture - conchoidal
Streak- uncolored
Inclusions- see below

Color- see below
RI- O-1.544, E-1.553
Critical angle- 40°
Birefringence- .009, weak
Dichroism- weak, moderate in amethyst
Transparent to translucent and opaque
Luster- vitreous
Optically- uniaxial positive
Name- *quarz* (Ger) - meaning unknown, *crystallum* (L); *krystallos* (Gr)
Alternate names for colorless quartz: Rock crystal, "desert diamonds", Herkimer diamond", "Arkansas diamond", etc.

COLOR VARIETIES:

Amethyst (AM-eh-thist) - violet to purple [*amethystos* (Gr) - not to intoxicate]

Ametrine (AM-eh-trine) - amethyst and citrine combined in wedge-shaped sections, three of each color at 60° This can be cut into excellent two-color faceted gems. It is found at the Annji mine in Bolivia.

Citrine (SIT-reen) - yellow to orange, usually the result of heat treating amethyst or smoky quartz [citron (Fr) - lemon]

Morion (MORE-ee-on) - opaque black [*mormorion* (L) - black rock crystal]

Prasiolite (PRAISE-ee-oh-lite) - pale green color is from heat treating and/or irradiating amethyst. Incorrectly called "green amethyst". [*prason* (Gr) leek]

Rose quartz- pink to light red

"***Siderite***" or "***sapphire***" ***quartz*** - incorrect name for dumortierite quartz

Smoky quartz and cairngorm (CARE-n-gorm) - transparent gray, brown to black [Cairngorm Mountains, Scotland]

Vermarine (VUR-mer-ine) - green to yellowish-green, the result of heat treatment of amethyst [*verd & marine* (Fr) - green sea]

Vertine (VUR-teen) - greenish-yellow, often with thin smoky phantoms, which make interesting included gems. The color is said to be natural. However, the yellow-green color of "Oro verde" [(Sp) - green gold] quartz is created by irradiating and heating colorless quartz. [a combination of *verd* (Fr) - green and the ending of citrine]

INCLUDED VARIETIES:

Aventurine quartz (ah-VENT-your-een) - spangled green or red, due to flakes of fuchsite (green mica) or hematite (red). [*aventure* (It) - accident; for the accidental discovery of making goldstone]

Cat's-eye quartz - containing minute parallel needles

Dumortierite quartz (due-MORT-ee-er-ite) - blue to purple, colored by dumortierite

Sagenitic (SADG-en-it-ik) - containing needles of minerals such as rutile (rutilated quartz) or tourmaline (tourmalinated quartz) [*sagina* (L) - net]

Star quartz - containing a hexagonal pattern of minute needles, probably rutile, which induce a six-rayed star when cut cabochon. A twelve-ray star material has been reported.

ALTERNATE NAMES FOR INCLUDED VARIETIES:

"***Dumortierite***" ***and*** "***California lapis***" - dumortierite quartz

Occidental cat's-eye (OX-ih- dent-all) - quartz cat's-eye

Venus or thetis hairstone, grass stone (VEE-nus, THEE-tiss) - rutilated quartz

Crystalline quartz is extremely variable in color and hue, and the inclusions that it may contain. Only the most common colors and shades, and the more usual inclusions are noted above. Over one-hundred different mineral inclusions have been identified. Localities are very numerous; quartz is a widespread mineral. Brazil produces copious amounts of all colors and sizes. Locations in Africa have furnished good amethyst. Uruguay shares amethyst deposits (geodes) with Brazil. Utah has many pegmatites that contain excellent smoky quartz crystals. Brazil produces fine rose quartz as crystals as well as massive material. Massive rose quartz is also found in Madagascar. Fine colorless crystals come from Arkansas. California's Mother Lode region contains much quartz. The pegmatites of Southern California have produced excellent clear and smoky quartz crystals and massive rose quartz. Australia produces good smoky quartz, natural citrine, and many types of included crystals.

QUARTZ (cryptocrystalline)

CRIP-toe-chris-tull-in

Silicon dioxide
SiO_2
Habit- massive, botryoidal
Hardness- 7
Specific gravity- 2.57 to 2.64
Fracture- conchoidal to subconchoidal
Streak- uncolored
Inclusions- see below

Color- Nearly colorless, colored by inclusions
RI- approximately 1.535
Translucent to opaque
Luster- dull, vitreous, waxy
Name- *kryptos* & *krystallos* (Gr) - hidden crystal; *crystallum* (L)

VARIETIES:
Agate - various medium shades, with translucency [*Achates* (Gr) - the name of a river in Sicily (now the Drillor River)]
Chalcedony (kal-SED-oh-nee) - light shades [Chalcedon, a seaport in Asia Minor]
Jasper (JAS-per) - opaque or nearly so, deep colors [*iaspis* (Gr) - a green stone]

SUB-VARIETIES OF CHALCEDONY:
Chalcedony rose - a much convoluted and folded microcrystalline aggregate; usually white, may be pinkish or bluish
Fire agate - containing iridescent goethite (limonite) layers
Turtle-back agate - a pattern resembling the back of a turtle

SUB-VARIETIES OF AGATE, single color:
Carnelian (cornelian) (CAR-neel-yun) - shades of orange [*carnis* (L) - flesh]
Chrysoprase (CHRIS-oh-praise) - apple green [*chrysos* & *prason* (Gr) - gold & leek]
Gem chrysocolla (CHRIS-oh-cola) - blue to greenish-blue, containing chrysocolla; also called gem silica
Iris agate (EYE-ris) - iridescent colors when cut in thin sections, due to diffraction of light by crystalline layers [*iris* (Gr) - rainbow]
Plasma (PLAS-muh) - dark green [*plasma* (Gr) - molded]
Prase (PRAISE) - yellow-green to leek-green [*prason* (Gr) - leek]
Sard (SAHR-d) - brown to reddish-brown [sardis, a city in Asia Minor]

SUB-VARIETIES OF AGATE, multiple colors:
Banded agate - straight parallel bands of any color in any order
Fortification agate - bands in an irregular circular pattern
Moss agate, plume agate, etc. - various inclusions resembling the names
Onyx (AHN-ix) - straight parallel bands, white alternating with black, gray, or any color except red, orange, or brown [*onyx* (Gr) - onyx]
Sardonyx (SAHRD-ahn-ix) - as onyx, but banding is white with red, orange, or brown [sarda (L) - sard] (see sard, above)

SUB-VARIETIES OF JASPER:
Bloodstone or heliotrope (HEEL-ee-oh-trope) - green with red spots [*helios* & *tropion* (Gr) - sun & to turn, a plant that turns to the sun]
Buddstone (BUD-stone) - mottled and swirled green
Chert (CHUR-t) - light colors to red and brown [ceart (Persian) - a stone]
Flint - light to dark colors; usually formed under water
Tiger-eye ("crocidolite") (CROW-sid-oh-lite), (brown to orange) and ***hawk's-eye,*** (blue) - a pseudomorph; of chalcedony after asbestos
Touchstone, "***black onyx***" - black; used to test gold fineness. Much of what is sold as black onyx is cryptocrystalline quartz that has been dyed black.

OTHER VARIETIES:
Coprolite (COP-roe-lite) fossilized dinosaur dung
Dinosaur Bone (DI-no-sawr) fossilized dinosaur bone infiltered with agate or jasper (also calcite)
Myrickite (MY-rick-ite) - light color agate with included cinnabar (see also opal)
Novaculite (no-VAC-you-lite) - fine grained quartz cemented with chalcedony
"***Pecos diamond***" (PAY-cos) - quartz crystal replaced with chalcedony
Petrified wood (PET-rih-fide) - wood infiltered with agate or jasper (also opal)

All types of cryptocrystalline quartz are essentially made of very small quartz crystals that are locked and entwined to produce a tough and durable gem material. The admixture of colored minerals makes for the many varieties. Agates, jaspers, etc., are found world wide. The southwest desert regions are especially good producers; a result, in part, of sparse vegetation. Mexican agates are probably the world's finest. Brazil is a prolific producer of agates of many types. The desert regions of Africa are also good producers. There are many other localities, too numerous to mention.

QUARTZITE (see breccia)

QUARTZ-ite

REALGAR

ree-AL-gar

Arsenic monosulfide
AsS
Monoclinic
Habit- crystals rare, usually massive
Hardness- 1.5 to 2
Specific gravity- 3.56
Cleavage- easy, two directions
Fracture- conchoidal
Streak- red to red-orange
Inclusions- veils and cracks

Color- Deep red, red-orange, (yellow-orange)
RI- X-2.538, Y-2.684, Z-2.704
Critical angle- 23°
Birefringence- .166, very strong
Dispersion- strong
Transparent to translucent
Luster- resinous to adamantine
Optically- biaxial negative
2V angle- 400
Name- *rahj al ghar* (Ar) - powder of the mine

A very brittle material that disintegrates on exposure to light. The brittleness is of real concern during cutting. It has been cut into beautiful faceted gems. The sensitivity to light makes it unsatisfactory for collections on view for long periods.

RED BERYL (see beryl)

RHODIZITE

ROE-diz-ite

Basic cesium aluminum beryllium borate
$CsAl_4Be_4B_{11}O_{25}(OH)_4$
Isometric
Habit- dodecahedral
Hardness- 8
Specific gravity- 3.4
Cleavage- none
Fracture- uneven
Streak- uncolored
Inclusions- usually flawless when clear

Colorless, yellowish, greenish, (red)
RI- n-1.6935
Critical angle- 36.5°
Transparent to translucent
Luster- vitreous
Name- *rhodozein* (Gr) - to be rose- colored; from the color in a flame

This very rare mineral is found only in very small crystals. If it were more plentiful it would probably have some popularity as a gem. At present it is to be found in very few collections. Presently found in gem quality in only two mines in Madagascar. It is always associated with red tourmaline.

RHODOCHROSITE (Calcite Group)

roe-doe-CROW-site

Manganese carbonate
$MnCO_3$
Hexagonal
Habit- rhombohedral, massive
Hardness- 3.5 to 4.5
Specific gravity- 3.45 to 3.7
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Inclusions- crystals are usually flawless, interference planes in groups and in the massive material

Color- Pink to red, brownish, yellowish-red
RI- O-1.816 to 1.82, E-1.597 to 1.60
Critical angle- 33.5° and 38.5°
Birefringence- .22, very strong
Transparent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- *rhodo & chrosis* (Gr) - pink colored
Alternate names- inca rose or rosinca, the massive banded type

This material is plentiful in the massive type, but rare in the transparent facetable type. The transparent material produces exceedingly beautiful gems. The best present source of facetable material is South Africa. Argentina has produced excellent massive material. Colorado produced excellent faceting material about twenty years ago; the potential for more production probably exists. Peru produces fine crystals that may have a faceting potential.

RHODOLITE (See Garnet Group – pyralspite subgroup) ROAD-oh-lite

RHODONITE (Pyroxene Group) ROE-dun-ite

Manganese silicate
$MnSiO_3$
Triclinic
Habit- prismatic, massive
Hardness- 5.5 to 6.5
Specific gravity- 3.4 to 3.7 (3.5)
Cleavage- very perfect, two directions
Fracture- conchoidal to uneven
Streak- white
Inclusions- black manganese oxide blobs

Color- Rose-red to brownish-red
RI- X-1.738, Y-1.741, Z-1.751
Critical angle- 35.5°
Birefringence- .013, medium
Transparent to opaque
Luster- vitreous
Optically- biaxial positive or negative
2V angle- 76°
Name- *rhodo* (Gr) - pink

Fairly plentiful in the massive variety, but rare in transparent facetable crystals. Faceted gems are excellent. The crystals are very cleavable. The massive material is tough, sometimes greenish to grayish due to impurities. The black inclusions are pyrolusite or psilomelane (manganese oxides). The massive material, when fine grained, makes excellent cabochons. Massive material comes from Australia, Canada, Brazil, California, and other locations. The Australian material is the finest, and is often called gem rhodonite. The only good sources of facetable rhodonite are Australia and Brazil.

RHYOLITE RYE-oh-lite

A type of lava containing a high percentage of quartz
Habit- chunks
Hardness- approximately 6 to 7
Specific gravity- 2.53 approximately
Cleavage- none
Fracture- subconchoidal

Color- White, yellow, red, brown, usually banded
Opaque
Luster- earthy
Name- *rhyax* (Gr) - lava flow
Alternate names- wonderstone, rainbow rock, "hickoryite, and others

This is a highly variable cutting material. Some is very dense, and will produce excellent cabochons. Wonderstone ("hickoryite") is found in Nevada, New Mexico, and Mexico. Material known as orbicular rhyolite is found in Chihuahua, Mexico and Arizona. Chihuahuan orbicular rhyolite produces interesting cabochons. Arizona material has a fair lapidary potential.

RIBBONSTONE

A rock
Habit- lumps
Hardness- 7
Specific gravity- about 2.6
Cleavage- none
Fracture- subconchoidal
Streak- whitish

Color- Gray, yellow, greenish, reddish, black
Opaque
Luster- dull
Name- for the ribbon-like banding

This is a fine-grained sedimentary material that can be classed as a mudstone or siltstone. It was formed under water with currents determining the shape of the banding; which varies from slight curves to a swirl pattern. The color of the bands is determined by sediments which range from fine particles to very fine ones. Evidently some impurities are also factors in determining colors. The material takes an excellent polish. The best patterns are usually obtained by cutting at a 90° angle to the banding. It is found in a number of deposits in both Australia and New Zealand.

RICOLITE (see serpentine)

RUBELLITE (see Tourmaline Group – elbaite-dravite series)

RUBY (see corundum)

RUTILE GROUP (see individual minerals)

CASSITERITE - RUTILE

RUTILE (Rutile Group)

RUE-teel

Titanium dioxide
TiO_2
Tetragonal
Habit- prismatic, twins common
Hardness- 6 to 6.5
Specific gravity- 4.18 to 4.25
Cleavage- distinct, two directions
Fracture- subconchoidal
Streak- pale brown
Trimorphous with anatase and brookite
Inclusions- none observed

Color- Red, yellow, (blue), (violet), black
RI- O-2.612 to 2.616, E- 2.899 to 2.903
Critical angle- 21°
Birefringence- .287, very strong
Dichroism- strong, medium to dark
Dispersion- .30, very strong
Transparent to opaque
Luster- adamantine to submetallic
Optically- uniaxial positive
Name- *rutilus* (L) - red

At best, the natural red material is so dark that transparency is seen only in thin sections. The synthetic material (see page 122) is a very transparent gem material. Natural rutile is best known as the inclusions in rutilated quartz. Brazil is the best source for both single crystals and crystals included in quartz. California has produced some single crystals and rutilated quartz. Large crystals, or massive material, can be cut into splendent reddish cabochons.

SAMARSKITE (see euxenite)

SAM-are-skite

SAPPHIRE (see corundum)

SAPPHIRINE

SAFF-er-ine

Magnesium aluminum silicate
$Mg_4Al_9Si_2O_{20}$
Monoclinic
Habit- tabular, granular
Hardness- 7.5
Specific gravity- 3.4 to 3.5
Cleavage- indistinct
Fracture- uneven to subconchoidal
Streak- white
Inclusions- mica flakes

Color- Pale to deep blue, (green)
RI- X-1.716, Y-1.721, Z-1.723
Critical angle- 36°
Birefringence- .007, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 47.5°
Name- *sapphirios* (Gr) - blue

This mineral is very rarely seen as facetable pieces. The color is usually much lighter than the name implies. Madagascar is the only known source of faceting material.

SARCOLITE

SAHR-coe-lite

Sodium calcium aluminum silicate
$NaCa_4Al_3Si_5O_{19}$
Tetragonal
Habit- crystals pseudocubic
Hardness- 6
Specific gravity- 2.92
Cleavage- ?
Fracture- ?
Streak- ?

Color- Flesh-red
RI- O-1.604-1.640, E-1.615-1.657
Critical angle- 38°
Birefringence- .011 to .017, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial positive
Name- *sarkos* (Gr)- flesh colored

This is a one-location mineral found only in volcanic rock on Mt. Vesuvius, Italy. It is reported to have been faceted. Most material is usable for cabochons.

SATIN SPAR (see gypsum)

SAUSSERITE (see zoisite)

SCAPOLITE GROUP (wernerite is an old name)

SCAP-oh-lite

Calcium sodium aluminum silicates
$Na_3AlSi_3O_8$ NaCl-to-$Ca_3Al_2Si_{12}O_8$ $CaCO_3$
Tetragonal
Habit- prismatic, massive
Hardness- 5 to 6
Specific gravity- 2.60 to 2.78
Cleavage- distinct, two directions
Streak- white
Inclusions- needles, some parallel that produce cat's eye gems. Most crystals are very clean.

Colorless, yellow, orange, purple
RI- O-1.54-1.55, E-1.49-1.577
Critical angle- 40°
Birefringence- medium (variable)
Dispersion- .017, medium (variable)
Dichroism- medium to strong
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- *scapos* (Gr) - rod; for the long prismatic crystals
Name- for A. G. Werner, mineralogist

What is usually known as scapolite is one member of the following series; meionite, mizzonite, or marialite. [*meios* (Gr) - less; *mezzano* (It) - middle; for Maria, the wife of a mineralogist]. Most cutting material on the market may be about midpoint (mizzonite) between the two end members. None of the group are plentiful. East Africa produces a fine orange and an excellent purple faceting material; and an excellent cat's-eye material. A nice yellow material is found in Brazil. A mottled material from Colorado makes nice cabochons.

SCHEELITE

SHE-lite

Calcium tungstate
$CaWO_4$
Tetragonal
Habit- pyramidal, massive
Hardness- 4.5 to 5
Specific gravity- 5.9 to 6.1
Cleavage- distinct, two directions
Fracture- uneven
Streak- white
Inclusions- cleavage plane cracks, veils

Colorless, yellow, orange, brown
RI- O-1.918, E-1.934
Critical angle- 31.5°
Birefringence- .016, medium
Dispersion- .026, medium
Transparent to translucent
Luster- vitreous to adamantine
Optically- uniaxial positive
Name- for Karl W. Scheele, Swedish chemist

Excellent faceted gems have been cut from this mineral. This usually fluoresces bright bluish-white under short-wave ultraviolet light. Colorless material comes from California and a fine orange comes from Mexico. Massive material can be cut into lustrous cabochons.

SCHORL (see Tourmaline Group – dravite-schorl series)

SHORE-L

SCOLECITE (Zeolite Group)

SKOL-eh-site

Hydrous calcium aluminum silicate
$CaAl_2Si_3O_{10}{\bullet}3H_2O$
Monoclinic
Habit- slender prismatic, massive
Hardness- 5
Specific gravity- 2.16 to 2.27
Cleavage- perfect, one direction
Fracture- uneven, brittle
Streak- white
Inclusions- needle-like lines

Colorless, white
RI- X-1.507, Y-1.518, Z-1.521
Critical angle- 41°
Birefringence- .014, medium
Transparent to translucent
Luster- vitreous to silky
Optically- biaxial negative
2V angle- 36° to 56°
Name- *skolex* (Gr) - a worm

This mineral is found in long slender crystals, some of which contain small clear areas that may be faceted. Gems will usually be very small and low in brilliance. India produces the best crystals with faceting potential.

SCORODITE

SCORE-oh-dite

Hydrous iron arsenate
$FeAsO_4 \cdot 2H_2O$
Orthorhombic
Habit- pyramidal, prismatic, massive
Hardness- 3.5 to 4
Specific gravity- 3.29
Cleavage- imperfect
Fracture- conchoidal, brittle
Streak- white
Inclusions- veils and cracks

Color- Green, brownish, blue, violet
RI- X-1.785, Y-1.796, Z-1.812 (variable)
Critical angle- 34.5°
Birefringence- .027, medium
Dichroism- strong, purple to blue
Transparent to translucent
Luster- vitreous to resinous
Optically- biaxial positive
2V angle- 75° (Tsumeb material)
Name- *skorodon* (Gr) - garlic; for the odor when heated

A few years ago this material was found at Tsumeb, Namibia in nice clear purple crystals which have been cut into small gems. This is one of the few localities that produce cutting material. Gems are very nice, showing the dichroism.

SCORZALITE (see lazulite)

SELENITE (see gypsum)

SELLAITE

SELL-uh-ite

Magnesium fluoride
MgF_2
Tetragonal
Habit- prismatic to acicular
Hardness- 5
Specific gravity- 3.158
Cleavage- perfect, two directions
Fracture- conchoidal, brittle
Streak- white
Inclusions- none observed

Colorless, white, purple
RI- O-1.378, E-1.390
Critical angle- 45°
Birefringence- .012, medium
Transparent to opaque
Luster- vitreous
Optically- uniaxial positive
Name- for Quintino Sella, Italian mineralogist

Recently, fine clear crystals have been found in Brazil. These are large enough to be cut into reasonable sized gems. The price, compared to the optics of the resultant gem, is much out of line.
A massive purple material (from Australia) can be cut into interesting cabochons.

SENARMONTITE

sen-ARM-on-tite

Antimony trioxide
Sb_2O_3
Isometric
Habit- octahedral, massive
Hardness- 2
Specific gravity- 5.3
Cleavage- perfect, four directions
Fracture- uneven, very brittle
Streak- white
Inclusions- many veils

Colorless, gray
RI- n-2.087
Critical angle- 29°
Transparent to opaque
Luster- adamantine
Name- for Henry de Senarmont, French professor

This rare mineral is sometimes found in small transparent crystals; some of which have been faceted. It is extremely brittle. The best crystals presently come from Morocco.

SEPIOLITE

SEA-pea-oh-lite

Hydrous magnesium silicate
$Mg_2Si_3O_8 \cdot 2H_2O$
Orthorhombic
Habit- amorphous lumps
Hardness- 2
Specific gravity- 2
Cleavage- none
Fracture- uneven
Streak- white

Color- White
RI- approximately 1.52
Opaque
Name- *sepion* (Gr) - cuttlefish bone, which it resembles
Alternate name- meerschaum, [*meer & schaum* (Ger) - sea foam; as it will float]

Originally used to make pipes for tobacco. It recently has been used for carving. In spite of the specific gravity, it will float on water; which is due to a high porosity. A number of locations in Europe have produced good material, with Turkey being the prominent producer. Sepiolite from Utah has recently been sold on the market.

SERANDITE

sir-AND -ite

Basic manganese sodium silicate
$Mn_2NaSi_3O_8(OH)$
Triclinic
Habit- tabular to prismatic
Hardness- 4.5 to 5
Specific gravity- 3.32
Cleavage- perfect, two directions
Fracture- uneven, brittle
Streak- white
Inclusions- many cleavage plane cracks

Color- Pink, rose-red, pinkish-orange
RI- X-1.660, Y-1.664, Z-1.668
Critical angle- 35.5°
Birefringence- .008, weak
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 35.5°
Name- for J. M. Serand, West African mineral collector

This is a relative newcomer for faceting. Gems are not really spectacular, but the pink color is interesting. A location in Canada produces fair sized crystals, but they are seldom flawless. The cleavages are troublesome during cutting. Massive pieces, or flawed crystals, can be cut into interesting reflective cabochons.

SERAPHINITE (see clinochlore)

SERENDIBITE (Aenignatite Group)

sir-END-dih-bite

Calcium magnesium iron aluminum boro-silicate
$(Ca_4Mg_6Fe_{15}Al_{21})\ Si_6B_3O_{40}$
Monoclinic
Habit- rounded grains, massive
Hardness- 6.5 to 7
Specific gravity- 3.4
Cleavage- none, probable parting along polysynthetic twinning planes
Fracture- uneven
Streak- white

Color- Blue, greenish-blue
RI- X-1.701, Y-1.703, Z-1.706
Critical angle- 36°
Birefringence- .005, weak
Trichroism- strong, yellow, green, blue
Dispersion- strong
Feebly transparent to translucent
Luster- vitreous
Optically- biaxial positive
Name- from Serendib a former name for Sri Lanka (also formerly Ceylon)

Very little is known about the lapidary use of this material, but material from Sri Lanka has been cut into cabochons. It appears in very few other localities.

SERICITE (a variety of muscovite) (Mica Group)

SEHR-ih-site

Basic potassium aluminum silicate
$KAl_3Si_3O_{10}(OH)_2$
Monoclinic
Habit- compact massive
Hardness- 2.5 and 4?
Specific gravity- 2.6
Cleavage- not evident
Fracture- splintery
Streak- white
Colorless, gray, yellowish
RI- 1.5 to 1.6 (unimportant)
Translucent to opaque
Luster- dull
Name- *sericus* (L) - silky

This is an unusual material that can be cut into cabochons. A good gem will show a spangled look from the reflections from the flat surfaces of the mica flakes. Polishing is difficult because the hardness of the edges of the flakes (crystals) is greater than that of the flat faces.

SERPENTINE (antigorite)

SIR-pen-teen, an-TIG-or-ite

Basic magnesium silicate
$(Mg, Fe)_3Si_2O_5(OH)_4$
Monoclinic
Habit- massive, never crystalline
Hardness- 2.5 to 4, rarely 5
Specific gravity- 2.2 to 2.65
Cleavage- rarely distinct, one direction
Fracture- conchoidal to splintery
Streak- white
Inclusions- veils & dark to light particles
Color- Leek to dark green, yellow, brownish
RI- 1.49 to 1.57 (variable)
Critical angle- 40° (unimportant)
Birefringence- weak
Nearly transparent to opaque
Luster- resinous to greasy
Name- *serpens* (L) - snake; for its resemblance to snakeskin
Imitation- has often been used as a jade substitute

VARIETIES:
Bowenite - light green to yellow [George T. Bowen, mineralogist]
Ricolite - banded light to dark green [for Rico, New Mexico; where it is found]
Chrysotile - green to white, fibrous (asbestos) [*chrysos & tilos* (Gr) - golden fiber]
Verd antique - green and white mottled, mixed with calcite [*verde antico* (It) - ancient green]
Williamsite - bright green (chromium bearing) [for L. W. Williams, American collector]

The well-known lapidary materials are all now classed as the mineral antigorite [Antigorio Valley, Italy]. All are potential cabochon or carving materials. Williamsite and bowenite have been faceted, but do not produce clear gems.

SHATTUCKITE

SHAT-tuck-ite

Basic copper silicate
$Cu_5(SiO_3)_4(OH)_2$
Monoclinic
Habit- always massive, fibrous
Hardness- 3.5 to 4
Specific gravity- 3.8
Fracture- uneven
Streak- blue
Color- Blue
RI- 1.75 (approx.)
Opaque
Luster- dull
Name- for Shattuck Mine, Bisbee, Arizona

This material is sometimes used to make interesting cabochons. It ordinarily is composed of small groups of interlocking radiating crystals. It has been found in copper mines in Arizona, Africa and Mexico.

SHELL (see pearl)

SHORTITE

SHORT-ite

Sodium calcium carbonate
$Na_2Ca_2(CO_3)_3$
Orthorhombic
Habit- wedge-shaped crystals
Hardness- 3
Specific gravity- 2.60
Cleavage- distinct, one direction
Fracture- conchoidal, brittle
Streak- white
Inclusions- clay and some veils

Colorless to pale yellow
RI- X-1.531, Y-1.555, Z-1.570
Critical angle- 41°
Birefringence- .039, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 75°
Name- for Maxwell Short, professor of mineralogy

This is a very rare mineral, occurring only in two known localities. Both are in the clay and drill cores of oil wells; one in Wyoming, the other in Utah. Cut gems are very rare, and somewhat uninteresting.

SIBERITE (see Tourmaline Group – elbaite-dravite series)

SIDERITE (Calcite Group)

SID-er-ite

Iron carbonate
$FeCO_3$
Hexagonal
Habit- rhombohedral, massive
Hardness- 3.5 to 4
Specific gravity- 3.83 to 3.9
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Inclusions- many cleavage plane cracks, some dark blobs

Color- Gray, yellowish, greenish, brown
RI- O-1.873, E-1.633
Critical angle- 32.5° and 38°
Birefringence- .24, very strong
Dispersion- strong
Transparent to opaque
Luster- vitreous to pearly
Optically- uniaxial negative
Name- *sideros* (Gr) - iron; for the constituent

Crystals are sometimes transparent and can be faceted into excellent gems. Occasionally, massive material is cut into cabochons. Portugal has produced fine faceting material.

SILLIMANITE (fibrolite)

SILL-ih-man-ite, FIE-bro-lite

Aluminum silicate
Al_2SiO_5
Orthorhombic
Habit- long prismatic, massive
Hardness- 6 to 7.5
Specific gravity- 3.23 to 3.25
Cleavage- perfect, one direction
Fracture- uneven
Streak- uncolored
Inclusions- rarely cleavage plane cracks in transparent material

Colorless, gray, brownish, green, blue
RI- X-1.654, Y-1.658, Z-1.673 variable
Critical angle- 37.5°
Birefringence- .03, (approx.) medium
Pleochroism- sometimes distinct
Dispersion- .019, medium (variable)
Transparent to opaque
Luster- vitreous
Optically- biaxial positive
2V angle- 25° (approx.)
Names- for Benjamin Silliman, American mineralogist for the fibrous massive structure

VARIETIES:
Fibrolite - very tough jade-like massive material, hardness 6 to 7
Sillimanite - the transparent crystal form, hardness 7+

The gem gravels of the orient produce the best facetable material. Locations in United States produce good massive cabochon material (fibrolite). Fine cat's eye comes from Brazil.

SILVER (see copper)

SIMPSONITE

SIMP-son-ite

Basic aluminum tantalate
$Al_4Ta_3O_{13}OH$
Hexagonal
Habit- tabular, prismatic
Hardness- 7.5 to 8
Specific gravity- 6.0 (approximately)
Cleavage- indistinct
Fracture- subconchoidal
mineralogist
Inclusions- many cracks

Color- Yellow, orange
RI- O-1.976, E.2.034
Critical angle- 31°
Birefringence- .10, very strong
Transparent to translucent
Luster- vitreous to adamantine
Optically- uniaxial positive
Name- for Dr. E. S. Simpson, Australian Streak- uncolored

Simpsonite is a very rare mineral, with faceting material known from only two locations; Australia and Brazil. If it were more common, it would be a popular gem material. Brazilian material was on the market in the 1970's.

SINHALITE

SIN-ah-lite

Magnesium aluminum iron borate
$Mg(Al, Fe)BO_4$
Orthorhombic
Habit- prismatic
Hardness- 6.5
Specific gravity- 3.47 to 3.49
Cleavage- none
Fracture- conchoidal
Streak- uncolored
Inclusions- none observed, but veils are no doubt a possibility

Color- Yellow-brown, golden, greenish-brown
RI- X-1.667, Y-1.697, Z-1.705
Critical angle- 36.5°
Birefringence- .038, medium
Trichroic- light green to dark brown
Dispersion- .017, medium
Transparent to opaque
Luster- vitreous
Optically- biaxial negative
2V angle- 55°
Name- Sinhala, Sanskrit name for modern Sri Lanka

Very few crystals have been found. The material is usually rolled pebbles. It was formerly thought to be brown peridot. Sri Lanka is the only known source of facetable material. Recently, excellent water-worn pieces have been on the market. These produce excellent gems.

SKUTTERUDITE

scut-er-OO-dite

Cobalt arsenide
$CoAs_3$
Isometric
Habit- massive, cubic, octahedral
Hardness- 5.5 to 6
Specific gravity- 6.1 to 6.9
Cleavage- distinct, two directions
Fracture- uneven to conchoidal
Streak- black

Color- Tin white, may tarnish iridescent or gray
Opaque
Luster- metallic
Name- for Skutterud, Norway

Massive material is usually mixed with other minerals such as arsenopyrite, silver, etc. When unmixed, the massive material can be cut into bright silvery-white cabochons with a unique angular crystal pattern. Material from Morocco seems to have the best lapidary potential. A variety, smaltite (cobalt nickel arsenide) from Ontario, Canada, also has good cabochon potential.

SMALTITE (see skutterudite)

SMITHSONITE (Calcite Group) SMITH-son-ite

Zinc carbonate
$ZnCO_3$
Hexagonal
Habit- prismatic, reniform
Hardness- 4 to 5.5
Specific gravity- 4.3 to 4.45 (4.3)
Cleavage- perfect, three directions
Fracture- uneven
Streak- white
Inclusions- cleavage plane cracks in the transparent material

Color- Yellow, green, blue, pink, purple
RI- O-1.849. E-1.621
Critical angle- 33°
Birefringence- .228, very strong
Transparent to opaque
Luster- greasy to pearly
Optically- uniaxial negative
Name- for James Smithson, founder of Smithsonian Institution
Alternate name- calamine [*calamina* (L) from *kadmeia* (Gr) - earth]

Transparent crystals are sometimes faceted; Namibia is the best source for these. Smithsonite is best known as the blue or green massive material that makes fine splendent cabochons. New Mexico and other worldwide locations produce this type of material. A nice yellow color is sometimes called "turkey fat". A beautiful pink material is found in Mexico. Much of the massive material is banded. The alternate name calamine is unique. It is also used for hemimorphite. In the massive forms, the two minerals are difficult to separate. Smithsonite effervesces with hydrochloric acid, hemimorphite will not.

SOAPSTONE (see Talc)

SODALITE GROUP (see individual minerals)
HAUYANE - LAZURITE - NOSEAN - SODALITE

SODALITE (Sodalite Group) SODA-lite

Sodium aluminum chloro-silicate
$Na_4Al_3Si_3O_{12}Cl$
Isometric
Habit- dodecahedral, massive
Hardness- 5.5 to 6
Specific gravity- 2.14 to 2.3 (2.24)
Cleavage- poor
Fracture- conchoidal to uneven
Streak- white
Inclusions- numerous veils and cracks

Color- Blue, white, rarely yellow, gray, green, red
RI- n-1.483 to 1.487
Critical angle- 42.5° (unimportant)
Subtransparent to opaque
Luster- vitreous
Name- for its sodium content

Pieces of this material have been faceted, even though it is never truly transparent. It is most often used as a cabochon material. Namibia is the best possible source of potential faceting material. Brazil has produced material nearly as good. Brazil, Canada, and Namibia produce excellent cabochon material. Hackmanite is a variety containing a small amount of sulfur in the molecule. It exhibits an interesting fluorescence and phosphorescence. The mineral is white, but turns orange or red in ultra-violet light. With short-wave light the color may remain for a period, but it fades rapidly in sunlight. The color cycle can be repeated many times. There are reports of transparent hackmanite, but the authors have not seen it. Good material comes from near Ontario, Canada. [for Victor Hackman, Finnish scientist]

SPESSARTINE (see Garnet Group – pyralspite subgroup) SPESS-are-tine

SPHAEROCALCITE (see calcite)

SPHALERITE (Sphalerite Group)

SFAY-ler-ite, SFAL-er-ite

Zinc sulfide
ZnS
Isometric
Habit- tetrahedral, cubic, massive
Hardness- 3.5 to 4
Specific gravity- 3.9 to 4.1
Cleavage- perfect, six directions
Fracture- conchoidal
Streak- white to brownish
Inclusions- cleavage plane cracks and metallic particles

Colorless, green, orange, red, black
RI- n-2.369 to 2.428, variable
Critical angle- 25°
Dispersion- .156, very strong
Transparent to translucent
Luster- adamantine
Name- *sphaleros* (Gr) - treacherous; for its poor melting properties
Alternate names- zinc blende, blende [*blenden* (Ger) - deceiver; for its association with galena]

When transparent, this material will produce brilliant, fiery, faceted gems. The massive material, of most types, can be cut into splendent cabochons. The difference in refractive index is due to impurities. Spain and Mexico produce very excellent clear facetable material. The name blende is used in Europe.

SPHENE (titanite)

SFEEN, TIE-tan-ite

Calcium titano-silicate
$CaTiSiO_5$
Monoclinic
Habit- wedge-shaped prisms
Hardness- 5 to 5.5
Specific gravity- 3.4 to 3.56 (3.5)
Cleavage- distinct to imperfect, two directions
Fracture- uneven
Streak- white
Inclusions- many veils of small bubbles, cracks; a crystal is seldom completely clear

Color- Yellow, green, red, brown, black
RI- X-1.950, Y-2.034, Z-2.110
Critical angle- 30.5°
Birefringence- .160, very strong
Trichroism- feeble to distinct
Dispersion- .051, strong
Transparent to translucent
Luster- adamantine
Optically- biaxial positive
2V angle- small
Name- *sphen* (Gr) - wedge, from the shape of the crystals
Alternate names- spinthere, green; [from *spinther* (Gr) -spark; for dispersion], also titanite- brown to black; for titanium (titanite is the mineral name)

Sphene produces very brilliant fiery faceted gems. Twin crystals are common. Baja California, Mexico, Brazil and Madagascar have produced excellent clear material. Massive pieces can be cut into very splendent cabochons; but if the material is transparent the high value makes it sensible to cut only faceted gems.

SPINEL GROUP (see individual minerals)

CHROMITE - GAHNITE - JACOBSITE - MAGNETITE - SPINEL

SPINEL (Spinel Group)

spin-ELL

Magnesium aluminate
$MgAl_2O_4$
Isometric
Habit- octahedral, twins common
Hardness- 8
Specific gravity- 3.5 to 3.98 (3.6)
Cleavage- imperfect
Fracture- conchoidal
Streak- uncolored
Inclusions- angular small crystals, negative crystals

Color- Blue, green, orange, red, purple, black
RI- n-i.715 to 1.73 plus
Critical angle- 35.5°
Dispersion- .020, medium
Transparent to opaque
Luster- vitreous
Name- *spina* (L) - thorn; for the sharp pointed crystals

VARIETIES:
"Almandine" spinel - purple [in reference to the garnet]
Chlorospinel (ceylonite) - deep green [*chloros* (Gr) - green]
Gahnospinel - a deep blue (zinc-rich, RI-1.753) [J. G. Gahn, Swedish mineralogist]
Hyacinth spinel - orange-red [*hyacinthus* (L) - a yellow-orange flower]

Spinel continued on next page.

Pleonaste and picotite - opaque black [*pleonastus* (Gr) - abundant; for extra crystal faces & for a French botanist named Picot]
"Ruby" spinel - red

Other color shades are exhibited by spinel, with some having varietal names. All colors can be cut into excellent faceted gems, but the blue and purple are often "muddy" appearing. Pleonaste and picotite are sometimes cut into jet black gems. These can be cut into cabochons, but because of the value of the clear material, it is seldom cut in this manner. Sri Lanka and Africa are the best sources.

SPODUMENE (Pyroxene Group)

SPOD-you-mean

Lithium aluminum silicate
$LiAlSi_2O_6$
Monoclinic
Habit- prismatic
Hardness- 6.5 to 7
Specific gravity- 3.13 to 3.20 (3.18)
Cleavage- perfect, two directions
Fracture- uneven to conchoidal
Streak- uncolored
Inclusions- cleavage plane cracks, long needles which are known as etching pits; they are hollow

Colorless, yellow, green, blue, violet
RI- X-1.660, Y-1.666, Z-1.676
Critical angle- 37°
Birefringence- .016, medium
Pleochroism- strong, light to deep colors
Dispersion- .017, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial positive
2V angle- 54° to 69°
Name- *spodumenos* (Gr) - burned to ashes; from the look after being burned for testing

VARIETIES:
Colorless - no varietal name recorded
Hiddenite - yellowish-green to green [William Hidden, American collector]
Kunzite - shades of violet, pink and bluish [George F. Kunz, American gemologist]
Triphane - light yellow to greenish-yellow [*tri* & *phanein* (Gr) - three to appear]

A beautiful highly dichroic (really trichroic) gem material that makes excellent gems. Sometimes one trichroic color is undesirable (ie a yellow in kunzite). Brazil is the most prominent source of most colors of faceting material. A new source for lighter colors is Afghanistan. California produces kunzite.

SPURRITE

SPUR-ite

Calcium silico-carbonate
$Ca_5Si_2O_8CO_3$
Monoclinic
Habit- usually massive
Hardness- 5
Specific gravity- 3.0
Cleavage- distinct, one direction
Fracture- interrupted
Streak- white

Color- Gray to lavender-gray
RI- 1.64 to 1.67
Translucent
Luster- vitreous
Name- for Josiah E. Spurr, American geologist

Massive material can be cut into unique cabochons.

STAUROLITE

STAR-oh-lite

Basic iron aluminum silicate
$Fe_2Al_9Si_4O_{22}(OH)_2$
Orthorhombic
Habit- prismatic, usually twins
Hardness- 7 to 7.5
Specific gravity- 3.7 to 3.8
Cleavage- poor
Fracture- subconchoidal
Streak- uncolored to grayish
Inclusions- many cracks and veils in the transparent material

Color- Brown, black, reddish
RI- X-1.736, Y-1.741, Z-1.746
Critical angle- 35°
Birefringence- .01, medium
Trichroism- red to yellowish-red
Transparent (rarely) to opaque
Luster- vitreous to resinous
Optically- biaxial positive
2V angle- 88°
Name- *staros* (Gr) - cross; from the shape of the crystals
Alternate names- fairy stone, fairy cross

Rarely, crystals will contain areas clear enough to facet brilliant, deep reddish gems. Brazil is the only known source of facetable material. Opaque crystals can be cut into velvety cabochons.

STEATITE (see talc)

STIBIOTANTALITE

stib-ee-OH-tan-tah-lite

Antimony tantalate
$SbTaO_4$
Orthorhombic
Habit- prismatic
Hardness- 5.5 to 6
Specific gravity- 6.0 to 7.5
Cleavage- perfect, one direction
Fracture- uneven
Streak- white to grayish
Inclusions- numerous veils, some dark blobs

Colorless, yellow, reddish-brown, brown
RI- X-2.374, Y-2.403, Z-2.456 (variable)
Critical angle- 25.5°
Birefringence- .082, strong (variable)
Trichroism- strong in deep colors
Dispersion- strong
Transparent to translucent
Luster- subadamantine
Optically- biaxial positive
2V angle- 75° (approx.)
Name- *stibium* (L) - antimony; plus the tantalum in the molecule

A very rare mineral, occasionally seen in transparent pieces. A dark brown to golden, nearly clear, material has come from California. Madagascar has produced a fine yellow material. An excellent colorless type comes from Brazil. None of the localities have produced large quantities.

STICHTITE

STICK-tite

Hydrous magnesium chromium carbonate
$Mg_6Cr_2CO_3(OH)_{16}•4H_2O$
Hexagonal
Habit- massive, micaceous
Hardness- 1.5 to 2.5
Specific gravity- 2.16
Cleavage- perfect, one direction
Fracture- uneven
Streak- white

Color- Lilac with green serpentine veins
RI- O-1.545, E-1.518
Dichroic- light to dark lilac
Transparent to opaque
Luster- greasy to pearly
Optically- uniaxial negative
Name- for Robert Sticht, Tasmanian

An alteration product of serpentine or chromite, suitable for cabochons and carvings. South Africa and Tasmania, Australia produce nice cabochon material.

STILBITE (Zeolite Group)

STILL-bite

Hydrous sodium calcium aluminum silicate
$NaCa_2Al_5Si_{13}O_{36}•16H_2O$
Monoclinic
Habit- sheaf-like twins, massive
Hardness- 3.5 to 4
Specific gravity- 2.09 to 2.2
Cleavage- perfect, one direction
Fracture- uneven
Streak- white

Colorless, gray, pinkish, orange, brown
RI- X-1.484, Y-1.492, Z-1.494
Critical angle- 42°
Birefringence- .01, medium
Transparent to translucent
Luster- vitreous to pearly
Optically- biaxial negative
2V angle- 30° to 49°
Name- *stilbein* (Gr) - glitter; from the pearly luster

This mineral usually forms as twins. The sheaf-like form is unique and will sometimes furnish cabochon material. Cabochons are not greatly interesting, but may show a cat's-eye semblance. The quarries of New Jersey sometimes produce lapidary material. Nice orange crystal groups come from Australia.

STRONTIANITE (Aragonite Group)

STRON-tee-an-ite

Strontium carbonate
$SrCO_3$
Orthorhombic
Habit- prismatic
Hardness- 3.5
Specific gravity- 3.66 to 3.76
Cleavage- perfect, one direction
Fracture- uneven to subconchoidal
Streak- white
Inclusions- numerous veils

Colorless, yellow, greenish, reddish
RI- X-1.519, Y-1.666, Z-1.669
Critical angle- 41.5°
Birefringence- .150, very strong
Dispersion- weak
Transparent to translucent
Luster- vitreous to resinous
Optically- biaxial negative
2V angle- 7°
Name- for Strontian, Scotland; where first found

This unusual mineral is sometimes faceted or cut as cabochons. Gems have little to recommend them. Austria is the best probable source of facetable material. California produces a massive material that can be cut into cabochons.

STURMANITE (see ettringite)

SUCCINITE (see amber)

"SUCCINITE" (see Garnet Group – ugrandite subgroup – grossular)

SUGILITE (Osumlite Group)

SUE-jill-ite

Potassium sodium iron lithium silicate
$(K,Na)(Na,Fe)_2(Li,Fe)Si_{12}O_{30}$
Hexagonal
Habit- massive
Hardness- 5.5 to 6.5
Specific gravity- 2.74 (variable)
Cleavage- none
Fracture- granular, somewhat tough
Streak- white

Color- Magenta to purple to grayish
RI- 1.610 (approximately)
Translucent to opaque
Luster- waxy
Name- for Kenichi Sugi, Japanese petrologist
Commercial names- “Royal Lavulite”, from the lavender color, and “Royal Azel”, from the Hotazel location

This mineral was first discovered in Japan in 1944. This was of no lapidary consequence. In 1975 the mineral was noted, in small quantities, in a manganese mine in the Hotazel area of South Africa. The deposit was not mined until 1979 and then large amounts of sugilite were found. Reports show that about 24,000 pounds were recovered, of which about half was of gem quality. Most of the gem quality material has small inclusions of other minerals, mostly manganese oxides. The mine is no longer producing quality material. Sugilite can be cut into excellent purple to pinkish-purple cabochons with a good luster. The gems appear velvety through this luster. The more translucent pieces have been faceted, but any brilliance, which is slight, depends entirely on light reflection from the facet surfaces. Lavulite was the first name given (incorrectly) to this mineral, any use of it should be discouraged.

SULFUR (sulphur)

SUL-fur

A native element
Pure sulfur
Orthorhombic
Habit- prismatic
Hardness- 1.5 to 2.5
Specific gravity- 2.05 to 2.09
Cleavage- imperfect
Fracture- conchoidal
Streak- white
Inclusions- negative crystal cavities

Color- Yellow
RI- X-1.958, Y-2.038, Z-2.245
Critical angle- 28°
Birefringence- .287, very strong
Dispersion- weak
Transparent to opaque
Luster- resinous to adamantine
Optically- biaxial positive
2V angle- 68°
Name- *sulphur* (L) - sulfur

Sulphur has been faceted. It is very brittle. The gem surface alters and becomes cloudy. Italy produces perfectly clear crystals.

SUSSEXITE

sus-SEX-ite

Basic manganese borate
$MnBO_2OH$
Orthorhombic
Habit- massive, sometimes porcelaineous
Hardness- 3 to 3.5
Specific gravity- 3.30
Cleavage- none
Streak- white

Color- White, pinkish, yellow
RI- 1.67 to 1.73 (unimportant)
Translucent to opaque
Name- for Sussex County, New Jersey; where it was first found

The massive material sometimes has a fibrous structure and can be cut into silky cabochons.

TAAFFEITE (taaffeite group)

TARF-ite

Beryllium magnesium aluminate
$BeMg_3Al_8O_{16}$
Hexagonal
Habit- unknown
Hardness- 8
Specific gravity- 3.61
Cleavage- none
Fracture- conchoidal

Color- Light lilac to mauve
RI- O-1.722, E-1.718
Critical angle- 36°
Birefringence- .004, weak
Transparent
Luster- vitreous
Optically- uniaxial negative
Name- for Count Taaffe, Irish gemologist

Very few specimens of taafeite have ever been found. Less than 100 gems are known. Sri Lanka is the only known source. Some gems are probably unidentified and thought to be spinel. Gems are very good and much sought after.

TACHYLITE (see obsidian)

TALC (steatite)

TAL-k, STEE-uh-tite

Hydrous magnesium silicate
$Mg_3Si_4O_{10}(OH)_2$
Monoclinic (rarely triclinic)
Habit- massive, crystals very rare
Hardness- 1 to 1.5
Specific gravity- 2.58 to 2.83
Cleavage- sometimes perfect, one direction
Fracture- uneven
Streak- usually white

Color- White to green, brown, black
RI- 1.58 (approx.)
Translucent to opaque
Luster- greasy to pearly
Name- *talq* (Ar), to *talcum* (Fr)
Alternate names- soapstone; for the slippery feel
- steatite- massive, fine-grained; from *steatites* (Gr) - for a dough made with tallow (stear) [also *steatitis* (L)]

This material is often carved. Localities for material are widespread. Crystals may rarely be found within the massive material. The crystals are usually long and slender under these conditions.

TANTALITE (see columbite)

TAN-tall-ite

TANZANITE (see zoisite TAN-zan-ite)

TEKTITE

TECK-tite

Natural glass
SiO_2 plus various minerals
Amorphous
Habit- lumps
Hardness 5 to 6
Specific giavity- 2.2 to 2.5
Cleavage- none
Fracture- conchoidal
Streak- white
Inclusions- many bubbles

Color- Greenish-yellow, green, brown, black
RI- approximately n-1.5 (when clear)
Critical angle- 42°
Transparent to opaque
Luster- vitreous
Name- *tektos* (Gr) - molten

Tektite continued on next page.

VARIETIES:

Agni gemma, agni mani, "fire pearl" - tektites to which much lore is attached [Agni- a people of Africa & mani (Sp) - peanut].

Australite and billitonite - dark colors to black, somewhat smooth etched surfaces. Named for Australia and for Billiton Island, Indonesia

Moldavite - transparent green, very rough etched surfaces. Named for the Moldau River, Czechoslavakia

A yellowish glass called silica glass, of uncertain origin (may be a tektite), has been found in the Libyan desert. Tektites are very similar to obsidian, but are thought to have traveled through space. One thought is that they are from outer space; another thought is that they are terrestrial, but have been splashed out into space by a meteor, and then returned to earth. The finest tektites (clear green moldavites) are from Czechoslavakia. Nearly transparent, dark brown (billitonites) have recently come from Thailand.

TELLURIUM

TELL-ur-ee-um

A native metal
Te
Hexagonal
Habit- usually massive
Hardness- 2 to 2.5
Specific gravity- 6.25
Cleavage- perfect, one direction; imperfect, two directions
Fracture- uneven, brittle
Streak- gray
Color- Tin white
Opaque
Luster- metallic
Name- *tellus* (L) - the earth

This material can be cut into very splendent cabochons. New Mexico produces good cutting material.

TENNANTITE (Tetrahedrite Group)

TEN-an-tite

Copper iron arsenic sulfide
$(Cu,Fe)_{12}As_4S_{13}$
Isometric
Habit- massive, crystals rare
Hardness- 3 to 4
Specific gravity- 4.37 to 4.49
Fracture- uneven
Streak- black
Color- Black
Opaque
Luster- metallic
Name- for Smithson Tennant, English chemist

This mineral sometimes appears in veins of chrysocolla which makes striking cabochons. Montana, Arizona, and Chile have been sources.

TENORITE

TEN-or-ite

Cuprous oxide
CuO
Monoclinic
Habit- massive
Hardness- 3.5 to 4
Specific gravity- 6.5
Cleavage- none
Fracture- conchoidal
Streak- black
Color- Black, metallic gray
RI- ?
Opaque
Luster- dull
Name-for M. Tenor, Italian botonist

Tenorite is usually associated with chrysocolla, where it can impart interesting figuring in cabochons. Cabochons of pure tenorite have a nice luster, but are not of much interest. Tenorite is fairly common in localities that produce copper secondaries, such as Arizona, Mexico, Congo and Peru.

THAUMASITE

THAW-muss-ite

A complex basic hydrous calcium silicate
$Ca_3Si(CO_3)(SO_4)(OH)_6\ 12H_2O$
Hexagonal
Habit- massive, filling cavities in lava
Hardness- 3.5
Specific gravity- 1.877
Cleavage- in traces
Fracture- uneven
Streak- white

Color- White
RI- O-1.507, E-1.468
Translucent to opaque, weak chatoyancy
Luster- earthy to vitreous
Name- *thaumazein* (Gr) - wonder; from the complicated formula

Occasionally, this is compact enough to cut into cabochons. It is soft when found, and hardens on exposure to air. Good cutting material has come from Russia.

THOMSONITE (Zeolite Group)

TOM-son-ite

Hydrous calcium sodium aluminum silicate
$NaCa_2Al_5Si_5O_{20}{\bullet}6H_2O$
Orthorhombic
Habit- usually spherical concretions
Hardness- 5 to 5.5
Specific gravity- 2.3 to 2.4
Cleavage- crystals perfect, two directions
Fracture- uneven
Streak- white

Color- White, yellow, green, red, brown
RI- approximately 1.2
Translucent to opaque
Luster- vitreous to pearly
Name- for Thomas Thomson, Scottish chemist

Crystals are very rare. Most material is mottled or banded with various colors. The spherical material is cut into interesting cabochons. The Great Lakes region of the United States is the best known source.

THORITE

THOR-ite

Thorium silicate
$ThSiO_4$
usually metamict, and thus isotropic
Habit- short prismatic, massive
Hardness- 4.5, variable
Specific gravity- 4.1 to 6.7
Cleavage- not apparent in metamict form
Streak- usually brownish

Color- Brownish, yellowish, (orange)
RI- n-1.664 to 1.87 rarely O-1.78 to 1.825, Tetragonal, but E-179 to 1.84
Usually translucent to opaque. May be transparent in thin pieces.
Luster- vitreous to resinous to greasy
Name- for the thorium content

VARIETY:
Orangite - orange: s.g. 5.19- 5.4; RI- 1.8 (U+). A very rare form and sometimes is transparent enough to facet.

Thorite is not a rare mineral, it is found in pegmatites, limestones, and other formations. Most material is not suitable for lapidary purposes. A locality in Colorado produces material that can be cut into velvety looking brown cabochons. The best source for any form is Madagascar.

THULITE (see zoisite)

TILASITE

TILL-ah-site

Calcium magnesium fluor-arsenate
$CaMg(AsO)_4F$
Monoclinic
Habit- complex crystals, massive
Hardness- 5
Specific gravity- 3.77
Cleavage- good, one direction; parting, three directions
Fracture- granular
Streak- white

Color- Gray to violet-gray, greenish
RI- 1.64 to 1.67 (unimportant)
Translucent
Luster- vitreous to resinous
Name- for Daniel Tilus, Swedish mining engineer

Sweden produces a mottled material that can be cut into cabochons with a mediocre luster.

TITANITE (see sphene)

TOPAZ

TOE-paz

Basic aluminum fluo-silicate
$Al_2SiO_4(F,OH)_2$
Orthorhombic
Habit- prismatic
Hardness- 8
Specific gravity- 3.4 to 3.65 (3.53)
Cleavage- very perfect, one direction
Fracture- conchoidal to uneven
Streak- uncolored
Inclusions- small cavities containing liquids that appear as veils, some cubic crystals, some needles

Colorless, virtually all colors
RI- X-1.606 to 1.629, Y-1.609 to 1.631, Z-1.616 to 1.639 variable
Critical angle- 38°
Birefringence- .008, weak (approx.)
Trichroism- distinct, light to dark color
Dispersion- .010, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
2V angle- 49° to 66°
Name- *topazion* (Gr) to guess; for a foggy island in the Red Sea, now called Zeberget (a peridot location). Also - *topas* (sanskrit) - fire. The name topaz has a very uncertain origin.

VARIETIES:

Blue topaz - light to medium blue (most material on the market has been irradiated). Skyblue is medium-light blue, Swiss blue is medium blue, and London blue is a steel blue color.
Colorless topaz ("slaves diamond") - colorless to very light tan
Golden topaz - yellow to yellow-orange
Imperial topaz - red-orange to pink (the pink is often the result of heat treatment). Imperial topaz has risen greatly in price in recent years.
Peredell topaz - greenish hues (very rare)
Red or pink topaz - very rare color.

Much topaz contains veil-like inclusions which evidently are small drops of liquid carbon dioxide. Topaz is well known for its basal cleavage which can give trouble during cutting and polishing, if any facet is parallel to it. Some colors of topaz are rare, which has given rise to the (now illegal) practice of calling various hues of quartz as topaz. The blue color is not rare and excellent faceted gems are cut from it. Golden and imperial topaz are rare in large sizes, but small pieces (less than 10 carats), usually flawed, are commonly on the market. A recent introduction to the market is a fine deep blue topaz that has been gamma irradiated from colorless material.

Brazil produces nearly all colors. Mexico produces a fine sherry colored material. A fine blue comes from Rhodesia. Afghanistan produces excellent pure light pink crystals that can be cut into excellent gems. Australia produces small amounts. A true smoky topaz has been a subject of controversy for many years. Most of the books on gemology (if it is mentioned) have stated that such a gem material did not exist. The authors have agreed with this information. However, on a recent trip to Australia, the authors saw, (but did not obtain) a few pieces of topaz that certainly bordered on a smoky color. Perhaps we have been mistaken for many years.

TOPAZOLITE (see Garnet Group – ugrandite subgroup)

THE TOURMALINE GROUP [tourmali (Singhalese) - mixed gems]

TOUR-ma-leen

Until tourmaline was divided into a number of species, there were many very perplexing questions. These species were: elbaite, containing most of the known gem varieties; schorl was the name given to black tourmaline; and dravite was the name given to brown tourmaline. Another species, liddicoatite, was soon recognized. A new red material was found to be dravite, which prompted a closer look at dravite. Now it is thought that most Oriental brown material is uvite, which was previously theoretical. Recently, a bright yellow material was classed as tsilaisite. In 1985, a new greenish material, discovered in Russia, was found to be the species chromdravite. This is a sodium magnesium chromium boro-silicate [$NaMg_3Cr_6(BO_3)_3Si_6O_{18}(OH)_4$]. Crystals are very small needles about one-tenth millimeter across.

TOURMALINE GROUP (elbaite-dravite series)

ELBAITE (Tourmaline Group – elbaite-dravite series)

EL-buh-ite

Complex lithium aluminum boro-silicate
$Na(Li,Al)_3Al_6(BO_3)$
Hexagonal
Habit- prismatic, hemimorphic
Hardness- 7 to 7.5
Specific gravity- 3.03 to 3.10
Cleavage- none to indistinct
Fracture- subconchoidal to uneven
Streak- uncolored
Inclusions- liquid filled needles, flat films that reflect light, many cracks

Colorless, virtually all colors
RI- O-1.640-1.655, E-1.615-1.620
Critical angle- 38°
Birefringence- .025, medium
Dichroism- strong, light to dark colors
Dispersion- .017, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- for the island of Elba

VARIETIES:

Achroite (A-crow-ite) - colorless or nearly so [*achros* (Gr) - without color]
Bi-color tourmaline - a portion of the length of the crystal one color, the balance another color (usually pink and green)
Indicolite (IN-dick-oh-lite) - various shades of blue [*indicum* (L) - indigo blue]
Rubellite (RUE-bell-ite) - pink to red [*rubella* (L) - red]
Siberite (SIGH-burr-ite) - violet, purple [for Siberia]
Verdelite (VUR-dell-ite)- various shades of green [*verde* (Fr) - green]
Watermelon tourmaline - a pink center the length of the crystal, with a green skin (the opposite is known as reverse watermelon)

Elbaite is the popular gem material of the tourmaline group. It exhibits many shades of the above colors, plus other colors without varietal names; the variety is almost endless. Collecting all shades of elbaite could be a lifetime project. The presence of various elements (impurities) affect color, RI, and possibly crystal shape. The dichroism of elbaite is very striking. The green and blue varieties (in deep colors) are usually completely opaque through the long (c) crystal axis. Light blue, pink, and other light colors are usually fairly deep colored through the c axis, and a lighter or different shade of the color perpendicular to the c axis. Localities for elbaite are numerous. Brazil has produced virtually all colors for many years. African countries produce excellent material in a wide variety of colors. The California pegmatites have been producers of excellent material for many years, and have recently had a resurgence of activity. Pegmatites in the eastern U.S. have also had a resurgence of activity. Many other regions of the world are sporadic producers.

LIDDICOATITE (Tourmaline Group – elbaite-dravite series)

LID-ih-coat-ite

Complex lithium aluminum boro-silicate
$Ca(Li,Al)_3Al_6(BO_3)_3Si_6O_{18}O,OH,F)_4$
Hexagonal
Habit- prismatic, large crystals
Hardness- 7 to 7.5
Specific gravity- 3.02
Cleavage- very indistinct
Fracture- subconchoidal to uneven
Streak- uncolored
Inclusions- numerous flaws and veils

Color- Virtually all colors
RI- O-1.636, E-
Critical angle- 38°
Birefringence- .024, medium
Dichroism- strong
Dispersion- .016, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- for R. T. Liddicoat, American gemologist

Liddicoatite is a recent discovery in Madagascar. It was first found as very large crystals (six or more inches in cross section). Slices of these crystals show very interesting triangular patterns of many colors. Much of this material is quite dark colored, but a few lighter colored pieces have been cut into excellent gems. Brazil has produced deep red-purple crystals of a fairly large size, but nothing to compare with the size or color pattern of the Madagascar material. It is now thought that all tourmaline in Madagascar is liddicoatite.

TOURMALINE GROUP Cont. (elbaite-dravite series)

TSILAISITE (Tourmaline Group – elbaite-dravite series) sill-EYE-site
(a discredited mineral)

Complex sodium manganese aluminum boro-silicate
$Na(Mn,Al)Al_6(BO_3)_3Si_6O_{18}(OH,F)_3$
Hexagonal
Habit- presently unknown, but assumed to be prismatic
Hardness- 7 to 7.5
Specific gravity- 3.20
Cleavage- very indistinct
Streak- uncolored
Inclusions- veils, cracks

Color- Intense yellow, greenish-yellow, brownish
RI- O-1.645-1.648, E-1.622-1.623
Critical angle- 38°
Birefringence- .023 to .025
Dichroic- light to dark colors
Transparent to translucent
Luster- vitreous
Optically- uniaxial negative
Name- probably from a Zambian location

This tourmaline is a fairly recent determination (1984). Evidently it has been known earlier, but was thought to be a yellow elbaite. Recent investigations (Bank and Schmetzer; *Journal of Gemmology*, Vol.XIX, #3, pages 218-223) found that the material contained much greater amounts of manganese than was normal for elbaite. Further investigation showed that it (rather than liddicoatite) is the end member of the elbaite series. A few deep yellow gems have been cut, but rough material is difficult to obtain. This points out that the tourmaline group is much more extensive than originally thought. Perhaps more new members of the group will be determined. The present supply comes from Zambia, Africa.

TOURMALINE GROUP (dravite-schorl series)

BUERGERITE (Tourmaline Group – dravite-schorl series) BURR-ger-ite

Complex iron aluminum boro-silicate
$NaFe_3Al_6(BO_3)_3Si_6O_{21}F$
Habit- short prismatic, nearly equant
Hardness- 7 to 7.5
Specific gravity- 3.31
Cleavage- prismatic, distinct
Fracture- subconchoidal to uneven
Streak- yellow-brown
Inclusions- numerous needle inclusions

Brown, with schiller
RI- O-1.735, E-1.655
Critical angle- 38° (unimportant)
Birefringence- .020, medium
Translucent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- for Martin Buerger, mineralogist

Buergerite is known only from a single location in Mexico, in small crystals that are different from most tourmalines, and exhibit a silky schiller. The larger crystals can be cut into interesting silky cabochons.

DRAVITE (Tourmaline Group – dravite-schorl series) DRAVE-ite

Complex magnesium aluminum boro-silicate
$NaMg_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$
Hexagonal
Habit- short to long prismatic, massive
Hardness- 7 to 7.5
Specific gravity- 3.03 to 3.15
Cleavage- very indistinct
Fracture- uneven to conchoidal, brittle
Streak- uncolored
Inclusions- cracks, veils

Brown, red, black
RI- O-1.634, E-1.611
Critical angle- 38°
Birefringence- .023, medium
Dichroism- strong, light brown to opaque
Dispersion- ?
Transparent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- for the Drava River in Austria

Dravite has long been known as the brown material from Sri Lanka. It is now thought that this material is the species uvite (see below). If this is true, material from Kenya and Brazil should be considered as uvite also. A deep red material, in long prismatic crystals, was found in Kenya about thirty years ago. This is evidently the true dravite.

TOURMALINE GROUP Cont. (dravite-schorl series)

SCHORL (Tourmaline Group – dravite-schorl series) SHORE-L

Complex aluminum boro-silicate
$NaFe_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$
Hexagonal
Habit- prismatic, hemimorphic (?)
Hardness- 7 to 7.5
Specific gravity- 3.1 to 3.24
Cleavage- very indistinct, brittle
Fracture- uneven to conchoidal
Streak- uncolored
Color- Black
RI- 1.62 to 1.67 (unimportant)
Opaque
Luster- vitreous
Name- *skor* (Gr) - brittle

Schorl is very common in pegmatites and pegmatite-like formations. Usually it is badly flawed and very brittle. Some areas produce nice glassy pieces that show a strong conchoidal fracture, and can be cut into bright black cabochons and faceted gems. The faceted gems are not very interesting. Crystals can be large.

UVITE (Tourmaline Group – dravite-schorl series) OO-vite

Complex aluminum boro-silicate
$(Ca,Na)(Mg,Fe)_3Al_5Mg(BO_3)_3Si_6O_{18}\bullet(OH,F)4$
Hexagonal
Habit- prismatic, often double terminated
Hardness- 7 to 7.5
Specific gravity- 3.0 to 3.1
Cleavage- very indistinct
Fracture- uneven to conchoidal, brittle
Streak- uncolored
Inclusions- cracks and veils
Color- Brown to black
RI- O-1.64, E-1.63
Critical angle- 38°
Birefringence- .01, medium
Dichroism- strong, light brown to opaque
Dispersion- ?
Transparent to opaque
Luster- vitreous
Optically- uniaxial negative
Name- *uva* (L) - grape; probably for the shape of the crystals

Uvite forms short, nearly equant, double terminated crystals. Presently it is thought that the material from Sri Lanka is uvite rather than dravite. If this is true, then material from Kenya and Brazil may be members of this species. Excellent jet black crystals are found in New York. These are of interest to mineral collectors only. Excellent brownish clear crystals were found in a road cut in New York about thirty years ago. These were cut into nice gems. At present this species is evidently being studied for its simiarity to dravite. More information should become available in the near future.

"TRANSVAAL JADE" (see Garnet Group – ugrandite subgroup)

TREMOLITE (Amphibole Group) TREM-oh-lite

Basic calcium magnesium silicate
$Ca_2Mg_5Si_8O_{22}(OH)_2$
Monoclinic
Habit- rough prismatic, fibrous
Hardness- 5 to 6
Specific gravity- 2.9 to 3.3
Cleavage- perfect, two directions
Fracture- uneven
Streak- white
Inclusions- cleavage plane cracks, flaws
Colorless, gray, lavender, green
RI- X-1.560, Y-1.613, Z-1.624
Critical angle- 38°
Birefringence- .024, medium
Transparent to opaque
Luster- vitreous to silky
Optically- biaxial negative
2V angle- 80° to 88°
Name- for Tremola Valley, Italy

VARIETY:

Hexagonite - lavender [for the pseudohexagonal shape of the crystals]. Hexagonite makes a pleasing, though seldom flawless gem. Hexagonite is from New York.

On rare occasions, transparent crystals are large enough to facet. Canada produces a green type that will produce cat's eye cabochons.

TRIPHANE (see spodumene)

TRIPHYLITE (see lithiophyllite)

TSAVORITE (see Garnet Group – ugrandite subgroup – grossular)

TSILAISITE (see Tourmaline Group – elbaite-dravite series) sill-EYE-site

TUGTUPITE

tug-TOOP-ite

Sodium aluminum beryllium silicate
$Na_4BeAlSi_4O_{12}Cl$
Tetragonal
Habit- massive
Hardness- 6 to 6.5
Specific gravity- 2.36 to 2.57
Cleavage- none (?)
Fracture- uneven
Streak- white
Color- Pink to red
RI- O-1.496, E-1.502
Birefringence- .006, weak
Opaque
Name- *tugtup* (Dan) - reindeer, also a town in Greenland, near the deposit

This is a new mineral, discovered in Greenland in 1960; then subsequently in Siberia. The first gems (cabochons) were fashioned only for Danish Royalty. These are unique. Reasonably good rough material has recently reached the market.

TURGITE (see hematite)

TURQUOISE

TUR-koiz

Hydrous copper aluminum phosphate
$CuAl_6(PO_4)_4(OH)\cdot5H_2O$
Triclinic
Habit- massive, crystals very rare
Hardness- 5 to 6
Specific gravity- 2.6 to 2.9 (2.76)
Cleavage- none
Fracture- small conchoidal
Streak- white to greenish
Color- Sky-blue to blue-green, green
RI- approximately 1.62
Opaque
Luster- waxy, dull on fracture surface
Name- *pierre turquaise* (Fr) - Turkish stone

A very popular cabochon material. Highly variable in color shades, toughness, and porosity. Arizona, New Mexico, China and Iran (Persia) are better known sources. Blue-green crystals have been found in Virginia. In 1958 crystals were found in Belgium, at three locations in England; in 1983 in Australia. All crystals are very small, usually less than one millimeter in length.

UINTALITE (see gilsonite)

ULEXITE

YOU-lex-ite

Hydrous sodium calcium borate
$NaCaB_5O_9\cdot8H_2O$
Monoclinic
Habit- massive, fibrous
Hardness- 1
Specific gravity- 1.65
Cleavage- none in massive
Fracture- uneven
Streak- white
Inclusions- mud, veils
Color- Nearly colorless, to white
RI- approximately 1.51
Transparent to translucent
Luster- silky
Name- for George L. Ulex, German chemist

This mineral has been cut into silky spheres and cabochons. Transparent material, with polished faces, transmits light through the fibers, and will faithfully transmit a figure from the lower to upper surface. This has led to the name "T.V. crystal". This is the only known example of naturally occurring fiber optics. Material with a lapidary potential is known only from a borax mine in California.

UNAKITE

YOU-nah-kite

A rock composed of pink feldspar, epidote, and quartz
Habit- lumps
Hardness- 6.5 to 7
Specific gravity- 2.85 to 2.94
Cleavage- none
Fracture- uneven
Streak- variable

Pink and green with white spots
Opaque
Luster- dull
Name- for the Unaka Mountains, North Carolina

An unusual cabochon material, found only in a few American localities. It has been cut into cabochons, but its greatest use could be as a carving medium. It will take a fairly good polish in spite of the variation in hardness.

UVAROVITE (see Garnet Group – ugrandite subgroup)

oo-VAHR-oh-vite

UVITE (see Tourmaline Group – dravite-schorl series)

OO-vite

VALLERIITE

val-AIR-ee-ite

A complex metallic hydroxide
$2(Fe, Cu)_2S\ 3(Mg,Al)\ (OH)_2$
Hexagonal
Habit- massive
Hardness- very soft (below 1)
Specific gravity- 3.09 to 3.14
Cleavage- perfect, one direction
Fracture- conchoidal
Streak- dark, metallic

Color- Bronze-yellow
Opaque
Luster- metallic
Name- for G. Vallerius, Swedish mineralogist

This material can be cut into splendent golden-colored cabochons. There probably will be some color change (darkening) over a period of time. Arizona has produced good cabochon material.

VANADINITE (Apatite Group)

van-AID-in-ite

Lead chloro-vanadate
$Pb_5(VO_4)_3Cl$
Hexagonal
Habit- prismatic crystals
Hardness- 2.5 to 3
Specific gravity- 6.88
Cleavage- none
Fracture- conchoidal to uneven, brittle
Streak- white or yellowish
Inclusions- veils

Color- Red, orange-red, brown, yellow, white
RI- E-2.350, O-2.416
Critical angle- 25°
Birefringence- .066, strong
Dispersion- strong
Transparent to opaque
Luster- subadamantine to resinous
Optically- uniaxial negative
Name- from the vanadium content

This mineral usually appears as translucent to opaque crystals, but the authors have observed some clear crystals. If these are of reasonable size, they could be faceted into exceptional gems. The mines in Morroco presently seem to be the best possible source for clear material. Massive material is rare, but, can be cut into cabochons with a good luster.

VARISCITE (Variscite Group)

VARE-iss-ite

Hydrous aluminum phosphate
$AlPO_4 \cdot 2H_2O$
Orthorhombic
Habit- massive, crystals very rare
Hardness- 4
Specific gravity- 2.2 to 2.55 (2.5)
Cleavage- none
Fracture- uneven
Streak- white

Color- Green to yellow-green
RI- approximately 1.57
Opaque to sub-translucent
Luster- waxy, dull on fracture surface
Name- for Variscia, an old name for Voightland, Germany; where it was first found
Alternate name- utahlite, for Utah

Variscite is a popular cabochon material. It is sometimes easily confused with turquoise. Some pieces contain other minerals in mixture. A few localities in Utah are the best known sources of good quality variscite. An Australian cabochon material, much resembling variscite, has been offered as foggite. The cutting qualities are somewhat different than most variscite. As a result, the authors accepted this as a new material. A careful check of mineralogical literature did not show that foggite (which is a crystalline mineral) appears in a massive form. Queries made in Australia found no one that knew of massive foggite. Perhaps later investigation will clarify the problem.

VAYRYNENITE

vay-REE-nen-ite

Basic beryllium manganese fluo-phosphate
$BeMnPO_4(OH, F)$
Monoclinic
Habit- prismatic, usually massive
Hardness- 5
Specific gravity- 3.183 to 3.215
Cleavage- distinct, one direction
Fracture- uneven, brittle
Streak- white
Inclusions- veils

Color- Pink to rose-red
RI- X-1.638, Y-1.658, Z-1.664
Critical angle- 38°
Birefringence- .026, medium
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 54°
Name- Heikki Vayrynen, Finnish geologist

This mineral is found, as clear pieces, only in a pegmatite in Finland. It has been reported to have been faceted. Massive material from Arizona makes interesting cabochons with a network of black lines.

VERD ANTIQUE (see serpentine)

VERDELITE (see Tourmaline Group – elbaite-dravite series)

VERDITE (Mica Group)

VUR-dite

A rock, essentially muscovite mica, colored with the chrome-mica fuchsite
Habit- chunks
Hardness- 3
Specific gravity- 2.8 to 2.99
Cleavage- none
Fracture- uneven
Streak- greenish

Color- Deep green, sometimes with red or yellow spots
RI- approximately 1.58
Opaque
Luster- dull
Name- *verd* (Old Fr) - green

Verdite is most commonly used as an ornamental stone, but it has been made into somewhat interesting cabochons and carvings. It is known only from the Transvaal, South Africa. Rough material has seldom been on the market. Carvings can easily be purchased in South Africa.

VERMARINE (see quartz - crystalline)

VERTINE (see quartz - crystalline)

VESUVIANITE (see idocrase)

VILLIAUMITE

vee-YOE-mite

Sodium fluoride
NaF
Isometric
Habit- usually massive
Hardness- 2 to 2.5
Specific gravity- 2.79
Cleavage- perfect, one direction
Fracture- uneven, brittle
Streak- white

Color- Pink, orange, deep red
RI- n-1.3270
Critical angle- 47.5°
Transparent to translucent
Luster- vitreous
Name- for French explorer and collector, Villiaume
This mineral is slightly water soluble.

A rare mineral found as non-gem material in a number of locations. It has been found in gem material on an island (Isls de Los) off the west coast of Africa, and also in Canada. Transparent material has been reported to have been faceted. These gems undoutedly are not brilliant.

VIOLANE (see diopside)

VIRIDINE (see andalusite)

VIVIANITE (Vivianite Group)

VIV-ee-an-ite

Hydrous iron phosphate
$Fe_3(PO_4)_2 \cdot 2H_2O$
Monoclinic
Habit- prismatic
Hardness- 1.5 to 2
Specific gravity- 2.58 to 2.68
Cleavage- very perfect, one direction
Fracture- uneven to fibrous
Streak- white to bluish

Colorless, altering to green to violet
RI- X-1.578, Y-1.602, Z-1.629
Critical angle- 39.5°
Birefringence- .051, strong
Trichroism- strong; bluish to green
Transparent to translucent
Luster- vitreous to pearly to metallic
Optically- biaxial positive
2V angle- 80°
Name- for J. G. Vivian, English mineralogist

Transparent crystals have been faceted into interesting gems. The cleavage is very troublesome during the cutting process. Idaho, Bolivia, and Cameroons have produced excellent clear material. When vivianite is mined, crystals are colorless, and change to green, then purplish on exposure to light.

VONSENITE

VON-sen-ite

Iron magnesium borate
$(Fe,Mg)FeBO_4$
Orthorhombic
Habit- granular masses
Hardness- 5
Specific gravity- 4.21 to 4.77
Cleavage- none apparent
Fracture- uneven
Streak- dark

Color- Black
Opaque
Luster- metallic
Name- for M. Vonsen, American collector

This material can be cut into brilliant black cabochons. Spain has produced good cabochon material.

WARDITE

WARD-ite

Hydrous sodium aluminum phosphate
$NaAl_3(PO_4)_2(OH)_4 \cdot 2H_2O$
Tetragonal
Habit- pyramidal
Hardness- 5
Specific gravity- 2.61
Cleavage- perfect, one direction
Fracture- conchoidal?
Streak- white
Inclusions- many veils

Colorless, white, (pale green)
RI- O-1.586, E-1.595 variable
Critical angle- 39°
Birefringence- .01, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial positive
Name- for H. A. Ward, American mineralogist

This mineral is rarely found as crystals. It appears in massive variscite from Utah. In this form it has been cut into cabochons, but appears only as streaks in the variscite. A few localities produce small crystals, some of which can be faceted. Crystals from Brazil are very sharp, but seldom clear. Crystals from South Dakota and New Hampshire sometimes have clear areas.

WAVELLITE

WAVE-ell-ite

Hydrous basic aluminum phosphate
$Al_3(PO_4)_2(OH)_3 \cdot 5H_2O$
Orthorhombic, single crystals rare
Habit- radiating crystal aggregates
Hardness- 3.5 to 4
Specific gravity- 2.31 to 2.36
Cleavage- perfect in crystals
Fracture- uneven to subconchoidal
Streak- white

Color- White, yellow, green, brown, black
RI- approximately 1.53
Translucent to opaque
Luster- vitreous to pearly and resinous
Name- for William Wavell, British physician

The yellow to green radiating aggregates have been cut into interesting cabochons, slabs, and other ornamental items. Single crystals, if clear, could conceivably be faceted. Arkansas and Brazil are the best sources for cabochon material.

WHEWELLITE (an organic mineral)

WHEW-ell-ite

Hydrous calcium oxalate
$CaC_2O_4 \cdot H_2O$
Monoclinic
Habit- prismatic, twins common
Hardness- 2.5
Specific gravity- 2.23
Cleavage- distinct, two directions
Fracture- conchoidal
Streak- white
Inclusions- usually none, (veils?)

Colorless
RI- X-1.490, Y-1.555, Z-1.650
Critical angle- 40°
Birefringence- .16, very strong
Transparent
Luster- vitreous
Optically- biaxial positive
2V angle- 83°
Name- for William Whewell, English mineralogist

Crystals are always very small. Some have been faceted into uninteresting gems. Coal mines in Germany are the best source for clear crystals.

WILKEITE (Apatite Group)

WILL-key-ite

Complex calcium silico-phosphate
$Ca_5(SiO_4,PO_4,SO_4)_3(O,OH,F)$
Hexagonal
Habit- massive, granular
Hardness- 5 (approximately)
Specific gravity- 3.12 to 3.23
Cleavage- imperfect
Fracture- uneven, brittle
Streak- white

Color- Pinkish, yellowish
RI- 1.655, (approximately)
Translucent
Luster- vitreous to resinous
Name- for R. M. Wilke, a California mineral dealer

This mineral has been known to the authors for many years and thought to have no lapidary potential. Recently, uninteresting cabochons have been cut. It appears in lapidary quality only at the Crestmore quarries near Riverside, California.

WILLEMITE

WILL-em-ite

Zinc silicate
Zn_2SiO_4
Hexagonal
Habit- massive, crystals rare
Hardness- 5.5
Specific gravity- 3.89 to 4.2 (4.0)
Cleavage- distinct, two directions
Fracture- conchoidal to uneven
Streak- white
Inclusions- dark manganese oxide flecks

Color- Yellow, green, reddish, brown
RI- O-1.691, E-1.719
Critical angle- 36°
Birefringence- . 028, medium
Transparent to translucent
Luster- vitreous
Optically- uniaxial positive
Name- for Willem I, King of the Netherlands

Clear crystals of this rare mineral are faceted into very interesting gems. Some specimens will fluoresce bright green under short wave ultra-violet light. New Jersey is the only good source of facetable material. The mines are presently inactive. Massive material can be cut into brilliant cabochons.

WILLIAMSITE (see serpentine)

WITHERITE

WITHER-ite

Barium carbonate
$BaCO_3$
Orthorhombic
Habit- massive, crystals always twins
Hardness- 3 to 4
Specific gravity- 4.27 to 4.35
Cleavage- distinct, one direction
Fracture- uneven
Streak- white
Inclusions- copious amounts of veils

Color- White, yellow, gray
RI- X-1.529, Y-1.676, Z-1.677
Critical angle- 41°
Birefringence- .148, very strong
Dispersion- weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
Name- for W. Withering, English mineralogist

This mineral is seldom transparent. Most faceted gems have a "sleepy" look. The translucent material is sometimes cut into cabochons. Massive material is usually fibrous-appearing and lacks the many twinning planes. The most nearly clear faceting material comes from England.
Cabochons have an interesting "moonstone" look.

WOLLASTONITE

woe-LAST-on-ite

Calcium silicate
$CaSiO_4$
Monoclinic
Habit- massive, crystals rare
Hardness- 4.5 to 5
Specific gravity- 2.8 to 2.9
Cleavage- sometimes, three directions
Fracture- uneven
Streak- white

Color- White, yellow, gray, red, brown
RI- 1.62 (approximately)
Subtransparent to translucent
Luster- vitreous to pearly
Optically- biaxial negative
Name- for William H. Wollaston, English chemist and physicist

Massive wollastonite is sometimes cut into cabochons. These seldom are interesting. Arkansas produces a mottled gray material that does not take a high polish.

WULFENITE

WULF-en-ite

Lead molybdate
$PbMoO_4$
Tetragonal
Habit- tabular, rarely prismatic
Hardness- 2.5 to 3
Specific gravity- 6.5 to 7.0
Cleavage- distinct, three directions
Fracture- subconchoidal, very brittle
Streak- white
Inclusions- many veils

Color- Nearly colorless, yellow, orange, red
RI- O-2.405, E-2.282
Critical angle- 25.5°
Birefringence- .123, very strong
Dispersion- strong
Transparent to translucent
Luster- adamantine
Optically- uniaxial negative
Name- for Franz Wulfen, Austrian mineralogist

Transparent crystals have been cut into very brilliant faceted gems. Arizona has produced clear but small colored facetable material. Namibia has produced excellent large, nearly colorless, very clear pieces. The massive material can be cut into cabochons, but they are seldom flawless and undercut badly. Arizona has produced an orbicular material that can be cut into very excellent cabochons.

XALOSTOCITE (see Garnet Group – ugrandite subgroup)

XANTHITE (see idocrase)

XENOTIME

zen-oh-TIME

Yttrium phosphate
YPO_4
Tetragonal
Habit- prismatic, aggregates
Hardness- 4 to 5
Specific gravity- 4.4 to 5.1
Cleavage- perfect, one direction
Fracture- splintery to uneven
Streak- dark
Inclusions- none observed

Color- Yellowish-brown to brown, pink
RI- O-1.720, E-1.827
Critical angle- 35°
Birefringence- .004, weak
Transparent to opaque
Luster- vitreous to resinous
Optically- uniaxial positive
Name- *xenos* & *time* (Gr) - vain honor; because the yttrium was thought to be a new element

This is a widespread mineral, but not well known. Crystals are usually small and go unrecognized. Pegmatites are the usual locations for them. In the spring of 1979 excellent clear pink crystals were found in Brazil. These have been faceted into deep pink gems. Previous to this, the mineral was not known to be transparent.

YUGAWARALITE (Zeolite Group)

you-gah-WAH-rah-lite

Hydrous calcium aluminum silicate
$CaAl_2Si_6O_{16}{\cdot}4H_2O$
Monoclinic
Habit- crystals flattened
Hardness- 4.5
Specific gravity- 2.23
Cleavage- imperfect, one direction
Fracture- uneven, very brittle
Streak- white
Inclusions- none observed

Colorless to white
RI- X-1.495, Y-1.497, Z-1.504
Birefringence- .009, weak
Critical angle- 43°
Transparent to translucent, often iridescent
Luster- vitreous
Optically- biaxial positive
2V angle- 78°
Name- for the Yugawara hot springs, Japan, where first found

This mineral is one of the zeolites, which are noted for excellent clarity, but low RI. A gem cut from this material will have very little brilliance and of interest only for collectors that wish to have a cut gem of the most species possible. As noted above, it is found in Japan. The most likely source of faceting material is from the excellent zeolite sources near Bombay, India.

ZEKTZERITE
ZEK-zer-ite

Sodium lithium zirconium silicate
$NaLiZrSi_6O_{15}$
Orthorhombic (nearly isometric)
Habit- prismatic
Hardness- 6
Specific gravity- 2.79
Cleavage- perfect, two directions
Fracture- conchoidal
Streak- white
Inclusions- veils

Colorless to pink
RI- X-1.582, Y-1.584, Z-1.584
Critical angle- 39°
Birefringence- .002, weak
Transparent to translucent
Luster- vitreous
Optically- biaxial negative
2V angle- 0°
Name- Jack Zektzer, American collector

This mineral has been found in transparent form only at a single location in the state of Washington. Some small gems have been faceted; they are not spectacular. The axial lengths of the crystal are nearly equal (thus the low 2V angle) and the crystals are nearly equi-dimensional. However, they do not really look isometric.

ZEOLITE GROUP (minerals described in this book)
ZEE-oh-lite

Name- zein (Gr) - to boil; from behavior when melted; zeolit (Swedish)

ANALCIME - CHABAZITE - GMELINITE - MESOLITE - NATROLITE - POLLUCITE
SCOLECITE - STILBITE - YUGAWARALITE

ZINCITE
ZINC-ite

Zinc oxide
ZnO
Hexagonal
Habit- massive, crystals rare
Hardness- 4 to 4.5
Specific gravity- 5.43 to 5.7
Cleavage- perfect, one direction
Fracture- subconchoidal
Streak- yellow-orange
Inclusions- asbestos threads, flaws

Color- Red to yellow-orange
RI- O-2.013, E-2.029
Critical angle- 30°
Birefringence- .016, medium
Dispersion- weak
Transparent to opaque
Luster- subadamantine
Optically- uniaxial positive
Name- *zink* (Ger) - zinc; for the metal in the molecule

Transparent pyramidal crystals and cleavages are rare. These make excellent dark red faceted gems. Opaque material is sometimes cut into cabochons. New Jersey has produced excellent deep red facetable crystals. Some massive pieces from the same locality have been cut into cabochons. The mines are now inactive.

ZIRCON
ZUR-con

Zirconium silicate
$ZrSiO_4$
Tetragonal
Habit- prismatic
Hardness- 7.5
Specific gravity- 4.2 to 4.86 (4.7)
Cleavage- imperfect, sometimes distinct, one direction
Fracture- conchoidal, very brittle
Streak- uncolored
Inclusions- a few cracks or cleavages

Colorless, yellow, green, red, brown
RI- O-1.923 to 1.960, E-1.968 to 2.015
Critical angle- 32°
Birefringence- .05, (approx.) strong
Dichroism- strong in deep colors
Dispersion- .038, medium
Transparent to opaque
Luster- adamantine
Optically- uniaxial positive
Name- *zargoon* (Singalese) - zircon

VARIETIES:
Golden - may be heat treated from brown material
Hyacinth (jacinth) - yellow through orange to brown [*hyacinthus* (L) - a yellow-orange flower]
"Starlite" - blue, heat treated from brown material [for the color starlight blue]

Zircon continued on next page.

Metamict ("low zircon") - a mixture of zirconium oxide and SiO_2, has an RI of 1.78 to 1.81, a lower specific gravity (3.94 to 4.1), and hardness about 6.5. The color is green. Metamict zircon is a decomposition product from normal zircon due to the inclusion of radioactive minerals in very small amounts. [*meta* (Gr & L) - after, and *miktos* (Gr) - mixed]. "Intermediate" zircon is at some theoretical midpoint between normal and metamict. The best the term could indicate is a degree of decomposition. "Low" zircon was evidently originated to indicate the final stage of decomposition, but there is no way to visibly determine this. The terms are poor; metamict is correct. Metamict zircon is surprisingly tough; especially so when normal zircon is usually considered to be brittle. Grinding is slower than might be expected for a zircon. Polishing is sometimes slower and difficult. The toughness is probably due to the intimate mixture of zirconium oxide and silicon dioxide.

Zircon is an excellent gem material with hardness, RI, and dispersion in its favor. Brittleness and the high birefringence are not desirable characteristics. The gem districts of the Orient have produced much fine material. The political situation there has presently worked against production. Australia and some East African countries are fairly good producers. Zircon is very brittle. A group of specimens (gems) wrapped in paper will scratch each other.

ZOISITE (tanzanite) — ZO-iss-ite, TAN-zan-ite

Basic calcium aluminum silicate
$Ca_2Al_3Si_3O_{12}OH$
Orthorhombic
Habit- prismatic, massive
Hardness- 6 to 6.5
Specific gravity- 3.1 to 3.37 (3.3)
Cleavage- perfect, one direction
Fracture- uneven
Streak- uncolored
Inclusions- random needles, some may be oriented, veils and flaws

Colorless, pink, blue, violet, orange, (greenish)
RI- X-1.696, Y-1.703, Z-1.706 variable
Critical angle- 36°
Birefringence- .006, weak
Trichroism- strong in intense colors
Dispersion- strong
Transparent to translucent
Luster- vitreous
Optically- biaxial positive
Name- for Baron Zois von Edelstein, Austrian mineralogist [*edeistein* (Ger) - precious stone)

VARIETIES:

Piemontite (piedmontite) - is a variety of zoisite that has lapidary potential. Nice pink material comes from Norway. These can be cut into interesting cabochons. [for the Piemonte region, Italy]

Saussurite - greenish, resembling jade [H. B. de Saussure, Swiss mineralogist). Saussurite is seldom of good cutting quality. It is a mixture of zoisite and albite feldspar. Some pieces have been cut into interesting cabochons.

Tanzanite - blue, purple, orange (trichroic) [for Tanzania, where it is found]. Most tanzanite is without the orange; it having been driven off by heat treatment. This makes an interesting situation. Zoisite is normally trichroic, but the heat treatment changes one color to match that of one originally present (blue). Thus, a trichroic material is seemingly converted into dichroic material. Tanzania is the only known source for the tanzanite variety. Tanzania also produces a green material (chromium colored) that encloses large sized opaque rubies. This has been made into carvings, bookends, etc., and a few cabochons.

Thulite - mottled pink, massive [Thule is an ancient name for Norway]. Thulite can be cut into interesting pink cabochons; these are sometimes mottled and streaked in a very pleasing pattern. Norway has produced excellent material.

Colorless to nearly colorless zoisite has been found in Baja California, Mexico, and other locations. These can be cut into faceted gems that are not very interesting. In late 1984, a new material called "lapis Nevada" was introduced. Owner of the mine states that it is a mixture of thulite (pink), scapolite (lavender), diopside (green), epidote (green), and other minerals. The authors have seen the material previously. It is interesting, but not as beautiful as represented. As it contains a large number of minerals, it has a tendency to undercut. The polish on the gems seen was not excellent. As the owner says, it is really a rock. The name is a very poor choice.

Section 2

MAN-MADE GEM MATERIALS

The word synthetic, pertaining to minerals, should be used only with man-made materials that have a natural counterpart. In other words, a synthetic must be identical to a mineral. Any other material, that has no natural counterpart, must be looked at differently, and given another name. That name which seems to be the best is "man-made". It is very true that a true synthetic is also man-made, but this should not be confusing.

As a result of this thinking, in this book (as was done in the second edition) the term man-made is used to denote the whole group of manufactured gem materials.

This term is deviated from in only one situation in this book. In Sections 3, 4, and 5, the identification tables, those materials that have a natural counterpart are followed by the abbreviation (syn). This was done so that the reader may be apprised of the fact that there is such a mineral, and that it may be covered in Section 1. The balance of the man-made materials are separated from the synthetics by being followed by a double asterisk (**).

This edition lists a good number of man-made materials. In many respects this is a good situation. Many gem cutters are extremely happy that they are able to draw from this group for their cutting needs. Most of them hope for more new materials in the future.

There is a disconcerting side to this story. The history of man-made materials has followed a declining price pattern almost without exception. Whenever a new gem material has been introduced, usually at a reasonably high price, all who could manufacture it have done so. This has quickly glutted the market and the price has gone into a sharp decline. Some materials have declined to a point where they sell at only a very few cents per carat for rough material. Thus, a new material that had sold for a small number of dollars per carat at the time of introduction, has rapidly dropped in price to where it is nearly worthless.

In the eyes of the authors, this is a shame; especially in the light of the fact that natural gem materials have steadily risen in price during the same period that the man-made materials made their decline.

In the following section, those materials that are true synthetics are nearly all included in Section 1, and if so, a reference is made back to them. Materials that have no natural counterpart are again indicated with the double asterisk.

Some characteristics have been deleted from the descriptive portions. Streak in all cases is assumed to be white or colorless unless stated otherwise. All materials are transparent if they are classified as facetable. Some characteristics such as optic character and sign, and the 2V angle were not available.

Man-made materials are made by a number of methods. The two most common are in the form of boules (somewhat carrot-shaped) and as crystals. Boules are made by two methods. The oldest, by flame fusion in the Verneuil furnace. Here, a fine powder of the material is dropped through a flame onto a small crystal that acts as a seed.

The other, and much newer method, is by pulling a boule from a melt. This is known as the Czochralski method. Boules of each method usually appear similar, but the Czochralski boules can be greatly larger.

Crystals are grown by a number of methods. The hydrothermal method grows crystals from a saturated solution under heat and pressure. Another has crystals growing within a cooling molten mass.

A much newer method, by which cubic zirconia is produced, is by a melt enclosed within a grid of electrical heating elements. There is no crucible, but the mass is contained within an envelope of the raw material. This is called the skull method.

Practically all man-made materials in the pure form are colorless, or nearly so. Color is induced by dopants (DOPE-unts). These may be free ions of some element or some compound. Most dopants are reported as elements even if some of them are compounds. When this is the case, the metallic portion of the compound is the coloring agent, with the balance of the compound being inert.

ALEXANDRITE (see natural mineral page 23)

al-ex-AND-rite

Beryllium aluminum oxide
$BeAl_2O_4$
Orthorhombic
Habit- sawed chunks
Hardness- 8.5
Specific gravity- 3.7
Cleavage- poor
Fracture- conchoidal

Color- Purple, blue, green
RI- 1.74 to 1.75
Critical angle- 35°
Birefringence- .01, medium
Dispersion- .015, medium
Luster- vitreous
Pleochroism- strong, light to medium purple or blue or green
Optically- biaxial positive 2V angle- 70°

At least two companies are making synthetic alexandrite. There evidently is no financial incentive to make any other form of chrysoberyl. The material made by a California based company is nearly identical to natural material.

ALEXANDRIUM**

alex-AND-ree-um

Lithium aluminum silicate
Formula ?
Amorphous
Habit- chunks
Hardness- 6
Specific gravity- 2.45
Cleavage- none
Fracture- conchoidal
Streak- white

Color- Blue to purple
RI- 1.58
Critical angle- 39.5°
Transparent
Photochroism- pinkish to blue
Luster- vitreous
Name- for the color change

The authors are not certain of the chemical make-up, but believe (as reported) that it is doped with small amounts of the rare element neodymium. This dopant gives it a startling photochroism; in daylight a bluish-purple; incandescent light, light pink to light magenta; and in fluorescent light a light blue. The authors like to ask, what is the color? Evidently we should standardize on daylight for color determination. In most respects, this material is really a glass. The real attribute is the photochroism. It can be cut into faceted gems of moderate brilliance.

BADDELEYITE (see natural mineral page 11)

bed-DELL-ee-ite

Zirconium dioxide
ZrO_2
Monoclinic
Habit- probably chunks
Hardness- 6.5
Specific gravity- 5.5 to 6.0
Cleavage- distinct, one direction
Fracture- subconchoidal to conchoidal

Colorless
RI- 2.13 to 2.2
Critical angle- 28°
Birefringence-.07, strong
Luster- adamantine
Optically- biaxial negative
2V angle- 30°

To date synthetic baddeleyite has not been reported, but it is the material that is stabilized in order to make cubic zirconia (page 128). There is some doubt that this will be offered as a gem material due to the low hardness, but others with the same (or lower) hardness have been offered. It should make an interesting gem.

BARIUM TITANATE**

BARE-ee-um TIE-tan-ate

$BaTiO_3$
Isometric ?
Habit- fused boules
Hardness- 6 to 6.5
Specific gravity- 5.9

Colorless
RI- n-2.4
Critical angle- 24°
Dispersion- very strong
Luster- vitreous

This is very similar to strontium titanate (page 124), but with the heavier barium replacing strontium. It has not been offered as a gem material, but could conceivably appear on the market.

BARIUM FLUORIDE**

BARE-ee-um FLUE-or-ide

BaF
Habit- pulled boules

Colorless, doped blue, purple
RI- probably medium

This material has been grown as boules over 20mm in diameter and 50mm in length. Most characteristics are not available, but it appears that it would not make a good gem material.

BORON CARBIDE**

BORE-on CAR-bide

B_4C
Isometric
Habit- cubic
Hardness- 9.5
Specific gravity- 2.51
Cleavage- ?
Fracture- ?

Colorless
RI- evidently high
Critical angle- ?
Luster- adamantine ?
Trade name- Norbide

Boron carbide has been known for many years as an abrasive. It has never been grown as lapidary size crystals, but evidently this is possible. If so, it could possibly make a good gem.

BORON NITRIDE

BORE-on-NIGH-tride

BN
Isometric
Habit- cubic crystals
Hardness- 10+ (scratches diamond?)
Specific gravity- 3.45

Color- Gray to yellow
RI- probably high
Transparent to opaque
Luster- adamantine ?
Trade name- Borazon

Boron nitride has not been found naturally, but its subterranean presence is suspected. Normally it is a hexagonal material, (and known as white graphite), but when heated under great pressure it changes to isometric with a great increase in hardness. To date no crystals of lapidary size have been reported. The material is now being offered as abrasive wheels. This might make it possible that some lapidary size crystals might be manufactured. There is some confusion as to the hardness. Originally it was reported as 10+. Recent information reports that it is slightly below 10 in hardness.

BORO-SILICATE (see glass)

BROMELLITE

bro-MEL-ite

Beryllium oxide
BeO
Hexagonal
Habit- ?
Hardness- 9
Specific gravity- 3.017

Colorless
RI- O-1.720, E-1.735
Critical angle- 35.5°
Birefringence- .015, medium
Optically- uniaxial positive
Caution- toxic
Name- for Magnus von Bromell; Swedish mineralogist

Bromellite has been found naturally as small translucent crystals. From all appearances this should make a fine gem, whether natural or synthetic, but the dust resulting from the lapidary process is toxic. This should preclude any use as a synthetic gem. The authors know of no occurance of natural lapidary material.

CATSEYTE**

CATS-ite

A glass
Formula unknown (a boro-silicate)
Habit- 6 to 10 mm rods
Hardness- about 6
Specific gravity- ?

Honey yellow, blue, green
RI- about 1.5; coated with a low RI material

This is a fairly good catseye imitation. The rod shape allows relatively easy orientation to make a cabochon. The reason for the lower RI coating could not be determined. In the final analysis, this is a glass made to imitate a good gem. It will probably not be popular.

CORAL** (see natural material page 27)

CORE-all

Calcite plus other materials
$CaCO_3$+
Amorphous
Habit- discs
Hardness- 3.5
Specific gravity- 2.44
Cleavage- none
Streak- white
Structure- brecciated
Color- Pink to white, medium red, deep red
RI- 1.55
Luster- dull to vitreous

This product has been made by the Gilson Company of France. Gemologists say that it cannot be considered as a true synthetic. This material is very similar to natural coral as far as cutting characteristics are concerned. The difference in pattern (brecciated versus concentric banding) will be the most noticeable. It is produced in discs up to 105mm in diameter and about 32mm thick. This will allow for gems of much greater size than those of natural coral.

CORUNDUM (see natural mineral page 27)

core-UN-dum

Aluminum oxide
Al_2O_3
Hexagonal
Habit- boules, crystals
Hardness- 9
Specific gravity- 4.0 approximately
Cleavage- none
Fracture- conchoidal
Colorless, many colors
RI- 1.75 to 1.77
Critical angle- 34.5°
Birefringence- .02, weak
Luster- vitreous
Dichroic- light to dark colors
Dispersion- .015, medium
Optically- uniaxial negative

Synthetic corundum is virtually identical to natural with the possible exceptions of a slightly greater hardness, slightly higher RI, and better clarity. The boule type material has none of the usual corundum inclusions, but contains some bubbles, and characteristic curved striae due to the method of growth. Crystals of ruby are being grown, and some of these contain inclusions similar to natural crystals. They are virtually identical to natural material. Rough crystals are not available.

Synthetic corundum is available as boules in almost any color. Many of these are not known in nature. Some of these have imitated and are named for other gem materials (i.e. alexandrite, peridot, tourmaline, etc.), but they are obviously corundum. Few of them look exactly like the gem they are imitating. Synthetic ruby never quite equals the color of natural ruby. Fine star rubies and sapphires have been produced. The colors are due to various dopants. Some are: chromium- red; titanium- pink; titanium + iron- blue; nickel- yellow; titanium + nickel- yellow-green; magnesium- orange; cobalt- green; iron + chromium + titanium- purple; vanadium- rose-purple.

C-OX (see zirconia)

CUBIC ZIRCONIA (see zirconia)

C-Z (see zirconia)

DIAMOND (see natural mineral page 32)

Small crystals for use as abrasives have been on the market for a number of years. Clear crystals of a size suitable for gem cutting are now being grown. In the past, the American synthesizers state that costs were too high to market them. However, synthetic diamonds, usually of lower grade color, are being sold on the market. Russia reported a few years ago that they had developed a low pressure method of synthesizing diamond. Recently, the Russians have been placing large quantities of small gems on the market. The amount of carats is thought to far exceed the possibilities of their diamond mine, which should now be going into a declining state of production. Many investigators are certain that they are marketing synthetic cut gems. If this is true, it will have a profound effect on the diamond market.

EMERALD (see natural mineral page 13)

EM-er-uhld

Beryllium aluminum silicate
$Be_3(Cr,Al)_2Si_6O_{18}$
Hexagonal
Habit- prismatic, chunks
Hardness- 7.25 to 7.5
Specific gravity- 2.65, approximately
Cleavage- none
Fracture- conchoidal

Color- Green
RI- O-1.563, E-1.560
Critical angle- 39.5°
Birefringence- .003, weak
Dispersion- .014, medium
Luster- vitreous
Dichroism- strong, light to dark green
Optically- uniaxial negative

Synthetic emerald is being made by three or more companies at present. Some have the typical natural emerald inclusions. Good quality, mostly clean rough is available for amateur cutters. The physical and optical characteristics of the synthetics are usually nearly the same as the natural mineral (see beryl), but there is some variation between the products of various manufacturers.

FLUORITE (see natural mineral page 41)

FLUE-or-ite

Calcium fluoride
CaF_2
Isometric
Habit- pulled boules
Hardness- 4
Specific gravity- 3.15
Cleavage- perfect, four directions
Fracture- uneven to conchoidal

Colorless, many doped colors
RI- n-1.43
Critical angle- 44°
Luster- vitreous

Large boules of fluorite have been available on rare occasions. Most interesting is a nice pink that is rare in nature. It does not appear that this material will become more available. The dopants for some of the many colors are: neodymium- purple or pink; erbium- reddish; chromium- light purple; samarium- green; holmium- yellow; uranium oxide- red to purple; uranium fluoride- green; calcium uranium oxide- yellow to brown.

GAHNITE (see natural mineral page 42)

GAH-nite

Reports of the synthesis of gahnite are known, but whether the properties are different from the natural mineral is not known. It is assumed that they are nearly the same. Evidently there is no financial incentive to produce it for gem material.

GGG** (gadolinium gallium garnet) (not a true garnet)

Gadolinium gallium oxide
$Gd_3Ga_5O_{12}$
Isometric
Habit- pulled boules, crystals?
Hardness- 6.5
Specific gravity- 7.02 to 7.05
Cleavage- none
Fracture- conchoidal

Colorless, many doped colors possible
RI- n-1.97
Critical angle- 30.5°
Dispersion- .038, medium
Luster- adamantine
Photochroism- weak to medium in some colors

This is one of the "diamond simulants" that received a burst of publicity and then was superseded by another simulant. It is a fine gem material in its own right.

GLASS**

Quartz plus lead oxide, and/or other coloring or decoloring oxides
Amorphous
Habit- lumps
Hardness- 5 approx. (highly variable)
Specific gravity- 2.5 to 4.2
Cleavage- none
Fracture- conchoidal

Colorless, all colors
RI- n-1.44 to 1.7
Critical angle- depending on RI
Dispersion- up to .041, strong
Transparent to translucent
Luster- vitreous
Alternate names- paste, strass, titrite, lead glass, others

Glass continued on next page.

VARIETIES:

Boro-silicate glass - presently being doped for use with layers with some gem use. Varieties of boro-silicate glass include: Royal Blue or Laser Blue- a deep blue material resembling sapphire blue; Electro Blue- a much lighter blue than above, but pleasing; both are claimed to be doped with copper; Tourmalike- highly photochroic; light bluish-pink in daylight, medium deep pink in incandescent light, light olive-green in fluorescent light; doped with a number of rare earths- lithium, neodymium, and praseodymium. Alexandrium (see page 114), should be classed here also. The boro-silicate glasses are usually slightly harder than most glasses, about 5.5 to 6. Their RI is about 1.51 to 1.52 (alexandrium is 1.58); the RI may depend upon the dopants used to create the colors. The authors disagree with the names for some of the boro-silicate glass materials. Tourmalike is not like tourmaline except for the pink, which is only a very slight resemblance. There is no recorded photochroic tourmaline. Alexandrium does not even closely resemble alexandrite; the colors are entirely different. Regardless of any disagreement, it is sadly admitted that the names, however confusing, will no doubt remain attached to the materials, and they will probably become popular.

Crown glass - the ordinary type used for bottles, etc., properties are lower

Flint glass - contains lead oxide, thus the specific gravity and RI will be high

Goldstone - contains flecks of copper that give it a shiller effect. Goldstone is commonly available in copper (red), blue and green colors

Trinitite - is a glass (fused sand), that is the result of the first atomic bomb explosion in New Mexico. It is considered to be highly radioactive, but has been cut into gems.

GOLDSTONE (see glass)

GREENOCKITE** — GREEN-ock-ite

Cadmium sulfide
CdS
Hexagonal
Habit- crystals (vapor phase method)
Hardness- 3.5
Specific gravity- 4.82
Cleavage- distinct, two directions
Fracture- conchoidal
Color- Yellow
RI- O-2.505, E-2.529
Critical angle- 24°
Birefringence- .024, medium
Luster- adamantine to resinous
Optically- uniaxial positive
Name- for Charles M. Cathcart, Lord Greenock; an English soldier

Natural facetable material is not known. Synthetic crystals have been faceted. This material is not on the market at present.

HEMATINE** — HEM-uh-teen

A material much like hematite, and an obvious imitation. Its composition is highly variable, but the hardness and specific gravity are nearly the same as hematite. It has not been a popular item for the amateur lapidary market, but beads and cabochons sold as hematite may actually hematine.

IMORI STONE (see Victoria Stone)

JADEITE (see natural material page 54)

Sodium aluminum silicate
Cryptocrystalline (?)
Habit- short cylinders
Hardness- probably about 6.5
Specific gravity- about 3.3
Cleavage- none
Fracture- splintery
Streak- uncolored
Inclusions- probably none
Color- Green, black, lavender, & combinations
RI- probably about 1.66
Probably opaque
Luster- ?

In early 1985, the General Electric Company reported producing this material. It was the result of their high temperature and pressure studies. They have evidently been able to produce most of the colors found naturally. The cylinders are said to be about .25 inches wide and .5 inches long. There are no present plans to produce this for the market.

KTN** (potassium tantalate, colored with niobium)

This has been announced as a possible diamond substitute, but nothing has been seen of it on the market. It has a hardness of about 6, a specific gravity of 6.43, and a RI of 2.27.

LAPIS LAZULI (see natural material [lazurite] page 57)

LAP-iss LAZ-you-lie

Sodium aluminum sulfo-silicate
$Na_8(Al,Si_4)_6S_2$
Isometric (?), cryptocrystalline
Habit- discs about 100mm in diameter
Hardness- 5.5 to 6
Specific gravity- 2.4 to 3.0
Cleavage- none
Fracture- uneven, granular
Streak- light blue
Inclusions- pyrite
Color- Deep blue
RI- 1.50 to 1.55 (unimportant)
Luster- dull; polished surface vitreous
Opaque

Manufactured by the Gilson Co. The discs vary in diameter and width; some are almost free of pyrite, others contain large amounts, which accounts for the variation in specific gravity. This material is advertised s a synthetic, but many gemologists feel that it is not identical to the natural material and thus state that it is an imitation. In spite of this thinking, it can be cut into excellent gems closely resembling natural material.

LASER GEM (see glass)

LINOBATE**

LINE-oh-bait

Lithium niobate (or metaniobate)
$LiNbO_3$
Hexagonal
Habit- pulled (?) boules
Hardness- 5
Specific gravity- 4.62 to 4.64
Cleavage- none evident
Fracture- conchoidal
Colorless, and some doped colors
RI- 2.21 to 2.3
Critical angle- 26.5°
Birefringence- .090, very strong
Dispersion- .120 to .130, very strong
Luster- adamantine
Pleochroism- distinct in deep colors
Trade name- “Fiery Astrilite”

This material has a potential as a popular gem because of its high dispersion (over twice that of diamond) and the possible range of colors. The low hardness is a strong deterrent. Boules must be oriented for best results because of the strong birefringence. Linobate can be cut into excellent gems, with high brilliance and dispersion.

LITHIUM FLUORIDE**

LITH-ee-um FLUE-or-ide

LiF
Isometric
Habit- cleavages
Hardness- 3
Specific gravity- 2.65
Cleavage- perfect, three directions
Fracture- splintery, brittle
Colorless, doped many colors
RI- n-1.44
Critical angle- 44°
Luster- vitreous

This material has very few good gem characteristics, and appears to be slightly water soluble. It has been cut into uninteresting gems.

LITHIUM TANTALATE**

LITH-ee-um TAN-tall-ate

$LiTaO_3$
Isometric
Habit- crystals?
Hardness- 5.5 to 6
Specific gravity- 7.45
Cleavage- none evident
Fracture- conchoidal
Colorless
RI- n-2.18 to 2.22
Critical angle- 29.5°
Dispersion- strong
Luster- adamantine to vitreous

This is a material that has a doubtful place as a gem. It appears to fall in the same doubtful class as KTN.

MAGNETITE & MAGNETOPLUMBITE

MAG-net-oh-plum-bite

These two black opaque materials deserve some mention, even though they have a small place in lapidary. These synthetics are identical to the natural minerals, and information can be found in any mineralogy text, (see magnetite, page 61). Neither of the synthetics has been on the market, but they could be offered.

MOISSANITE (see silicon carbide)

OPAL (see natural mineral page 70)

OH-puhl

Silicon dioxide + water
$SiO_2 \cdot nH_2O$
Amorphous
Habit- chunks
Hardness- 6 to 6.5
Specific gravity- 2.10±
Cleavage- none
Fracture- conchoidal

Color- A play of colors
RI- n-1.45
Critical angle- unimportant
Translucent to opaque
Luster- vitreous

May exhibit anamolous double refraction due to internal strain (as natural opal) Precious opal was originally synthesized by the Gilson Co. of France. The material is very fiery, but does not really look like the natural mineral. It is reported to be made so that structurally it is virtually identical to natural opal, but some part of the process is at least slightly different in order to make such fiery material. Slocum stone is an imitation opal made with strips of multicolored aluminum enclosed in glass. The aluminum is easily seen with careful observation. The product is poor.

PERICLASE

PEAR-ih-clase

Magnesium oxide
MgO
Isometric
Habit- lumps
Hardness- 5.5
Specific gravity- 3.56 to 3.68
Cleavage- distinct, three directions
Fracture- conchoidal

Colorless, light yellow
RI- n-1.74
Critical angle- 36°
Luster- vitreous
Name- *periklasis* (Gr) - to break around; from its granular form
Alternate name- "lavernite"

Natural material as crystals or massive is rare and always small. Synthetic pieces are often available. Faceted gems lose luster after a few months, due to alteration to brucite.

PEROVSKITE

per-OFF-skite

Calcium titanate
$CaTiO_3$
Orthorhoinbic
Habit- probably fused boules
Hardness- 5.5 to 6
Specific gravity- 4.01 to 4.05
Cleavage- probably imperfect
Fracture- conchoidal

Colorless, other colors possible?
RI- 2.4
Critical angle- 24°
Birefringence- ?
Dispersion- very strong
Luster- adamantine to vitreous
Name- for Count L.A. Perovski, Russian Statesman

This is the synthetic analogue of the mineral perovskite, which has not been found in gem quality. It is very similar to strontium titanate (page 124) with calcium replacing the strontium. It could be offered as a gem material.

PLASTIC**

Highly variable composition of carbon, hydrogen, and oxygen
Amorphous
Habit- sheets, rods, molded, etc.
Hardness- 1.5 to 3
Specific gravity- 1.18 to 1.6
Fracture- conchoidal to uneven

Colorless, and all colors
RI- 1.47 to 1.7
Transparent to opaque
Luster- resinous to vitreous

Usually without inclusions, but may have bubbles or enclosed fragments. May show anomalous double refraction. Most emit a distinct "burning plastic" odor when heated. Bakelite emits a carbolic acid odor.

POWELLITE

POW-ell-ite

Calcium molybdate
$CaMoO_4$
Tetragonal
Habit- fused boules
Hardness- 4 to 4.5
Specific gravity- 4.25 to 4.34
Cleavage- indistinct
Fracture- uneven

Colorless, doped colors
RI- 1.924 to 1.967
Critical angle- 30.5
Birefringence- .011, medium
Dispersion- strong?
Luster- adamantine to vitreous
Dichroic in some colors
Photochroism- very strong in some colors
Optically- uniaxial positive
Name- for John W. Powell, American geologist

This synthetic is evidently made under the same circumstances as scheelite (page 122). Faceting material has been on the market in small amounts. It can be cut into an excellent gem. Photochroic behavior of this material is startling; each type of light will produce a different color or shade. The authors know of no occurance of facetable natural powellite.

QUARTZ (see natural mineral page 81-82)

SiO_2
Hexagonal
Habit- crystals
Hardness- 7
Specific gravity- 2.66
Cleavage- none
Fracture- conchoidal

Colorless, greenish, brownish, yellow, blue, purple
RI- 1.54 to 1.55
Critical angle- 40°
Birefringence- .009, weak
Dispersion- .013, medium
Luster- vitreous
Pleochroism- medium in amethyst
Optically- biaxial positive
Trade name- camilita, for amethyst

Colorless quartz has been synthesized for many years in this and other countries. The Russians have synthesized greenish, blue, brownish, amethyst and yellow. Nice amethyst has also been made in Japan. Material is plentiful on the market. The brownish material has been offered as synthetic andalusite, which it definitely is not.

RAINBOW CALSILICA (**)

RAIN-bow kal-SILL-ih-kah

Calcium based material
Amorphous
Habit- massive
Hardness- approximately 4 when stabilized
Specific gravity- ?
Cleavage- none
Fracture- conchoidal, may break on layers
Streak- ?

Color- Layers of yellow, turquoise, green, white, red and orange
RI- ?
Opaque
Luster- waxy
Name- Rainbow for the color layers, calsilica for the supposed calcium and silicates

This material must be stabilized before it can be worked and polished. Rainbow calsilica has been widely purported to be of natural rhyolitic origin, as well as from naturally occuring bands of clay. However, scientific analysis has proven that the colors are derived from synthetic pigments. The the editor does not need a scientific analysis to determine the manmade nature of rainbow calsilica, because he has seen a sample of this material with a bottle cap embedded in it!

It is unfortunate that rainbow calsilica has been misrepresented as a naturally occurring stone, because it is an attractive material when made into cabochons, carvings and beads.

RANGELY DOME STONE (**?)

RANGE-lee

A glass (?)
Calcium sodium phosphate?
Amorphous
Habit- chunks
Hardness- 4
Specific gravity- 2.59
Cleavage- none
Fracture- conchoidal, brittle
Streak- white
Color- Bluish-purple to purple
RI- n-1.53
Critical angle- 40°
Transparent
Luster- vitreous to waxy
Photochroism- blue in daylight; purple in incandescent light
Name- supposedly from an oil dome
Alternate name- cobalite

This material is reported to have been a precipitate out of the liquids pumped from a well at the Rangely Dome (oil well), in Colorado. A number of accessory elements are reported to be in the material also. These are aluminum 1 to 2%, cobalt 1 to 2%, silicon 1 to 2%, a trace of iron, magnesium, and titanium. The alternate name probably is from the color, rather than cobalt content. The most interesting feature of rangely dome stone is its striking photochroism. In daylight a brilliant deep blue; a nice purple in incandescent light. All factors being considered, this is not a good gem material. It is filled with bubbles, as well as the poorer characteristics above. It is included here with the man-made materials because it is the result of the operations of an oil well. The action of steam (and perhaps other ingredients) has evidently formed the material. Its status as a synthetic is somewhat controversial.

RUTILE (see natural mineral page 84-85)

RUE-teal

Titanium dioxide
TiO_2
Tetragonal
Habit- fused boules
hardness- 6 to 6.5
Specific gravity- 4.2
Cleavage- none apparent
Fracture- subconchoidal
Color- Slight yellow, red, blue, others
RI- O-2.61, E-2.90
Critical angle- 22°
Birefringence- .29, very strong
Dispersion- .30, very strong
Luster- adamantine
Dichroic in deep colors
Optically- uniaxial positive
Trade name- Titania

At the time of the introduction of titania it was greeted as a welcome respite from the sameness of the existing synthetic spinels and corundum. Its strong dispersion was breathtaking. It was not accepted as a diamond simulant. The first faint yellow titania was joined by a deep blue, a fine yellow-orange, and a garnet-like red-orange. Nearly colorless boules are now available. The yellow-orange is excellent; the other two colors are a bit dark.

SCHEELITE (see natural mineral page 86)

SHE-lite

Calcium tungstate
$CaWO_4$
Tetragonal
Habit- pulled boules
Hardness- 4.5
Specific gravity- 6.12
Cleavage- not evident
Fracture- uneven brittle
Color- Lavender, blue, pink, many other colors possible
RI- 1.918 to 1.934
Critical angle- 31.5°
Birefringence- .016, medium
Dispersion- .026, medium
Luster- vitreous to adamantine
Dichroic
Photochroism- strong, blue, pink, lavender
Optically- uniaxial positive

The photochroism of the lavender material (from daylight) is very spectacular. It turns to a bright pink in incandescent light, and an intense blue in fluorescent light. Other colors are possibly also photochroic. This material can be cut into beautiful, though soft, gems.

SILICON CARBIDE, MOISSANITE**

SILL-ih-con CAR-bide, MOY-san-ite

SiC
Hexagonal (also cubic)
Habit- tabular
Hardness- 9.25 to 9.5
Specific gravity- 3.17
Fracture- conchoidal

Color- Colorless, bluish-green to yellowish-green
RI- O-2.65, E-2.69
Critical angle- 22°
Birefringence- .04, strong
Dichroism- distinct
Dispersion- .08, strong
Luster- adamantine
Optically- uniaxial positive
Name- (for the natural material)- for Henri Moisson; French chemist who was an early synthetic investigator
Trade name- Carborundum

This material, commonly known as an abrasive, has a natural counterpart, moissanite, found in an Arizona meteorite. Small very brilliant "diamond-like" gems have been cut from the hexagonal type. The cubic, is becoming a very popular gem material as a diamond simulant.

SLOCUM STONE [see opal (syn)]

SOAP **

Calcium yttrium silica-oxide
$CaY_4(SiO_4)_3O$
Hexagonal
Habit- pulled boules
Hardness- 5
Specific gravity- 5.5
Cleavage- none evident
Fracture- conchoidal

Color- Many doped colors
RI- 1.8 approximately
Critical angle- 33.5°
Birefringence- ?
Dispersion- strong
Luster- vitreous
Photochroism- very strong

The name is an acronym based upon the silica (S), oxide (O), and the apatite (AP) structure.
Soap shows at least three photochroic colors when exposed to daylight, fluorescent light, and incandescent light. The change is much like synthetic scheelite, but a bit more spectacular. Gems are excellent in any light.

SPHALERITE (see natural mineral page 93)

SFAY-ler-ite

Zinc sulfide
ZnS
Isometric
Habit- pulled (?) boules
Hardness- 3.5 to 4
Specific gravity- 4.0
Cleavage- perfect, six directions
Fracture- conchoidal, brittle

Colorless, possibly other doped colors
RI- n-2.37
Critical angle- 25°
Dispersion- .156, very strong
Luster- adamantine

Sphalerite has been synthesized. It would make a very fine gem material, but it is doubtful if it will be on the market in any quantity. The low hardness and the six cleavages will work against popularity, thus reducing any financial stimulous to manufacture it. If true, this is a shame as it produces an excellent gem, especially in light colors.

SPINEL (see natural mineral page 93-94) SPIN-ell

Magnesium aluminum oxide
$MgAlO_4$
Isometric
Habit- fused boules
Hardness- 8
Specific gravity- 3.6
Cleavage- none
Fracture- conchoidal

Colorless, virtually all colors
RI- n-1.72
Critical angle- 35.5°
Dispersion- .020, medium
Luster- vitreous

Anomalous double refraction is often exhibited by synthetic spinel. It shows as spots and streaks. The well-known synthetic spinels of almost every color really need little mention here. They have a real advantage over the natural material in that they are usually much clearer and have more intense colors. Natural spinels are seldom available in sizes to cut larger than one carat gems. Until recently, red spinel defied synthesis, but now small pieces are available. Blue spinel has been made to imitate lapis lazuli, with the pyrite of lapis being imitated by (of all things) gold flecks. Some of the colors and dopants are: chromium- pink; cobalt- blue; manganese- pale blue; vanadium- violet.

STRONTIUM TITANATE** STRON-tee-um TIE-tan-ate

$SrTiO_3$
Isometric
Habit- fused boules, crystals from melt
Hardness- 5.5 to 6
Specific gravity- 5.13
Cleavage- evidently none
Fracture- conchoidal

Colorless, many doped colors
RI- n-2.41
Critical angle- 24°
Dispersion- .198, very strong
Luster- adamantine
Photochroism- probable with some colors
Trade names- fabulite, starilan, others

This material, when introduced, was the closest to a diamond substitute as was known. The lack of double refraction, and being colorless, put titania in second place. Strontium titanate has been eclipsed by cubic zirconia and moissanite as a diamond simulant. Gems are spectacular.

TELLURIUM OXIDE** tell-OOR-ium OX-ide

TeO_2
Crystal system- ?
Habit- boules
Hardness- 3
Specific gravity- 6.5
Cleavage- none evident
Fracture- conchoidal

Colorless
RI- high
Critical angle- ?
Luster- vitreous
Toxic

This material appears facetable, but information is only sketchy above because lapidary treatment could be hazardous. It is not recommended.

TITANIA (see rutile)

TOURMALINE (see natural mineral page 100-103)

Tourmaline has been synthesized as crystals by the hydrothermal method. To date, no material has reached the amateur market. As there is probably no financial incentive to do so, there is much doubt that any will be seen for a large number of years. Information at hand indicates that the synthetic has virtually the same properties as the natural mineral.

TURQUOISE (see natural mineral page 104)

TUR-koiz

Hydrous basic copper aluminum phosphate
$CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O$
Triclinic
Amorphous (cryptocrystalline)
Hardness- 5 to 6
Specific gravity- 2.6 to 2.9
Cleavage- none, moderately tough
Fracture- conchoidal to smooth
Streak- whitish

Color- Intense medium blue
RI- 1.59 to 1.60 (unimportant)
Opaque
Luster- waxy to dull

This is evidently a true synthetic manufactured by the Gilson Company of France. It is claimed that there is no iron in the compound, which evidently makes natural turquoise turn greenish. The material is available in chunks much like natural ones. Some investigators state that this material is treated with plastic, evidently in the same manner as some types of natural turquoise.

VICTORIA STONE**

Said to be a mixture of quartz, calcite, feldspar, magnesite, fluorite, etc
Habit- chunks showing crucible marks
Hardness- 5.5 to 6
Specific gravity- 3.02
Cleavage- none
Fracture- conchoidal

Color- Many colors
RI- 1.62
Critical angle- 38°
Luster- vitreous
Alternate name- Imori stone

This material was first offered as a chatoyant jade simulant. Some independent analyses state that the needles causing the chatoyance are much like actinolite, thus giving credence to a jade-like structure. Large chunks with a pseudo-conical shape of a crucible are on the market. Colors are variable. Clear material of at least three colors has been offered as a faceting material. It shows the same crucible mould shape, a hardness of 5.5, a RI of 1.52, and a specific gravity of 1.74. It could be remotely possible that it is a mixture as claimed above by the manufacturers, but in the eyes of the authors it is glass. Certainly, with a RI that low, any cut gems would appear about the same as glass.

WULFENITE (see natural mineral page 110)

WOLF-en-ite

Lead molybdate
$PbMoO_4$
Tetragonal
Habit- boules
Hardness- 2.5 to 3
Specific gravity- 7.0
Cleavage- distinct, one direction
Fracture- subconchoidal, brittle

Color- Nearly colorless to yellow
RI- 2.28 to 2.4
Critical angle- 25.5°
Birefringence- .120, very strong
Dispersion- strong
Luster- adamantine
Optically- uniaxial negative

Some boules have reached a diameter of 25mm and larger ones may be expected. The only color observed is the yellowish, but there appears to be no reason why many colors cannot be produced. Again, financial incentive will be the limiting factor. At present, the supply of rough material is meager. This material is very brittle, with careful handling in all stages very necessary. Any gems produced are spectacular.

YAG ** (yttrium aluminum garnet)

IT-ree-um

Yttrium aluminate
$Y_3Al_5O_{12}$
Isometric
Habit- fusion boules, flux crystals
Hardness- 8.5
Specific gravity- 4.55
Cleavage- none
Fracture- conchoidal

Colorless, many doped colors
RI- n-1.833
Critical angle- 32°
Dispersion- .016, medium
Luster- vitreous
Name- an acronym of the first letters of the written name

The authors made, (with the help of mineral grinder), a yag hemisphere for an old refractometer. Yag has the same RI as the liquid used on the instrument. In spite of the fact that this was first offered as a diamond simulant (for which it was unsuccessful) this is an excellent gem material in its own right. The hardness, good dispersion, and the many colors make it most desirable. This material has nicely outgrown the "diamond simulant" label. A good supply has been constantly available, and undoubtedly will continue to be offered to the amateur as well as professional cutter.

YALO**

YAH-low

Yttrium aluminate
$Y_2Al_2O_6$
Orthorhombic
Habit- pulled boules
Hardness- 8 to 8.5
Specific gravity- 5.35
Cleavage- none evident
Fracture- conchoidal

Color- Pink, other doped colors
RI- 1.938 to 1.95
Critical angle- 30.5°
Birefringence- .012, medium
Dispersion- .012, medium
Luster- vitreous to adamantine
Name- an acronym of the letters of the symbolic formula

This is a close relative of YAG, but has not received much attention. It has all the attributes of a fine gem material, but again, financial incentive is probably against it being offered in good amounts.

YTTRALOX**

IT-rah-lox

A sintered polycrystalline solid solution; 90% yttrium oxide, 10% thorium oxide
Habit- chunks
Hardness- 6 to 6.5
Cleavage- ?
Fracture- uneven ?

Colorless
RI- 1.92
Critical angle- 31°
Birefringence- probably none
Dispersion- .039, medium
Luster- vitreous to adamantine

This is a very unique material that has not been offered in any quantity. It is referred to at times in the literature in reference to experimental procedures. On the basis of this, the material could have a good gem potential if a supply were available. The advent of cubic zirconia as a diamond simulant will probably keep it off the market. The thorium content may also make it unhealthy for lapidary work.

YTTRIUM OXIDE**

IT-ree-um OX-ide

Y_2O_3
Isometric
Habit- fused boules
Hardness- 7.5 to 8
Specific gravity- 5.06
Cleavage- none evident
Fracture- conchoidal

Colorless to, other colors may be possible
RI- n-1.92
Critical angle- 30.5°
Dispersion- .144, very strong
Luster- vitreous to adamantine
Alternate name- yttria

Another member of the YAG group that has not been given much attention. Financial incentive is probably against it being offered in good amounts. Again, a fine gem material is being ignored.

YTTRIUM VANADATE**

IT-ree-um VAN-uh-date

$YVaO_4$
Tetragonal
Habit- chunks
Hardness- 5.5
Specific gravity- 4.23
Cleavage- perfect, two directions
Fracture- uneven

Color- Purple, doped colors possible?
RI- 1.88
Critical angle- 32°
Birefringence- .02, medium
Luster- vitreous to adamantine

This material has been on the market only sparingly and there is no reason why it should become more available. The hardness and RI are well below other materials that are readily available. The Bridgman-Stockbarger melt method is used to grow this material.

ZINCITE (see natural mineral page 111)

ZINC-ite

Zinc oxide
ZnO
Hexagonal
Habit- hydrothermal crystals
Hardness- 4 to 4.5
Specific gravity- 5.5
Cleavage- perfect, one direction
Fracture- subconchoidal, very brittle

Colorless, yellow to greenish-yellow
RI- 2.01
Critical angle- 30°
Birefringence- .016, medium
Dispersion- strong
Luster- adamantine
Optically- uniaxial positive

The natural mineral zincite is very rare. Synthetic zincite theoretically tends to fill this void. However, the natural material is red, but the synthetic is light colored. Synthetic material shows greater brilliance than the natural because of the lighter color. The above should make the synthetic very popular, but to date only thin crystals have been grown, and the seed occupies the center. Thus only small (6 to 10mm) gems can be cut from the present synthetic crystals. Hardness is also a negative factor. Again, financial incentive will control the future market, but the possibilities of a fine gem may tend to affect it.

In 1985 or 1986, colorless, yellow, and red-orange zincite cryststals came from Poland. During repairs at a zinc smelter, a flue was found to be filled with excellent zincite crystals. It is not surprising the the flue needed repairs when filled with crystals.

ZINC ORTHOTITANATE**

oar-tho-TIGHT-an-ate

$ZnTiO_4$
Isometric
Habit- fused boules
Hardness- 6.5
Specific gravity- ?

Colorless, green
RI- n-2.22
Critical angle- 26.5°

This material has never been offered on the market, and it now appears that it never will. It is included here in the event that the prediction is not correct.

ZIRCON (see natural mineral page 111)

ZERK-on

Small crystals of zircon have been grown, but not offered on the market. The process involves heating quartz (SiO_2) and zirconium oxide (ZrO_2) to 2700° Celsius. Interestingly, these two compounds are the components of metamict zircon and there have been past claims that the heating of this reverts it back to normal zircon. This has been doubted by many, but perhaps it has some truth. Apparently any color can be produced in the synthetic, and sizes could probably increase. Financial incentive is again the factor that will control any offerings. The present political chaos in the main zircon producing areas of the world (Asia and Africa) may affect the market to the point where it may become financially attractive to offer the synthetic.

ZIRCONIA

zir-CONE-ee-uh

Zirconium oxide
ZrO_2 + stabilizers
Isometric
Habit- chunks
Hardness- 8 to 4.5
Specific gravity- 5.65 to 5.95
Cleavage- none evident
Fracture- uneven to subconchoidal, brittle

Colorless, various doped colors
RI- n-2. 15 to 2.17
Critical angle- 28°
Dispersion- .058 to .066, very strong
Luster- adamantine
Correct name- cubic zirconia
Common name- C-Z or CZ
Name- for the zirconium in its molecule

With the possible exception of moissanite, this material is the closest diamond simulant to date. It has an excellent gem potential in its own right, and is outgrowing the "diamond simulant" label. It is very popular in the colorless form, but a large number of colors are now on the market and are gaining popularity. The material is grown by what is known as the "skull method" in which a molten mass is surrounded by a heating element. Upon cooling, the material must broken from the unit.

Actually, this is the isometric form of the mineral baddeleyite (see pages 11 and 114) that is converted to the isometric form by adding a stabilizer. Without the stabilizer it would convert to baddeleyite upon cooling. Evidently, different stabilizers are being used by each manufacturer, which makes for variation in some optical and physical characteristics. Presently, the better material is being made in Russia and the US. It is also manufacturered in Switzerland, South Korea and China. There is a record of cubic zirconia occuring naturally. In 1937, two German mineralogists were investigating zircon when they noted an enclosed cubic crystal. Investigation showed it to be cubic zirconia. They gave it so little importance that they did not bother to give the material a name. As a result, some mineralogists feel that cubic zirconia (at least colorless type) is a true synthetic. The typical price drop for synthetics has been experienced and this material now has very little value per carat. Nevertheless, it is very popular with amateur faceters and the general public.

In 1983, a material called C-Ox was introduced. It was made in Russia and was claimed to be a new material. The first introduction was a fine emerald green. As cubic zirconia had not been offered in green, it did appear to be a new material. Recent investigations have proved, however, that it is just a different color of cubic zirconia.

Section 3
TABLE OF HARDNESS

The following table lists, in ascending order, the Mohs hardness for all minerals and man-made materials included in Sections 1 and 2. The minerals shown in capital letters are the Mohs hardness indicators for the group that follows. The use of capitals for the indicators tends to separate the various hardness groups, assisting in the location of any desired group.

In recent years there has been an attempt to replace the Mohs scale with another scale showing a greater hardness number for diamond (15) in an attempt to show the great difference between 9 and 10 on the scale. The idea has much merit, but evidently is not being accepted. Regardless of its deficiencies, the Mohs scale has served geologists and mineralogists nicely for a long period of time and evidently will continue to do so. Its extreme simplicity and the use of common minerals as indicators is greatly in its favor.

Basically, the Mohs scale simply says that any mineral will scratch another mineral with a lower number, and in turn be scratched by all other minerals with a higher number. Whether or not the scratch is made with difficulty or with ease is not of importance. The one and only thought is whether or not a scratch is made. If the relative ease or difficulty of making the scratch is of importance, then other (and usually more complicated) scales are used. The Knoop scale is compared to the Mohs scale in a table below.

There appears to be a tendency toward some misunderstanding of the Mohs hardness scale as to relative hardness of minerals. Advertisements have been seen that claim that a certain material (man-made) is a percentage hardness of diamond. The thought conveyed is that diamond at 10 is represented at 100%, and each lower hardness is a percentage fraction of this amount. Thus a gem of 7 Mohs hardness might be represented at 70% of diamond hardness. This is far from correct. The Mohs scale was only designed to present a basis upon which one mineral would scratch those with a lesser number, and be scratched by those with larger numbers.

The Knoop hardness scale is based upon relative hardness, and is given below in comparison to Mohs scale. It can be readily seen that diamond is over three times as hard as corundum (exactly thirty-three and one-third percent of the hardness of diamond). The differential with other Mohs numbers is even more. For instance, quartz (Mohs 7) converts to about 11% rather than 70%.

MOHS HARDNESS

Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Orthoclase	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

KNOOP HARDNESS

Talc	--
Gypsum	32
Calcite	135
Flourite	163
Apatite	430
Orthoclase	560
Quartz	820
Topaz	1340
Corundum	2100
Diamond	7000

KNOOP HARDNESS FOR OTHER MATERIALS

Almandine garnet	1360
Andalusite	1180
Beryl	1200
Rutile	850
Strontium titanate	600
Tourmaline	1000
YAG	1800
Silicon carbide	2480
Boron carbide	2750

HARDNESS 0 to 1

Valleriite

HARDNESS 1 to 1.5

TALC
Agalmatolite
Aurichalcite
Ulexite

1 TO 2

Aurichalcite

1 TO 2.5

Agalmatolite

1.5 TO 2

Covellite
Orpiment
Realgar
Vivianite

1.5 TO 2.5

Stichtite
Sulphur
Tellurium

1.5 TO 3

Plastics**

HARDNESS 2

GYPSUM
Cinnabar
Covellite
Ettringite
Gilsonite
Halite
Hydrozincite
Kammererite
Mellite
Orpiment
Penninite
Proustite
Realgar
Senarmontite
Sepiolite
Tellurium
Viliaumite

2 TO 2.5

Amber
Clinochlore
Cinnabar
Ettringite
Gilsonite
Hydrozincite
Kammererite
Mellite
Penninite
Proustite
Sulfur
Tellurium
Villiaumite
Vivianite

2 TO 4

Chrysocolla (bisbeeite)
Ettringite

2.5

Anglesite
Bauxite (variable)
Boleite
Cinnabar
Crocoite
Cryolite
Diginite
Ettringite
Gilsonite
Hydrozincite
Inderite
Ivory
Kammererite
Kurnakovite
Lepidolite
Linarite
Mellite
Pearl
Penninite
Phosgenite
Pinite
Proustite
Pseudophite
Pyrargyrite
Sericite (also 4)
Serpentine
Silver
Stichtite
Sulfur
Tellurium
Villlaumite
Whewellite
Wulfenite

2.5 TO 3

Anglesite
Barite
Chalcocite
Copper
Crocoite
Digenite
Lepidolite
Millerite
Pachnolite
Pearl
Phosgenite
Pinite
Priceite
Shortite
Silver
Sussexite
Tennantite
Vanadinite
Wulfenite

2.5 TO 3.5

Barite

2.5 TO 4

Jet
Lepidolite
Sericite
Serpentine

2.5 TO 4.5

Pearl
Pearl shell

2.5 TO 5

Serpentine

HARDNESS 3

CALCITE
Anhydrite
Anglesite
Anhydrite
Argillite
Astrophyllite
Atacamite
Barite
Bornite
Celestite
Cerussite
Chalcocite
Copper
Diginite

Lithium fluoride**
Millerite
Pachnolite
Paravauxite
Silver
Tellurium oxide**
Verdite
Witherite

3 TO 3.5

Anhydrite
Atacamite
Celestite
Cerussite
Chiolite
Cryolite
Cryolithionite
Descloisite
Lepidolite
Millerite
Phosphophyllite
Priceite
Sussexite

3 TO 4

Algodonite
Allemontite
Argillite
Chrysocolla
Domeykite
Jet
Pearl
Phosphophyillite
Phosphosiderite
Priceite
Serpentine
Tennantite
Witherite
Zincite

3.5

Adamite
Anhydrite
Aragonite
Atacamite
Azurite
Barite
Brochantite
Celestite
Cerussite
Chalcopyrite
Chenevixite
Coral (nat & syn)
Cubanite
Cuprite
Descloisite
Dickinsonite
Dolomite
Greenockite (syn)
Howlite
Hureaulite
Jet
Lepidolite
Ludlamite
Malachite
Millerite
Mimetite
Pentlandite
Phosphophyllite
Priceite
Pyrrhotite
Rhodochrosite
Scorodite
Serpentine
Shattuckite
Siderite
Stilbite
Strontianite
Sussexite
Tennantite
Thaumasite
Wavelite

3.5 TO 4

Alunite
Aragonite
Azurite
Brochantite
Chalcopyrite
Chenevixite
Cuprite
Dickinsonite
Dolomite
Jet
Lepidolite
Malachite
Mimetite
Pentlandite
Phosphophyllite
Purpurite
Pyromorphite
Pyrrhotite
Rangely dome stone**
Rhodochrosite
Scorodite
Serpentine
Shattuckite
Siderite
Sphalerite
Stilbite
Tennantite
Tenorite
Wavellite

3.5 TO 4.5

Chenevixite
Magnesite
Pyrrhotite
Rhodochrosite
Tennantite
Witherite

HARDNESS 4

FLUORITE
Aragonite
Azurite
Black coral (approx)
Brochantite
Burnite?
Catlinite (approx)
Ceruleite
Chabazite
Chenevixite
Chiolite
Chrysocolla
Colemanite
Cryolite
Cryolithionite
Cuprite
Cuprosklodowskite
Dickinsonite
Dolomite
Gmelinite
Huebnerite
Jet
Kyanite
Lithiophylite
Magnesite
Malachite
Manganite
Meteorite
Mimetite

Pentlandite
Purpurite
Rainbow Calsilica**
Scorodite
Sericite (also 2.5)
Shattuckite
Siderite
Smithsonite
Sphalerite
Stilbite
Tennantite
Variscite
Wavellite
Witherite
Xenotime

4 TO 4.5

Chenevixite
Colemanite
Huebnerite
Lithiophilite
Magnesite
Powellite (syn)
Purpurite
Pyrrhotite?
Smithsonite
Zincite

4 TO 5

Chabazite
Friedelite
Gaspeite
Gmelinite
Lithiophilite
Meteorite
Mordenite
Smithsonite
Xenotime
Zincite

4, 5 & 7

Kyanite

4 TO 5.5

Smithsonite

4.5

Bayldonite
Chenevixite
Colemanite
Conichalcite
Eosphorite
Foggite
Friedelite
Hedyphane
Hemimorphite
Huebnerite
Lithiophilite
Mordenite
Parisite
Phosphosiderite (stabilized)
Purpurite
Rhodochrosite
Scheelite
Serandite
Smithsonite
Wollastonite
Yugawaralite
Zincite

4.5 TO 5.5

Apophyllite
Childrenite
Eosphorite
Friedelite
Hemimorphite
Hodgkinsonite
Lithiophilte
Opal (natural)
Orangite
Scheelite
Serandite
Thorite
Wollastonite

HARDNESS 5

APATITE
Analcime
Apophyllite
Arandisite
Augelite
Cancrinite
Charoite
Datolite
Diopside
Dioptase
Durangite
Ekanite
Enstatite
Eosphorite
Friedelite
Glass** (variable)
Hodgkinsonite
Hornblende
Hypersthene
Kakortokite
Kinoite
Kyanite (see 4 to 7)
Lazurite
Legrandite
Linobate**
Lithiophilite
Llanite
Maucherite
Meliphanite
Mesolite
Meteorite
Monazite
Mordenite
Natrolite
Niccolite
Odontolite
Opal (natural)
Pectolite
Perlite
Psilomelane
Scapolite
Scheelite
Scolecite
Sellaite
Serandite
Serpentine
SOAP**
Sphene
Spurrite
Tektite
Thomsonite
Tilasite
Tremolite
Turquoise (nat syn)
Vayrynenite
Vonsenite
Wardite
Wilkeite (approx)
Wollastonite
Xenotime
Zincite

5 TO 5.5

Analcime
Eudialite
Goethite
Herderite

Kakortokite
Lazurite
Limonite
Llanite
Meliphanite
Monazite
Natrolite
Niccolite
Obsidian
Opal (natural)
Perlite
Psilomelane
Smithsonite
Sphene
Tektite
Thomsonite
Tremolite
Turquoise (nat & syn)

5 TO 6

Actinolite
Albite feldspar
Andesine feldspar
Anorthite feldspar
Bytownite feldspar
Cancrinite
Charoite
Clinohumite
Diopside
Enstatite
Hornblende
Hypersthene
Jacobsite
Kakortokite
Labradorite feldspar
Microcline feldspar
Oligoclase feldspar
Opal (natural)
Psilomelane
Rhodonite
Rutile
Scapolite group
Sugilite
Tektite
Tremolite
Tugtupite
Turquoise (nat & syn)

5 TO 6.5

Clinohumite
Euxenite
Fergusonite
Jacobsite
Opal
Perlite
Psilomelane
Samarskite
Scapolite

5 TO 7

Clinohumite
Jacobsite
Psilomelane

5.5

Allanite
Analcime
Anatase
Anthophyllite
Augite
Beryllonite
Brazilianite
Briethauptite
Brookite
Cancrinite
Chlorastrolite
Chromite
Clinohumite
Cobaltite
Datolite
Hauyne
Hematite
Herderite
Hornblende
Jacobsite
Kakortokite
Lazulite
Lazurite (lapis lazuli nat & syn)
Leucite
Leucophoenicite
Magnetite
Microlite
Milarite
Miserite
Monazite
Monticellite
Natrolite
Nephelene
Niccolite
Nosean
Obsidian
Opal (natural)
Periclase (syn)
Perlite
Plancheite (bisbeeite)
Psilomelane
Rhodonite
Scorzalite
Smithsonite
Sodalite
Sphene
Stibiotantalite
Sugilite
Tektite
Thomsonite
Turquoise (nat & syn)
Willemite
Yttrium vanadate**

5.5 TO 6

Allanite
Anatase
Anthophyllite
Augite
Beryllonite
Brookite
Cancrinite
Clinohumite
Clinozoisite
Hauyne
Hematite
Herderite
Hornblende
Hydrogrossular
Jacobsite
Kakortokite
Lazulite
Leucite
Leucophoenicite
Lithium tantalate**
Magnetite
Milarite
Miserite
Nepheline
Opal (nat & syn)
Perlite
Perovskite (syn)
Psilomelane
Pyroxmangite
Rhodonite
Skutterudite
Scapolite

Scorzalite
Sodalite
Stibiotantalite
Strontium titanate**
Sugilite
Tektite
Turquoise (nat & syn)
Victoria stone**

5.5 TO 6.5

Bustamite
Clinohumite
Clinozoisite
Hematite
Hydrogrossular
Jacobsite
Magnetite
Miserite
Prehnite
Psilomelane
Pyrite
Rhodonite
Sugilite
Tektite

HARDNESS 6

ORTHOCLASE feldspar
Aegerine
Albite feldspar
Alexandrium**
Allanite
Andesine feldspar
Anorthite feldspar
Amblygonite
Amphibolite
Anatase
Anthophyllite
Argilite
Augite
Beryllonite
Brookite
Bustamite
Bytownite feldspar
Cancrinite
Cassiterite
Charoite
Chondrodite
Clinohumite
Columbite
Davidite
Diopside
Epidote
Hauyne
Hematite
Hornblende
Kakortokite
KTN**
Labradorite feldspar
Lawsonite
Lazulite
Leucite
Leucophoenicite
Magnetite
Manganotantalite
Marcasite
Microcline feldspar
Milarite
Miserite
Mookaite
Nepheline
Nephrite
Oligoclase feldspar
Opal (nat syn)
Patricianite
Perlite
Petalite
Porphyry
Prehnite
Psilomelane
Pyrite
Pyroxmangite
Sarcolite
Scapolite
Sillimanite
Skutterudite
Sodalite
Stibiotantalite
Sugilite
Tantalite
Zektzerite
Zoisite

6 TO 6.5

Albite feldspar
Andesine feldspar
Anorthite feldspar
Barium titanate**
Benitoite
Bytownite
Cassiterite
Chondrodite
Clinohumite
Hydrogrossular
Jacobsite
Labradorite feldspar
Manganotantalite
Marcasite
Microcline feldspar
Mookaite
Nephrite
Opal (nat & syn)
Patricianite
Petalite
Prehnite
Psilomelane
Pyrite
Rutile
Sillimanite
Tugtupite
Yttralox**
Zoisite

6 TO 7

Cassiterite
Clinohumite
Clinozoisite
Epidote
Hydrogrossular
Jacobsite
Maw Sit Sit
Mookaite
Peridot
Psilomelane
Rhyolite
Sillimanite

6 TO 7.5

Hydrogrossular
Serendibite
Sillimanite
Spodumene

6.5

Andradite garnet
Axinite
Baddeleyite
Benitoite
Bustamite
Chondrodite
Gadolinite
GGG**
Hydrogrossular

Idocrase
Jadeite
Jeremejevite
Kornerupine
Nambulite
Patricianite
Peridot
Petalite
Pollucite
Psilomelane
Rutile
Serendibite
Sinhalite
Spodumene
Tugtupite
Unakite
Zinc orthotitanate**
Zircon (metamict)
Zoisite

6.5 TO 7

Axinite
Diaspore
Gadolinite
Jadeite
Peridot
Psilomelane
Ribbon stone
Serendibite
Sillimanite
Spodumene
Unakite

HARDNESS 7

QUARTZ
Axinite
Boracite
Buergerite tourmaline
Cassiterite
Chambersite
Danburite
Diaspore
Dravite tourmaline
Dumortierite
Elbaite tourmaline
lolite
Jadeite
Liddicoatite tourmaline
Peridot
Psilomelane
Ribbonstone
Schorl tourmaline
Tsilaisite tourmaline
Uvite tourmaline

7 TO 7.25

Danburite

7 TO 7.5

Almandine garnet
Buergerite tourmaline
Dravite tourmaline
Elbaite tourmaline
lolite
Liddicoatite tourmaline
Schorl tourmaline
Sillimanite
Staurolite
Tourmaline group
Tsilaisite tourmaline
Uvite tourmaline

7.25

Danburite
Grandidierite
Grossular garnet
Iolite
Malaya garnet
Pyrope garnet
Rhodolite garnet
Spessartine garnet

7.25 TO 7.5

Emerald (syn)

7.5

Andalusite
Beryl
Euclase
Gahnite
Hambergite
lolite
Painite
Phenacite
Sapphirine
Sillimanite
Simpsonite
Staurolite
Uvarovite garnet
Zircon (normal)

7.5 TO 8

Beryl
Gahnite
Phenakite
Simpsonite
Yttrium oxide**

HARDNESS 8

TOPAZ
Pezzottaite
Rhodizite
Spinel
Taaffeite

8 TO 8 .5

YALO**
Zirconia**

8.5

Chrysoberyl
Holtite
YAG**

HARDNESS 9

CORUNDUM
Bromellite (syn)

9.25 TO 9.5

Silicon carbide**

HARDNESS 10

DIAMOND
10+
Boron nitride**

Section 4
TABLE OF SPECIFIC GRAVITY

The concept of specific gravity is very simple; it is based upon the weight of a mineral in relation to the weight of an equal volume of water. If the mineral has a specific gravity of 3, it will weigh three times as much as water. Specific gravity may be determined by using a weighing scale that will allow suspension of the specimen. It is weighed in air, then weighed in water. The weight in water is subtracted from the weight in air, with the quotient divided into the weight in air.

For those who have a set of balances that will do the weighing, this is a very simple procedure. A jolly balance may be constructed from a yardstick and a long supple coil spring. Any type of scale presents a problem of space for use, and storage. There is no doubt that specific gravity determined this way is very accurate, but extremes of accuracy are not always necessary for the person working with gem materials.

Most of the gem materials normally encountered have a specific gravity less than 4. If the worker wishes a quick, yet still quite accurate method that will determine the specific gravity of these materials, he can procure a few heavy liquids, and prepare a series to suit his needs. The most useful liquids are tetrabromo ethane (also known as acetylene tetrabromide), and methylene iodide (also known as di-iodomethane). The first, with a specific gravity of 2.95, may easily be diluted with kerosene to a number of lower gravities. The second liquid, with a gravity of 3.33, may be diluted with toluene to fill the gap between the two. Both may be purchased from chemical houses. The price of methylene iodide is high, but a small amount (approximately one ounce) should be ample for most people. These two liquids also have a high refractive index and can be used to immerse faceting material to locate inclusions.

Dilutions to the following gravities are suggested. The minerals shown in parentheses will barely sink in that dilution. Dilute tetrabromo ethane to: 2.2 (opal); 2.48 (obsidian; 2.7 (quartz); 2.95 pure (prehnite); and dilute methylene iodide to: 3.1 (tourmaline); 3.2 (fluorite); and pure methylene iodide 3.3 (axinite). Leavıng the indicator minerals in the bottles will tell at a glance if the diluents have evaporated. If so, they will float. The careful addition of a small amount of the diluent will restore the correct density. Other liquids up to 4. 6 are available, but are poisonous and not generally recommended.

1.06-1.07	Gilsonite
1.09-1.1	Amber
1.18-1.6	Plastics**
1.30-1.35	Jet
1.34	Black coral
1.38-1.42	Ivory (vegetable)
1.50	Catseyte**
1.64	Mellite
1.65	Ulexite
1.70-1.98	Ivory (dentine)
1.77	Ettringite
1.78-1.86	Inderite & Kurnakovite
1.877	Thaumasite
1.90-2.3	Opal (natural)
2.00	Sepiolite
2.00-2.4	Chrysocolla
2.04-2.17	Chabazite & Gmelinite
2.05-2.09	Sulphur
2.09-2.2	Stilbite
2.10	Opal (syn)
2.12	Mordenite
2.14-2.3	Sodalite
2.16	Halite
2.16	Stichtite
2.16-2.27	Scolecite
2.20-2.5	Tektite
2.20-2.55	Variscite
2.20-2.65	Serpentine
2.21-2.26	Natrolite
2.22-2.29	Analcime
2.23	Whewellite
2. 23	Yugawaralite
2.29	Mesolite
2.30-2.4	Thomsonite
2.30-2.4	Nosean
2. 30-2.5	Apophyllite
2. 30-2.5	Petalite
2.30-2.6	Obsidian
2.31-2.33	Gypsum
2. 31-2.34	Wavellite
2.347	Hambergite
2.36	Paravauxite
2.36-2.57	Tugtupite
2.38-2.4	Brucite
2.38-2.95	Lazurite (lapis lazuli)
2.4±	Argillite
2.4±	Perlite
2.40-3.0	Lapis lazuli (syn)
2.42	Colemanite
2.42	Priceite
2.42-2.52	Cancrinite
2.44	Coral (syn)
2.44-2.5	Hauyne
2.45	Alexandrium**
2.45-2.5	Leucite
2.5±	Llanite
2.50-2.6	Porphyry
2.50-3.5	Maw Sit Sit
2.50-4.2	Glass**
2.51	Boron carbide**
2.53±	Rhyolite
2.53±	Foggite
2.54-2.59	Microcline feldspar
2.55-2.59	Milarite
2.55-2.65	Nepheline
2.55-2.75	Clinochlore
2.55-2.75	Iolite
2.56-2.58	Orthoclase feldspar
2.57-2.64	Quartz (cryptocryst)
2.58	Howlite
2.58-2.68	Vivianite
2.58-2.83	Talc
2.59	Rangeley Dome stone**
2.60	Shortite
2.60	Sericite
2.60	Ribbonstone
2.60-2.62	Albite feldspar
2.60-2.7	Coral
2.60-2.8	Scapolite group
2.60-2.85	Penninite
2.60-2.9	Alunite
2.60-2.9	Turquoise (nat & syn)
2.62-2.65	Oligoclase feldspar
2.62-2.66	Mookaite
2.63-2.83	Beryl
2.64	Kammererite
2.65	Beryl (syn emerald)
2.65	Lithium fluoride**
2.65-2.66	Quartz (crystalline)
2.66-2.68	Andesine feldspar
2.66-2.77	Pearl
2.67-2.71	Labradorite feldspar
2.68±	Charoite
2.69	Pseudophite
2.69-2.70	Augelite
2.69-2.82	Calcite
2.70±	Bisbeeite
2.70-2.8	Kakortokite
2.70-2.8	Pinite
2.70-2.92	Agalmatolite
2.70-3.0	Eudialite
2.71	Creedite
2.72-2.74	Bytownite feldspar
2.74±	Sugilite
2.74-2.76	Anorthite feldspar
2.74 2.88	Pectolite
2.76	Phosphosiderite
2.77	Cryolithionite
2.78-2.92	Crandallite
2.79	Villiaumite
2.79	Zektzerite
2.80	Ceruleite

2.80-2.9	Dolomite
2.80-2.9	Wollastonite
2.80-2.95	Prehnite
2.80-2.99	Verdite
2.80-3.0	Beryllonite
2.80-3.3	Lepidolite
2.81	Wardite
2.84-2.96	Miserite
2.85±	Amphibolite
2.85-2.94	Pollucite
2.85-2.94	Unakite
2.85-2.95	Aragonite
2.85-2.57	Anthophyllite
2.89-2.99	Anhydrite
2.9+	Patricianite
2.90-3.0	Boracite
2.90-3.0	Datolite
2.90-3.02	Nephrite
2.90-3.3	Tremolite
2.92	Sarcolite
2.94-2.98	Brazilianite
2.95-3.0	Cryolite
2.97-3.0	Phenakite
2.97-3.0	Grandidierite
2.97-3.02	Danburite
2.97-3.06	Pezzottaite
2.98	Pachnolite
3.00	Herderite
3.00	Spurrite
3.0±	Burnite
3.00	Meliphanite
3.00-3.1	Amblygonite
3.00-3.1	Uvite tourmaline
3.00-3.2	Magnesite
3.00-3.3	Actinolite
3.00-3.3	Hydrogrossular
3.00-3.5	Odontolite
3.01-3.25	Fluorite
3.017	Bromellite (syn)
3.02	Liddicoatite tourmaline
3.02	Victoria stone**
3.02-3.47	Hornblende
3.03-3.10	Elbaite tourmaline
3.03-3.15	Dravite tourmaline
3.05-3.11	Euclase
3.05-3.12	Lawsonite
3.05-3.39	Lazulite & Scorzalite
3.06-3.19	Friedelite
3.06-3.25	Eosphorite & Childrenite
3.08	Fairfieldite
3.08	Phosphophyllite
3.08-3.27	Monticellite
3.09-3.14	Valleriite
3.10-3.2	Andalusite
3.10-3.2	Chondrodite
3.10-3.25	Schorl tourmaline
3.10-3.2	Apatite
3.10-3.37	Zoisite
3.10-3.5	Enstatite & Hypersthene
3.12-3.23	Wilkeite
3.13-3.2	Spodumene
3.158	Sellaite
3.16	Kinoite
3.17	Silicon carbide**
3.17-3.35	Clinohumite
3.18-3.21	Vayrynenite
3.19	Hureaulite
3.19	Ludlamite
3.20	Chlorastrolite
3.20±	Tsilaisite tourmaline
3.20-3.38	Diopside
3.20-3.5	Jadeite
3.21-3.38	Clinozoisite
3.23-3.25	Sillimanite
3.23-3.52	Augite
3.25-3.45	Peridot
3.25-3.5	Epidote
3.26-3.36	Axinite
3.26-3.36	Dumortierite
3.27-3.45	Kornerupine
3.28	Jeremejevite
3.28-3.35	Dioptase
3.29	Scorodite
3.30	Sussexite
3.30-3.5	Diaspore
3.30-4.7	Psilomelane
3.31	Buergerite tourmaline
3.32	Ekanite
3.32	Serandite
3.34	Astrophyllite
3.34	Lithiophillite
3.35-3.45	Idocrase
3.38-3.42	Dickinsonite
3.40	Purpurite
3.40	Rhodizite
3.40	Serendibite
3.40-3.5	Hemimorphite
3.40-3.5	Sapphirine
3.40-3.56	Sphene
3.40-3.65	Topaz
3.40-3.7	Bustamite
3.40-3.7	Rhodonite
3.40-3.8	Uvarovite garnet
3.42	Triphylite
3.45	Boron nitride**
3.45-3.7	Rhodochrosite
3.47-3.49	Sinhalite
3.49	Orpiment
3.49	Chambersite
3.50	Nambulite
3.50-3.53	Diamond
3.50 3.75	Grossular garnet

3.50-3.84	Chrysoberyl
3.50-3.98	Spinel
3.50-4.03	Malachite
3.53-3.67	Kyanite
3.55-3.6	Aegerine
3.56	Realgar
3.56-3.68	Periclase (syn)
3.58-3.8	Hydrozincite
3.60	Leucophoenicite
3.60-3.69	Benitoite
3.60-4.28	Geothite & Limonite
3.61	Taaffeite
3.61-3.8	Pyroxmangite
3.65-3.80	Pyrope garnet
3.65-3.80	Plancheite
3.66-3.76	Strontianite
3.70	Alexandrite (syn)
3.70-3.8	Staurolite
3.70-4.1	Andradite garnet
3.71	Gaspeite
3.74-3.94	Rhodolite garnet
3.76±	Atacamite
3.77	Tilasite
3.77-3.89	Azurite
3.80	Shattuckite
3.80-4.25	Spessartine garnet
3.82-3.97	Anatase
3.83-3.9	Siderite
3.84-3.89	Malaya garnet
3.85	Cuprosklodowskite
3.89-4.2	Willemite
3.90	Brochantite
3.90	Holtite
3.90-4.0	Allanite
3.90-4.1	Sphalerite
3.91	Hodgkinsonite
3.93	Chenevixite
3.94-4.1	Zircon (metamict)
3.95-3.97	Celestite
3.95-4.1	Corundum
3.95-4.25	Almandine garnet
3.96	Aurichalcite
3.97-4.07	Durangite
3.98-4.01	Legrandite
4.00	Arandisite
4.00-4.6	Gahnite
4.00-4.65	Gadolinite
4.01	Painite
4.01-4.05	Perovskite (syn)
4.03-4.18	Cubanite
4.10	Conichalcite
4.10-4.3	Chalcopyrite
4.10-4.9	Chromite
4.10-6.7	Thorite
4.11-4.14	Brookite
4.18-4.25	Rutile
4.20-4.86	Zircon (normal)
4.21-4.77	Vonsenite
4.23	Yttrium vanadate**
4.25-4.34	Powellite (syn)
4.27- 4.35	Witherite
4.30	Parisite
4.30-4.45	Smithsonite
4.30-4.6	Barite
4.30-5.87	Euxenite
4.33	Manganite
4.34-4.35	Adamite
4.37-4.9	Tennantite
4.40-5.1	Xenotime
4.42-4.49	Davidite
4.53-4.77	Pyrrhotite
4.55	YAG**
4.60-4.76	Covellite
4.60-5.0	Pentlandite
4.60-5.4	Monazite
4.62-4.64	Linobate**
4.76	Jacobsite
4.82	Greenockite (syn)
4.84	Yttrium oxide**
4.85 4.95	Marcasite
4.90-5.3	Hematite
4.90-5.4	Bornite
4.95-5.1	Pyrite
5.05	Boleite
5.13	Strontium titanate**
5.15	Columbite
5.175	Magnetite
5.19-5.4	Orangite (thorite)
5.25-5.69	Samarskite
5.30	Senarmontite
5.35	YALO**
5.35	Linarite
5.38	Fergussonite
5.41-5.42	Millerite
5.43-5.7	Zincite
5.50	Bayldonite
5.50	SOAP**
5.50	Microlite
5.50-5.7	Digenite
5.50-5.8	Chalcocite
5.50-6.0	Baddeleyite
5.57-5.64	Proustite
5.65-5.95	Zirconia**
5.77-5.86	Pyrargyrite
5.80-6.2	Allemontite
5.82	Hedyphane
5.85-6.15	Cuprite
5.90	Barium titanate**
5.90-6.1	Crocoite
5.90-6.12	Sheelite
6.0±	Simpsonite
6.00-6.3	Cobaltite

6.00-6.3	Phosgenite
6.00-7.5	Stibiotantalite
6.10-6.2	Skutterudite
6.24-6.26	Descloisite
6.25	Tellurium
6.30-6.39	Anglesite
6.43	KTN**
6.46-6.57	Cerussite
6.50	Tellurium oxide**
6.50	Tenorite
6.50-7.0	Wulfenite
6.50-7.1	Pyromorphite
6.80-7.1	Cassiterite
6.88	Vanadinite
7.00-7.28	Mimetite
7.00-8.0	Meteorite
7.02-7.05	GGG**
7.18	Huebnerite
7.20-8.3	Algodonite
7.20-8.3	Domeykite
7.45	Lithium tantalate
7.54	Breithauptite
7.78	Niccolite
7.83-7.95	Maucherite
8.00-8.2	Cinnabar
8.00-8.2	Manganotantalite

SPECIFIC GRAVITY AND HARDNESS OF METALS

METAL	S.G.	H.
Aluminum	2.71	2-3
Copper	8.89	2.5-3
Gold (24K, pure)	19.30	2.5-3
Gold (18K)	15.58	
Gold (14K)	13.07	
Gold (10K)	11.57	
Iridium	22.38	6-6.5
Iron	7.80	4-5
Lead	11.01	1.5
Nickel	8.90	5.25
Nickel silver	8.70	5
Palladium	11.50	4.5-5
Platinum	21.45	4-4.5
Silver (fine)	10.53	2.5
Silver (sterling)	10.36	2.5-3
Solder (50/50 tinners)	9.10	2
Steel	7.83	5-8
Tin	7.30	1.5-2
Zinc	7.14	2.5

Section 5
TABLE OF REFRACTIVE INDEX

Refractive indices for the gem materials included in Sections 1 and 2 are listed on the following pages in ascending order. The left column shows the gem material, the center column lists the smaller and larger normal RI figures, and the right column gives the optic character and sign.

The refractive index for normally opaque materials is either not given, or shown only as a single unprefixed number, regardless of the crystal system of which it is a member.

The following abbreviations are used. A = amorphous, I = isometric (cubic), U = uniaxial, B = biaxial, + = positive, – = negative, ? = when information was unavailable. In some instances ± is shown, and indicates that the mineral may be either positive or negative. If a dash (--) is shown in the optics column, the mineral is normally opaque and is listed as described in paragraph two above. Synthetics are usually shown by "syn" but may be shown by a double asterisk (**).

The most logical way to determine whether a material is isotropic (isometric) and amorphous or anisotropic (all crystal systems but isometric) is with the polariscope. This instrument is obtainable in either simple or elaborate form. It can easily be constructed from two pieces of polaroid filters and a small light source.

The use of the instrument is simple; rotate the gem material between the two polaroid plates when they are set so that no light may be seen through them. The lower plate, on which the gem material is usually allowed to rest, is the polarizer. The upper plate, through which the material is viewed, is the analyzer. The polarizer is fixed, but the analyzer is usually rotatable to be certain that the plates are "crossed" so that no light may pass through them.

If a material is isotropic, it will remain dark (or light) with no change during a complete rotation. If a material is anisotropic, it will change from light to dark, four times during a rotation. The normal anisotropic pattern is a sharp cut-off from light to dark to light, much the same as extinguishing a light.

There are two situations that may give false indications that must be kept in mind. First, it is possible that, with anisotropic materials, light is traveling through an optic axis, thus giving the impression it is an isotropic material. Second, some isotropic materials show what is known as anomalous double refraction, due to strain or other internal stress, giving the impression that it is anisotropic.

The first situation can be corrected by always rotating the specimen through more than two planes. When viewing down an optic axis, the specimen appears covered with spectral colors. With faceted gems, the tendency is to place the table flat to the polarizer. The gem may have been cut with an optic axis that is parallel to its own axis, thus appearing isometric. Also, the pavilion of the gem may totally reflect all light passing through the polarizer, again appearing to be isometric. Faceted gems may need to be rotated in three planes with other than the table against the polarizer.

The second situation is a bit more difficult. Anomalous double refraction can appear identical to an anisotropic pattern. However, the extinction is not as sharp and sudden as the normal anisotropic pattern. The anomalous pattern creeps in from the side or appears to be in dark spots on a light background. It is very possible to have a specimen be half dark and half light if the rotation is slow. If a material is suspected of anomalous double refraction, rotate it slowly.

Those materials known to exhibit anomalous double refraction are noted in their descriptions. However, almost any isometric material may show it.

1.327	Villiaumite	I
1.337-1.338	Cryolite	B+
1.3395	Cryolithionite	I
1.342-1.348	Chiolite	U–
1.378-1.390	Sellaite	U+
1.411-1.413	Pachnolite	B+
1.430-1.47	Opal (natural)	A
1.4339	Fluorite	I
1.44	Lithium fluoride**	I
1.440-1.55	Crown glass**	A
1.45	Opal (syn)	A
1.461-1.485	Creedite	B
1.468-1.507	Thaumasite	U–
1.470-1.49	Ettringite	U
1.470-1.494	Chabazite	U±
1.470-1.7	Plastics**	A
1.472-1.477	Mordenite	B–
1.479-1.493	Analcime	I
1.480-1.493	Natrolite	B+
1.480-1.57	Obsidian	A
1.483-1.487	Sodalite	I
1.486 & 1.658	Calcite	U
1.484-1.494	Stilbite	B–
1.488-1.505	Inderite	B+
1.489-1.649	Whewellite	B+
1.490-1.52	Kurnakovite	B–
1.490-1.57	Serpentine group	--
1.495±	Nosean	I
1.495-1.504	Yugawaralite	B+
1.496-1.502	Tugtupite	--
1.496-1.505	Hauyne	I
1.5±	Copal	A
1.5±	Catseyte**	A
1.5±	Lazulite (lapis lazuli)	A
1.5±	Tektite	A
1.50-1.55	Lapis lazuli (syn)	A
1.50-1.57	Goldstone** (glass)	A
1.50-1.6	Sericite	--
1.50-1.65	Coral	--
1.50-1.7	Bisbeeite	--
1.501 & 1.679	Dolomite	U
1.502-1.524	Cancrinite	U
1.504-1.506	Mesolite	B+
1.504-1.516	Petalite	B+
1.507-1.521	Scolecite	B
1.508-1.509	Leucite	U+
1.51±	Ulexite	B+
1.511-1.539	Mellite	U–
1.515 & 1.717	Magnesite	U
1.517-1.525	Pollucite	I
1.518-1.525	Microcline feldspar	B
1.518-1.545	Stichtite	U
1.519-1.525	Orthoclase feldspar	B
1.519-1.669	Strontianite	B
1.52±	Thomsonite	--
1.520-1.53	Gypsum	B+
1.520-1.74	Maw Sit Sit	--
1.526-1.546	Nepheline	U
1.527-1.538	Albite feldspar	B
1.529-1.532	Milarite	U–
1.529-1.677	Witherite	B–
1.53±	Sepiolite	--
1. 53±	Rangely Dome stone**	A
1.53±	Wavellite	--
1.530-1.556	Lepidolite	B–
1.530-1.685	Aragonite	B–
1.531-1.570	Shortite	B–
1.535±	Quartz (cryptocry.)	--
1.535-1.537	Apophyillite	U+
1.54±	Amber	A
L54±	Ivory (all)	A
1.540-1.59	Talc	B–
1.542-1.549	Oligoclase feldspar	B
1.543-1.551	Andesine	B
1.544-1.550	lolite	B±
1.544-1.553	Quartz (crystalline)	U+
1.544-1.577	Scapolite group	U–
1.5443	Halite	I
1.55±	Charoite	--
1.55±	Coral (syn)	A
1.552-1.562	Beryllonite	B–
1.552-1.572	Paravauxite	B+
1.554-1.628	Hambergite	B+
1.560-1.563	Emerald (syn)	U–
1.560-1.59	Penninite	--
1.560-1.624	Tremolite	B–
1.561-1.581	Brucite	U+
1.562-1.571	Labradorite feldspar	B+
1.566-1.602	Beryl	B–
1.568-1.576	Bytownite Feldspar	U–
1.569-1.613	Anhydrite	B+
1.57±	Chrysocolla	--
1.57±	Variscite	--
1.57±	Pseudophite	--
1.57±	Pinite	--
1.571-1.576	Clinochlore	B+
1.57-1.63	Odontolite	--
1.57-1.68	Flint glass**	A
1.572-1.592	Alunite	U+
1.574-1.588	Augelite	B+
1.575-1.590	Anorthite feldspar	B
1.578-1.629	Vivianite	B+
1.58±	Verdite	--
1.58	Alexandrium**	A
1.582-1.584	Zektzerite	B
1.582-1.670	Ekanite	B
1.586-1.595	Wardite	U+
1.586-1.614	Colemanite	B+
L587-1.594	Miserite	--
1.59±	Priceite	--
1.59-1.60	Turquoise (syn)	--
1.592-1.621	Herderite	B

1.592-1.621	Chondrodite	B+
1.593-1.612	Meliphanite	U–
1.593-1.694	Eudialite	U+
1.595-1.616	Phosphophyllite	B–
1.595-1.633	Pectolite	--
1.596	Howlite	--
1.596-1.615	Anthophyllite	B±
1.597-1.599	Kammererite	B+
1.597 & 1.816	Rhodochrosite	U–
1.599-1.622	Actinolite	B–
1.6±	Coral	A
1.6±	Pearl	A
1.60	Eudialite	U+
1.60-1.63	Crandallite	--
1.601-1.62	Pezzottaite	U-
1.602-1.639	Grandidierite	B–
1.603-1.623	Brazilianite	B+
1.604-1.657	Sarcolite	--
1.606-1.639	Topaz	B+
1.61±	Nephrite	B–
1.61±	Sugilite	--
1.611-1.634	Dravite tourmaline	U–
1.611-1.638	Amblygonite	B+
1.612-1.634	Lazulite	B–
1.614-1.636	Hemimorphite	B+
1.615-1.655	Elbaite tourmaline	U–
1.615-1.632	Hornblende	B+
1.616-1.649	Prehnite	B+
1.61-1.83	Gaspeite	U-
1.62±	Victoria stone**	A
1.62	Wollastonite	B–
1.62±	Turquoise	B+
1.621 & 1.849	Smithsonite	U–
1.622-1.631	Celestite	B+
1.622-1.648	Tsilaisite tourmaline	U–
1.626-1.67	Datolite	B–
1.630-1.636	Danburite	B+
1.63-1.64	Uvite tourmaline	U–
1.63-1.66	Friedelite	U–
1.631-1.668	Clinohumite	B+
1.632-1.634	Apatite group	U–
1.633 & 1.837	Siderite	U–
1.633-1.673	Scorzalite	B–
1.634-1.643	Andalusite	B+
1.634-1.685	Durangite	B–
1.635-1.75	Hydrozincite	--
1.636±	Liddicoatite tour.	U–
1.636-1.648	Barite	B+
1.636-1.664	Fairfieldite	B -
1.638-1.664	Vayrenenite	B–
1.638-1.668	Eosphorite	B–
1.638-1.676	Kinoite	B–
1.640-1.653	Jeremejevite	U & B
1.640-1.66	Allanite	--
1.640-1.66	Monticellite	B -
1.64-1.67	Spurrite	--

1.64-1.67	Tilasite	--
1.644-1.709	Dioptase	U+
1.648-1.662	Dickinsonite	B+
1.649-1.691	Childrenite	B–
1.650-1.658	Enstatite	B±
1.652-1.671	Euclase	B+
1.653-1.697	Ludlamite	B+
1.654-1.667	Jadeite	B+
1.654-1.667	Cuprosklodowskite	--
1.654-1.670	Phenakite	U+
1.654-1.673	Sillimanite	B+
1.654-1.689	Peridot	B+
1.654-1.756	Aurichalcite	--
1.655-1.735	Buergerite tourmaline	U–
1.655±	Wilkeite	--
1.655-1.909	Malachite	--
1.657-1.671	Hureaulite	B–
1.658-1.668	Boracite	I
1.660-1.668	Serandite	B+
1.660-1.676	Spodumene	B+
1.662-1.676	Bustamite	B–
1.664-1.684	Diopside	B+
1.664-1.87	Thorite	--
1.665-1.680	Kornerupine	B-
1.665-1.684	Lawsonite	B+
1.667-1.705	Sinhalite	B–
1.669-1.682	Lithiophylite	B+
1.67-1.73	Sussexite	--
1.671-1.761	Augite	--
1.675-1.734	Hydrogrossular garnet	I
1.675-1.735	Legrandite	B+
1.676-1.757	Parisite	U+
1.678-1.688	Axinite	B–
1.68-1.73	Astrophyllite	B+
1.686-1.723	Dumortierite	B–
1.690-1.719	Willemite	U+
1.692-1.705	Hypersthene	B–
1.692-1.738	Phosphosiderite	B-
1.6935	Rhodizite	I
1.696-1.706	Zoisite	B+
1.7±	Plancheite	--
1.701-1.706	Serendibite	B+
1.702-1.750	Diaspore	B+
1.703-1.746	Idocrase	U+
1.707-1.730	Nambulite	B+
1. 71±	Chlorastrolite	--
1.714	Pyrope garnet	I
1.715-1.732	Kyanite	B–
1.715-1.730	Spinel (natural)	I
1.715-1.734	Clinozoisite	B–
1.716-1.723	Sapphirine	B–
1.718-1.722	Taaffeite	U–
1.72	Spinel (syn)	I
1.720-1.735	Bromellite**	U+
1.720-1.827	Xenotime	U+
1.722-1.763	Adamite	B±

1.724-1.746	Hodgkinsonite	B
1.726-1.744	Pyroxmangite	B+
1.728-1.80	Brochantite	B–
1.729-1.768	Epidote	B
1.730-1.836	Azurite	B+
1.732-1.744	Chambersite	B+
1.734-1.75	Grossular garnet	I
1.736-1.746	Staurolite	B+
1.738-1.751	Rhodonite	B±
1.74	Periclase (syn)	I
1.74-1.75	Alexandrite (syn)	B+
1.743-1.761	Howlite	--
1.747-1.757	Chrysoberyl	B+
1.75±	Shattuckite	--
1.750-1.77	Malaya garnet	I
1.750-1.77	Rhodolite garnet	I
1.750-1.80	Aegerine	B
1.751-1.782	Leucophoenicite	B-
1.757-1.777	Corundum (all)	U–
1.757-1.804	Benitoite	U+
1.76-1.82	Arandisite	--
1.77-1.82	Gadolinite	B+
1.780-1.815	Zircon (metamict)	U+
1.780-1.83	Almandine garnet	I
1.780-1.84	Thorite	--
1.781-1.816	Painite	U–
1.785-1.812	Scorodite	B+
1.785-1.84	Monazite	B+
1.790-1.81	Spessartine garnet	I
1.790-1.82	Gahnite	I
1.8±	Conichalcite	--
1.8 mean	Orangite (thorite)	U+
1.8±	SOAP**	?
1.804-2.078	Cerussite	B+
1.809-1.859	Linarite	B
1.83 mean	Chenevixite	--
1.831-1.88	Atacamite	B
1.833	YAG**	I
1.843-2.110	Sphene	B+
1.85-1.89	Andradite garnet	I
1.85-1.92	Purpurite	B+
1.87	Uvarovite garnet	I
1.877-1.894	Anglesite	B+
1.88±	Yttrium vanadate**	?
1.918-1.934	Scheelite	U+
1.92±	YTTRALOX**	A
1.92	Yttrium oxide**	I
1.92-2.03	GGG**	I
1.923-2.015	Zircon (normal)	U+
1.930-2.02	Microlite	I
1.938-1.95	YALO**	?
1.948-1.958	Hedyphane	--
1.95-1.99	Bayldonite	B+
1.958-2.245	Sulphur	B+
1.96-2.06	Simpsonite	U+
1.967-1.984	Powellite (syn)	U+
2.003-2.101	Cassiterite	U+
2.013-2.029	Zincite	U+
2.03-2.05	Boleite	U-
2.042-2.05	Pyromorphite	U–
2.06-2.26	Fergusonite	U–
2.087	Senarmontite	I
2.1	Chromite	I
2.118-2.144	Phosgenite	U+
2.128-2.147	Mimetite	B–
2.13-2.20	Baddeleyite	B–
2.15-2.17	Zirconia**	I
2.17-2.3	Heubnerite	B+
2.18-2.22	Lithium tantalate**	?
2.185-2.35	Descloisite	B+
2.19-2.43	Manganotantalite	U+
2.20 mean	Samarskite	--
2.21-2.3	Linobate**	?
2.22	Zinc orthotitanate**	?
2.24	Euxenite	I
2.260-2.398	Goethite	B
2.27	KTN**	?
2.282-2.405	Wulfenite	U-
2.29-2.66	Crocoite	B+
2.3	Jacobsite	--
2.3	Davidite	--
2.350-2.416	Vanadinite	U
2.369-2.428	Sphalerite	I
2.374-2.456	Stibiotantalite	B+
2.4	Magnetite	I
2.4	Perovskite (syn)	?
2.4	Barium titanate**	?
2.4-3.02	Orpiment	B-
2.41	Strontium titanate**	I
2.4175	Diamond	I
2.49-2.56	Anatase	U-
2.5	Columbite	--
2.505-2.529	Greenockite (syn)	U+
2.538-2.704	Realgar	B–
2.583-2.70	Brookite	B+
2.612-2.899	Rutile (all)	U+
2.65-2.69	Silicon carbide**	U+
2.792-3.087	Proustite	U-
2.849	Cuprite	I
2.881-3.084	Pyrargyrite	U-
2.905-3.256	Cinnabar	U+
2.94-3.22	Hematite	--

Section 6

GLOSSARY OF IMPORTANT GEMOLOGICAL TERMS

A

Acetylene tetrabromite - (Tetrabromoethane) A liquid bf high refractive index (1.63) and high specific gravity (2.95). Valuable in determining gem specific gravity. See page 137.

Acicular - Slender, needle-shaped crystals.

Acronym - A symbol or name made up of the first letter, or letters, of two or more words. YAG, for yttrium aluminum garnet, is an example.

Adamantine - The type of luster typical of diamond and other gems of very high refractive index. The name is derived from *adamas* (unconquerable- Latin), an old name for diamond.

Aggregate - A mass of separate small crystals, scales, or grains.

Amorphous - Any mineral without any regular geometric form. Characterized by having the same internal structure in all directions.

Anhydrous - A mineral with no water in its molecule.

Anisotropic - Minerals that crystalize in the tetragonal, orthorhombic, hexagonal, monoclinic, and triclinic crystal systems. They exhibit double refraction by breaking light into two or more rays that travel at different velocities (see birefringence).

Anomalous double refraction - A false birefringence, seen in a polariscope, that is exhibited by some garnets, and a few other isometric minerals.

Arborescent - Crystal growth that resembles branches of trees.

Asterism - A star-like effect seen in a mineral, or gemstone, when subjected to reflected or transmitted light. This is usually due to included crystals within the gem material.

B

Basic - A mineral formula that contains the base radical (OH).

Biaxial - Having two optic axes. The property of the minerals that crystalize in orthorhombic, monoclinic, and triclinic systems. These minerals have three refractive indices, one in each crystalographic direction. See unixial.

Bipyramidal - A mineral crystal having two pyramids; with or without a prism between them.

Bladed - A very flat, usually thin, crystal resembling a knife blade.

Blob - A small, usually rounded, inclusion of one material inside of a mineral.

Birefringence (double refraction) - The amount is measured by the difference in refractive index between the ray of highest and the ray of lowest RI.

Boro-silicate - A type of glass that has a large amount of boron in its makeup. This type of glass is often offered as gem material.

Botryoidal - A mineral having the form resembling a bunch of grapes.

Boule - The drop-shaped or bullet-shaped "crystal" of man-made materials. A boule may be produced in the Verneuil (gas) furnace, or by "pulling" from a melted mass.

Bridgman-Stockbarger method - A method of growing crystals by heating a mass to where it melts in a furnace, then lowering it slowly, within the furnace, to a cooler portion, where crystalization will take place.

Brittleness - The tendency of a mineral to break easily.

C

Cabochon - The style of gem cut with a dome-shaped top (crown).

Carat - The unit of weight used for gems. One-fifth of a gram.

Carbuncle - A type of high dome cabochon, usually cut from a red garnet.

Chatoyant - A material with an internal luster that moves with changes in position of the light. This is usually due to included structures that scatter the light.

Chemical composition - The makeup of a molecule of any substance. Usually two or more atoms combining under certain laws.

Cleavable - A mineral that is easily cleaved.

Cleavage - The tendency of certain crystals to break along certain directions. This breaking may produce very flat surfaces.

Colloid - A mineral made of very fine particles that are firmly held together by chemical attraction. An amorphous material.

Color zone - A band or spot of color that is a deeper hue in relation to that of the surrounding material.

Compact - A mineral, or group of minerals, tightly joined together. These are usually small particles or crystals.

Conchoidal fracture - The curved (seashell-like) surface produced upon breaking certain minerals.

Concretion - A nodular grouping of particles or grains. Usually constructed under water.

Critical angle - The critical angle is the lowest angle at which a ray of light will reflect off of a surface. In gemstones, facets cut below the critical angle will allow light to pass through the stone and therefore, the stone will appear lifeless. Facets cut at, or above the critical angle will reflect light and therefore display brilliance and scintillation.

Cryptocrystalline - A mass of crystals with such small crystals that none can be seen without magnification. These crystals are usually intergrown so as to render the material quite tough.

Crystal - A solid that is surrounded by flat surfaces that follow certain definite and invariable laws. The flat surfaces are known as crystal faces.

Crystal axis - (Crystalographic axis) An imaginary line drawn between opposite crystal faces through a crystal. Three or four of these axes intersect in the exact center of the crystal. See pages v and vi.

Crystal lattice - The molecular arrangement in a crystal.

Crystal systems - Six basic geometric forms. All natural and synthetic crystals form in one of these six systems.

Cube - A figure made of six equal squares arranged to form an equidimensional box. The simplest form of the isometric crystal system. See figure 1A, page v.

Cuneiform - a wedge-shaped crystal.

D

Diamond simulant - A gem material that is stated to resemble diamond in brilliance, dispersion, and perhaps other characteristics.

Dichroism - The property of a mineral to show two different colors, or color shades, through two different directions of the crystal.

Dimorphous - Two minerals that have the same chemical composition.

Dispersion - The property of a mineral to break ordinary daylight into the spectral colors.

Distinct cleavage - A cleavage surface that can be easily seen, but may not be perfectly smooth.

Dodecahedron - An isometric crystal with twelve faces that are "diamond-shaped". Some of the garnets form dodecahedral crystals.

Dope - (also doped). When a chemical is added to a man-made material, it is referred to as being doped. The chemical is referred to as a dopant.

Drusy - A crust of small crystals usually lining a cavity. These are usually the same mineral as the underlying material.

Ductile - A mineral (usually a metal) capable of being stretched to great lengths.

E

Earthy - Resembling a compacted fine sand, claylike.

Equant - A crystal that has the same, or nearly the same, diameter in all directions. Any two measurements that are essentially equal.

Exfoliate - To break or peel off in scales or thin plates.

F

Fabulite - A trade name for strontium titanate, a man-made gem material.

Feathers - Layers of inclusions in gemstones, usually many small cavities that have a feather-like or veil-like look.

Fibrous - A mineral that is composed of fibers. They may be tightly cemented into a solid mass, or may be peeled off as individual fibers.

Fire - The name given to flashes of color seen in a gem with dispersion.

Flaws - Any unwanted inclusions within a gemstone. The strictest definition would be actual cracks.

Flexible - A characteristic of some minerals in which they can be bent without breaking.

Fluorescent - A mineral, when bathed in ultra-violet light, that gives off a certain colored light.

Flux grown crystals - Man-made crystals that grow within a mass (a flux) that does not enter into the growth process. The flux must be removed at the end of the process.

Foliated - A mineral that has a layered structure in which the layers are very thin, resembling leaves. The folia may or may not be separable into layers.

Fracture - The name applied to a freshly broken surface of a mineral. This is sometimes applied to a crack within a gemstone.

Fused boule - A boule that is made by fusing it in a flame during growth. Other types of boules are made by pulling them from a melt.

G

Gem - A mineral cut and polished to a predetermined shape.

Gemstone - A term applied to material that has the potential of becoming a gem.

Granular - A mineral in which most of the grains are equant or equidimensional.

Group - A number of minerals that have some feature of similarity or relationship. This may be crystal system, chemical formula, or combinations of similarities.

H

Hardness - The ability of a mineral to resist scratching.

Heat shock - The result of raising the temperature of a mineral too rapidly for the stability of its internal structure. It usually results in fractures.

Heat treatment - A carefully controlled process of applying heat to gem materials in order to change the color or other characteristics.

Heavy liquids - Liquids of high specific gravity used to determine the specific gravity of minerals. See page 137.

Hemimorphic - A crystal that has no transverse plane of symmetry, and is composed of forms relative to only one end of a normal crystal.

Hexagonal - One of the crystal systems. See Figure 2, page v.

Hydrous - A mineral formula that contains water (H_2O) as an attachment to the balance of the formula. This is usually expressed with the H_2O at the end of the formula and separated from it by an elevated period.

Hydroxyl - The radical, usually at the end of a chemical formula (OH) that indicates a basic formula.

I

Imperfect cleavage - A cleavage surface that is not smooth.

Impurity - Any material that is foreign to, and enclosed, in a mineral. It may be visible, but usually is not.

Inclusions - The general term used to describe any foreign material in a gem material. These are small in relation to the bulk of the piece of material.

Index of refraction - See refractive index.

Interrupted cleavage - A cleavage surface that resembles a stairway.

Iridescent - The exhibition of colored reflections from the surface, or internally, from a mineral.

Isometric - (Cubic) One of the crystal systems. See Figure 1, page v.

Isotropic - The isometric and amorphous minerals in which light travels at only one speed in any direction within the substance.

L

Laminae - Thin layers of a mineral, or a number of minerals, or colors.

Lapidary - A name applied to craftsmen who cut and polish gems.

Low zircon - A name for zircon with a lower refractive index (about 1.80). It is usually of a green color and nearly amorphous. (See metamict)

Luster - The character of light reflected from a mineral surface. It is the result of the physical and optical conditions of the surface.

M

Mammillary - A smoothly rounded form resembling a portion of a sphere.

Massive - A mineral in a non-crystalline form.

Metallic - Having a surface reflection indicative of a metal. A material that may not be a metal, but has some characteristics resembling a metal.

Metamict - A term applied to a mineral that has had an internal chemical change. An excellent example is the so-called "low" zircon. Metamict is the better term to be applied to this type of zircon.

Metamorphosed - A mineral that is the result of change. The change may be due to intense heat, or pressure; or the result of weathering or chemical reaction.

Methylene iodide - A liquid of high specific gravity (3.33) and high RI (1.740) used as a specific gravity and immersion liquid. See page 137.

Metric carat - A unit of weight used for gems. It is one-fifth of a metric gram.

Micaceous - Made up of very small plates that are oriented at random. Resembling mica.

Millimeter - A unit of measurement for medium sizes. It is one-thousandth of a meter. A meter is approximately 39 inches. One inch is approximately 25mm.

Mineral - (Mineral Species) An inorganic substance, formed naturally, having a crystalline and chemical structure, and certain physical and optical properties that are reasonably constant.

Mohs Scale of Hardness - A scale for measuring the hardness of minerals. See p.138.

Molecule - A group of two or more atoms tied together by electrical bonds. The smallest particle of a mineral (and other substances) that can exist as a separate chemical entity.

Monoclinic - One of the crystal systems. See Figure 3, page vi.

N

Needles - A loosely used term to describe slender crystals enclosed in a mineral.

Nodule - A mineral that is in the form of a ball. The surface may or may not be smooth, and it may not be perfectly spherical.

O

Octahedron - A crystal form bounded by eight faces, each of which is an equilateral triangle. See Figure 1B, page v.

Oolitic - A material composed of very small spheres. These may be cemented together with the same or another material.

Opaque - A material that will allow no transmission of light.

Optic axis - The direction (or directions) in an anisotropic mineral through which a light ray shows single refraction.

Optical properties - The effects of a gem material upon light that may pass through it; i.e., refractive index, dispersion, birefringence, etc.

Organic - A mineral that is the result of the activities of living things.

Orthorhombic - One of the crystal systems. See Figure 3, page vi.

Oxides - A group of minerals consisting of a combination of a metal and oxygen.

P

Parting - (Parting plane) A direction of weakness in certain minerals, apparent along certain planes. For the lapidary, it is virtually identical to cleavage.

Pearly luster - A surface that resembles the surface of a pearl.

Pegmatite - A seam in a formation (usually granite-like) that contains a large number of minerals. Quartz, feldspar, garnet, topaz, tourmaline, beryls, etc., are usually found in pegmatites. A pegmatite dike.

Perfect cleavage - A perfectly flat cleavage surface; the potential for a mineral to produce such a surface.

Phantom - A mineral crystal that shows, internally, an earlier stage of its crystallization. This may be a layer of bubbles, a foreign inclusion, or some other material.

Phenocryst - A relatively large and conspicious crystal that formed during the early formation of a rock.

Photochroism - A property of a mineral (or other material) to emit a color if viewed in one type of light, and a second color if viewed in a second type of light; i.e. the behavior of alexandrite in natural and incandescent light.

Physical properties - The characteristics of a mineral, such as hardness, specific gravity, toughness, etc.

Platelet - A small plate-like form. Usually a thin crystal.

Pleochroism - The property of some anisotropic minerals to show more than one color or color hues through different directions of the mineral.

Poly-synthetic twinning - A form of twinning, often seen in feldspars as well as some other minerals. It is the result of the deposition of thin layers of molecules that are laid down successively. Each layer is flipped 180°, somewhat like turning pages of a book.

Porcelaineous - A surface resembling porcelain.

Prism - A figure bounded by faces that are parallel to the vertical axis. It usually. is capped by terminations which may be flat or pyramidal.

Prismatic - A crystal that shows prisms that are much larger than other faces. These are usually long crystals.

Pseudo - A prefix that indicates a false situation.

Pseudomorph - A mineral taking the form of another mineral, either by substitution or by alteration.

Pyramid - A portion of a crystal that resembles a pyramid. It may be made of three or more similar faces.

Pyralspite - An acronym for a group of garnets; pyrope, almandine, and spessartine.

Pyritohedron - A crystal enclosed by twelve five-sided faces.

R

Radiating - A group of mineral crystals that appear to radiate from a central point, producing a fan-like or ball-like group.

Random - A group of mineral crystals that have no systematic arrangement.

Rare - A mineral that is seldom found. What is rare at one time may not be so at a later date.

Rare earth - An oxide of a series of relatively scarce metals.

Refraction - The bending of a light ray as it passes from a medium of one density into a medium of another density.

Refractive index - The number attached to the ability of a material to bend light upon entry into it. Often written as RI. The refractive index number is based upon air as 1.0 (really a vacuum).

Refractometer - An instrument for measuring the refractive index of gems.

Reniform - A kidney-shaped mineral formation.

Resinous - A surface resembling resin.

Rhomb - A rectangular form with parallel sides, but with corners not at 90 degrees.

Rhombohedron - A crystal form made of six rhombs. See Figure 2F, page v.

Rough - Lapidary material on which no work other then perhaps sawing has been done.

Rutilated quartz - Colorless, citrine, or smoky quartz containing needle-like crystals of rutile. It is sometimes faceted, carved or cut en cabochon into interesting gems.

S

Scalenohedron - A six-sided steep pyramid.

Sesqui - A prefix indicating one and one-half times.

Sheaf-like - A group of crystals that are somewhat narrower centrally than at the ends. Resembling a sheaf of stalks of grain.

Short prismatic - A crystal that has the prism faces (sides) smaller than the terminal faces.

Silicates - A group of minerals that are a combination of silicon and oxygen, and one or more metals. This group contains most of the well-known gems.

Silicious - A mineral that is made of quartz.

Silky - A surface that has the luster of silk.

Spangled - A mineral that has a surface covered with, or encloses small flat reflective plates.

Specific gravity - The weight of a substance in relation to an equal volume of water. Water equals 1.0.

Sphenoid - A crystal resembling the blade of an axe.

Spherule - A very small sphere.

Splendent - A gem crystal or cleavage face that is highly reflective.

Splintery - A fracture resembling the broken end of a stick.

Stabilizer - In synthetic materials, an additive that keeps the material from altering.

Step cuts - The group of faceted cuts that are characterized by having fairly long and narrow parallel facets on both pavilion and crown.

Sub - A prefix indicating a lesser quantity; i.e. sub-metallic, sub-conchoidal, etc.

Sub-adamantine - A luster that is not quite as highly reflective as adamantine.

Synthetic - A man-made product that is identical to a natural material.

T

Tabular - A crystal that resembles a medicinal tablet; very flat in relation to width.

Tarnish - The alteration of the color of a surface; usually to a darker tone.

Tetragonal - One of the crystal systems. See Figure 2, page v.

Tetrahedron - A crystal made up of four equal triangular faces.

Texture - The aspects of the components of a rock or mineral as to size, shape, and arrangement.

Three-phase inclusions - Small cavities in a mineral filled with a liquid, a gas, and a solid. See emerald.

Toluol - (Toluene) One of the hydrocarbon liquids used to dilute certain heavy liquids, such as methylene iodide. See page 137.

Toughness - The ability of a mineral to resist breaking.

Translucent - The state of a material which transmits a small amount of light, but does not allow visibility through it.

Transparent - The state of a material (with or without color) which freely transmits light and allows visibility through it.

Trapezohedron - A crystal having twenty-four triangular faces.

Trichroism - The ability of a mineral crystal to transmit three different colors, or shades of colors, through three different directions.

Triclinic - One of the crystal systems. See Figure 3, page vi.

Trimorphous - Three minerals with the same chemical makeup.

Truncate - Having an obtuse end, cut at right angles to its length.

Twin crystal - A crystal in which two or more individuals have grown together according to certain laws.

Type locality - The place where a mineral was first found. The description of the mineral is used as a standard for all other finds of the same mineral.

U

Ugrandite - An acronym for the garnets uvarovite, grossular, and andradite.

Uniaxial - Having one optic axis. The property of the tetragonal and hexagonal minerals. These minerals have one direction of single refraction, and one direction of double refraction. See biaxial.

V

Vapor phase - The formation of a material directly from a vapor, without the material forming a liquid.

Veils - Layers of very small cavities in gem materials. These layers, having a feather-like look, are sometimes so small as to be barely discernible with the naked eye. The cavities are usually filled with a liquid, with or without bubbles of gas.

Verneuil - A very early experimenter for making synthetic materials. The Verneuil furnace was named for him.

W

Widnanstaetten figure - A pattern developed on a polished metallic meteorite by etching with an acid.

White light - Ordinary sunlight, which consists of all spectral colors and all wave lengths.

Section 7

INDEX OF ALTERNATE, VARIETAL, & INCORRECT NAMES

This section, even though appearing in the usual place of an index, and in part listed as such, is not to be considered one in the usual sense. Each mineral and man-made material listed in Sections 1 and 2 are in alphabetical order, and thus these are also indexes. Section 6 may be then considered as an accessory index to the first two sections. In order to find a gem material when the name is known, either Section 1 and 2 should be consulted. If the name cannot be found, then it may be assumed that the name is not the usual one, and it may be found in Section 6. If the name is not in Section 6, then it is probably highly incorrect, or was unknown at the time of publication.

In most cases, the last word in the reference is the key. In a few cases (such as the feldspars and garnets) the last two words are the key. It will be noted that almost without exception, page numbers are not referred to. Instead, the reader is referred to a mineral or man-made material.

The listings here are all the names known to the authors that could normally be used for the gem materials described. It is possible, obviously, that the reader may hear of a valid name that has escaped the authors attention.

Some of the names listed are placed within quotes. When this is done, the name is considered to be incorrect, and its usage is discouraged. The reasons for this thinking can be numerous, but generally stem from a reference to another gem material. The use of the name topaz for some of the color varieties of quartz is well known, and any continued use in this manner is to be deplored. Many other gem materials have shared the same fate. In other cases, the name is discouraged because it offers no clear description or indication as to the true nature of the material. Nearly all mineralogists and lapidaries have noted the chaotic situation in regard to names. Thus, if we make an effort to discontinue use of incorrect ones, we may hope to alleviate some of the problem.

A

Achroite, a variety of elbaite tourmaline (colorless)
Acmite, see aegerine
"Adamantine Spar", see corundum
Adularia, a variety of orthoclase feldspar
"African jade", a misnomer for hydrogrossular garnet
Agate, see cryptocrystalline quartz
Agni gemma or agni mani, see tektite
Alabaster, the compact form of gypsum
Alalite, a sub-variety of diopside
"Alaska diamond", a misnomer for hematite
Albite, a species of plagioclase feldspar
Alexandrite, a photochroic variety of chrysoberyl
Allanite, see epidote
Almandine, a species of garnet
"Almandine spinel", a misnomer for a type of spinel
Almandite, an alternate name for almandine garnet
Alurgite, see mariposite
Amazonstone or Amazonite, see microcline feldspar
Amelite, see synthetic opal (Section 2)
Amethyst, a variety of crystalline quartz
Amphigene, an alternate name for leucite
Analcite, an alternate name for analcime
Andesine, a plagioclase feldspar
Andradite, a species of garnet
Anorthite, a species of plagioclase feldspar
Anthracite, see jet
Antigorite, see serpentine
Antimony, see allemontite
Apache tear, see obsidian
Aquamarine, a variety of beryl
"Arizona ruby", a misnomer for pyrope garnet
"Arizona diamond", a misnomer for quartz
Arsenic, see allemontite
Asparagus stone, a varietal name for apatite
Australite, a type of tektite
Aventurine feldspar, see feldspar group
Aventurine glass, see glass (Section 2)
Aventurine quartz, see crystalline quartz
"Azel", see sugilite
Azurlite, See cryptocrystalline quartz
Azurmalachite, mixed azurite and malachite

B

"Balas ruby", a misnomer for red spinel
Ballas, a name for industrial diamond
Bakelite, a type of plastic (Section 2)
Billitonite, a type of tektite
Bismutotantalite, see columbite
"Bixbite", an incorrect name for red beryl
Black coral, see page 27
"Black diamond", a misnomer for hematite
"Black moonstone", see labradorite feldspar
Black onyx, see cryptocrystalline quartz
Blende, an alternate name for sphalerite
Bloodstone, see cryptocrystaline quartz
Blue John, a type of fluorite
Bonamite, an alternate name for smithsonite
"Bone turquoise", a misnomer for odontolite
Boro-silicate, see glass (Section 2)
Bort, a name for industrial diamond powder
Bortz, a name for industrial diamond powder
Bowenite, a variety of serpentine
"Brazilian emerald", an incorrect name for elbaite tourmaline
"Brazilian ruby", an incorrect name for pink topaz
Bronzite, see enstatite
Buddstone, see cryptocrystalline quartz
Buergerite, a species of tourmaline
Byssolite, see andradite garnet
Bytownite, a type of plagioclase feldspar

C

Cachalong, a type of opal
Cairngorm, see crystalline quartz
Calamine, an alternate name for hemimorphite, and smithsonite
Calcentine, see aragonite
Calcite onyx, a massive form of calcite
Californite, a name for a massive idocrase grossular mixture
"California jade", a misnomer for californite,
"California lapis", a misnomer for dumortierite quartz
"Campbellite", see copper
Campylite, see mimetite
"Canadian lapis", a misnomer for sodalite
Carbonado, a type of industrial diamond
Carbonyl chloride (phosgene), see phosgenite
Carborundum, see silicon carbide (Section 2)
Carbuncle, a cabochon cut red garnet. (see almandine)
Carnelian, see cryptocrystalline quartz
Castorite, an alternate name for petalite
Cat's-eye, a variety of chrysoberyl
Cat's-eye, see crystalline quartz.
Cat's-eye shell, see pearl
Celestine, an alternate name for celestite
Ceylonite, a dark opaque spinel
Chalcedony, see cryptocrystalline quartz
Chalcotrichite, see cuprite
Cherry opal, a variety of opal
Chert, see cryptocrystalline quartz
Chessylite, an alternate name for azurite.
Chiastolite, a variety of andalusite
Childrenite, see eosphorite
Chilean lapis, a type of lapis lazuli
"Chinese cat-eye", see pearl
Chiolite, See cryolite

Chlorapatite, see apatite
Chloromelanite, a variety of jadeite
Chlorospinel, a variety of spinel
Chrome diopside, a sub-variety of diopside
Chromian clinoclore, see kammererite
Chrysanthemum stone, see porphyry
Chrysolite, an alternate name for peridot
Chrysoprase, see cryptocrystalline quartz
Chrysotile, a sub-variety of serpentine
"Cinnamon stone", see grossular garnet
Citrine, see crystalline quartz
Cleavelandite, a variety of albite feldspar
"Cobalite", see Rangely Dome stone (Section 2)
Cobaltian calcite, see calcite
Coelestine, an alternate name for celestite
Colophonite, a type of andradite garnet
"Colorado jade", see microcline feldspar
Conglomerate, see breccia
Copal, see amber
Cordierite, the mineral name for iolite
Cornelian, see cryptocrystalline quartz
Corozo nut, see ivory
Covelline, an alternate name for covellite
C-OX, see zirconia (Section 2)
Crinoid marble, a variety of calcite
Cristobalite, see crystalline quartz
"Crocidolite", see cryptocrystalline quartz
Crown glass, see glass (Section 2)
Cryolithionite, see cryolite
Cubic zirconia, see zirconia (Section 2)
Cyanite, an alternate name for kyanite
Cymophane, a variety of chrysoberyl
Cyprine, a variety of idocrase
C-Z, see zirconia (Section 2)

D

Demantoid, a variety of andradite garnet
Dentine, see ivory
Diatomite, see opal
Dichroite, an alternate name for iolite
Disthene, an alternate name for kyanite
Domeykite, see algodonite
Doom (doum) palm, see ivory
Dravite, a species of tourmaline
"Dumortierite", see crystalline quartz

E

"Egyptian alabaster", see calcite
Eichwaldite, a former name for jeremejevite
Eilat stone, a type of chrysocolla
Elbaite, a species of tourmaline
Elaeolite, a variety of nepheline
Emerald, a variety of beryl
"Emeralite", a misnomer for greenish-blue elbaite tourmaline
Emery, a non-gem type of corundum
Endlichite, see mimetite
Essonite, an old name for grossular garnet
"Evening emerald", a misnomer for peridot

F

Fabulite, a trade name for strontium titanate (Section 2)
Fairystone, an alternate name for staurolite
"False lapis", a misnomer for lazulite
"False topaz", a misnomer for citrine quartz
Fergusonite, see euxenite
Ferroaxinite, see axinite
Fibrolite, the massive form of sillimanite
Figure stone, see agalmatolite
Fire agate, see cryptocrystalline quartz
Fire marble, see calcite
Fire opal, a variety of opal
"Fire pearl", a misnomer for tektite
Flint, see cryptocrystalline quartz
Flint glass, see glass (Section 2)
Fluorapatite, see apatite
Fluorspar, fluor; alternate names for fluorite
"Fool's gold", see pyrite
Forsterite, see peridot
Fuschite, see crystalline quartz, also verdite

G

Gahnospinel, a variety of spinel
Geyserite, a variety of opal
"G.I. cat-eye", see pearl
Girasol, an optical effect of opal
Gmelinite, see chabazite
Goldmanite, see garnet group
Goldstone, see glass (Section 2)
"Gooseberry stone", see grossular garnet
Goshenite, colorless variety of beryl
Grammatite, a type to tremolite
Granite, see graphic granite
"Grass stone", see crystalline quartz
Greenstone, an alternate name for nephrite
"Green amethyst", an incorrect name for prasiolite color variety of quartz
Grossular, a species of garnet

H

Hackmanite, see sodalite
Hauynite, an alternate name for hauyne
"Hawaiite", a misnomer for peridot
Hawk's-eye, see cryptocrystalline quartz
Hedenbergite, see diopside
Heliodor, yellow variety of beryl
"Heliolite", a common name for a type of labradorite feldspar
Heliotrope, see cryptocrystalline quartz
Henritermeirite, see garnet group
"Herkimer diamond", a misnomer for quartz
Hessonite, a variety of grossular garnet
Hexagonite, a variety of tremolite

P

Q

R

S

"Spinel ruby", a misnomer for red spinel
Spinthere, a variety of sphene
Starilan, a trade name for strontium titanate (Section 2)
"Starlite", a name for blue zircon
Steatite, an alternate name for talc
Stibarsen, see allemontite
Strass, a type of glass (Section 2)
Stream tin, a type of cassiterite
Sturmanite, see ettringite
"Styrian jade", an incorrect name for pseudophite
Succinite, a variety of amber
"Succinite", a misnomer for a type of grossular garnet
Sunstone, a type of feldspar

T

Tabasheer opal, a type of opal
Tachylite, a type of obsidian
Tagua nut, see ivory
Tantalite, see manganotantalite and columbite
Tanzanite, a variety of zoisite
Thetis hairstone, see crystalline quartz
Thulite, a variety of zoisite
Tiger-eye, see cryptocrystalline quartz
Tin stone, an alternate name for cassiterite
Titania, a trade name for synthetic rutile (Section 2)
Titanite, an alternate name for sphene
Titrite, a type of glass (Section 2)
"Topaz", a misnomer for citrine quartz
"Topaz quartz", a misnomer for citrine quartz
Topazolite, a variety of andradite garnet
"Transvaal jade", a misnomer for hydrogrossular garnet
Travertine, a variety of calcite
Trinitite, a fused glass, the result of an atomic bomb
Triphylite, see lithiophylite
Tsavorite, see grossular garnet
Tsilaisite, a member of the tourmaline group
Turgite, see hematite
"Turkey fat", see smithsonite
"T.V. Crystal" or "T.V. Stone", see ulexite

U

Ugrandite, see garnet group
Uintalite, an alternate name for gilsonite
"Uralian emerald", a misnomer for demantoid garnet
Utahlite, an alternate name for variscite
Uvarovite, a species of garnet
Uvite, a species of tourmaline

V

Vauxite, see paravauxite
Vegetable ivory, see ivory
Venus hairstone, see crystalline quartz
Verd antique, see serpentine
Verdelite, a variety of elbaite tourmaline
Vermarine a type of crystalline quartz
Vertine, a type of crystalline quartz
Vesuvianite, an alternate name for idocrase
Violane, a sub-variety of diopside
Viridine, a variety of andalusite
Volcanic glass, see obsidian
Vulpinite, see anhydrite

W

"Water sapphire", a misnomer for iolite
Watermelon tourmaline, see tourmaline
Wernerite, see scapolite group
Widmanstaetten figures, see meteorite
Williamsite, a variety of serpentine
Wonderstone, see rhyolite
Wood opal, wood infiltered (petrified) with opal

X

Xalostocite, see grossular garnet
Xanthite, a variety of idocrase

Y

Yogo sapphire, see corundum
Yttria, see yttrium oxide (Section 2)
Yttrium aluminum garnet, see YAG (Section 2)

Z

Zebra stone, see argilite
Zinc blende, an alternate name for sphalerite
Zinc spinel, an alternate name for gahnite

Section 8

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The Lapidary Journal
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This is the most comprehensive book on gem materials. It is a valuable reference for gem cutters, gemologists and all others with an interest in gemstones. It helps with gem identification, prepares the cutter for what may be expected when working a stone and provides information on the properties of all gems.

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