Vol. I. No. 2

THE

NATIONAL GEOGRAPHIC MAGAZINE.

PUBLISHED BY THE

NATIONAL GEOGRAPHIC SOCIETY.

WASHINGTON, D. C.

1889

Price 50 Cents.

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APRIL, 1889.

PRESS OF PUTTLE, MORRISON & TAYLOR, NEW HAVEN, CONN.

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AFRICA, ITS PAST AND FUTURE.

AFRICA, the oldest of the continents, containing the earliest remains of man, and the birthplace of European civilization, is the last to be explored. Long before the temples of India or the palaces of Nineveh were built, before the hanging garden of Babylon was planted, the pyramids of Cheops and Cephren had been constructed, the temples of Palmyra and Thebes filled with worshipers.

Greece owes its civilization to Egypt: its beautiful orders of architecture came from the land of the Nile. The civilization of Egypt had grown old, and was in its decay, when Rome was born. Think what a vast abyss of time separates us from the days of Romulus and Remus! And yet the pyramids of Egypt were then older by a thousand years than all the centuries that have passed since then.

For ages upon ages, Africa has refused to reveal its secrets to civilized man, and, though explorers have penetrated it from every side, it remains to-day the dark continent. This isolation of Africa is due to its position and formation. It is a vast, ill-formed triangle, with few good harbors, without navigable rivers for ocean-vessels, lying mainly in the torrid zone. A fringe of low scorched land, reeking with malaria, extends in unbroken monotony all along the coast, threatening death to the adventurous explorer. Our ignorance of Africa is not in consequence of

its situation under the equator, for South America in the torrid zone has long been known. There the explorer easily penetrates its recesses on its great rivers,—the Orinoco, Amazon, and La Plata,—for they are navigable from the ocean far into the interior. The Amazon, 3,000 miles from its mouth, is only 210 feet above the ocean-level, and, with its branches, is navigable for 10,000 miles. Africa also has three great rivers,—one on each side of this peninsula. On the north, the Nile, the river of the past, empties into the Mediterranean Sea, but its navigation is soon interrupted by five cataracts; so that the camel, the ship of the desert, bears the wares of Europe from the foot of the first cataract far up the river, 800 miles, to Berber, whence they are again shipped by boat 2,000 miles to Gondokoro, close to the lakes Albert and Victoria Nyanza, 4,000 feet above the sea-level, 4,200 miles by water from the Mediterranean.

On the west, the Kongo, the river of the future, empties into the Atlantic Ocean under the equatorial sun; but its navigation is also impeded by successive falls extending from its mouth to Stanley Pool. Then there is almost uninterrupted navigation on the river and its tributaries for 10,000 miles. Far inland the head waters of its north-eastern branches interlace with the waters of the Nile. Another branch rises in Lake Tanganyika in eastern Africa, while the main river finds its source higher up in the mountains, north of Lake Nyassa, 5,000 feet above the sea-level. On the east the Zambezi, the great river of southern Africa, empties into the Indian Ocean opposite Madagascar. The navigation of its main branch, the Shire, is interrupted not far from the ocean. The Zambezi itself is navigable to the rapids near Tete, 260 miles from its mouth; while one or two hundred miles higher up are the mighty falls of Victoria, only exceeded in volume of water by the Niagara, and nearly equal in height.

In whatever direction Europeans attempted to penetrate Africa, they were met by insurmountable obstacles. Communication by water was prevented by falls near the mouths of great rivers. The greater part of the coast was very unhealthy, and, where not unhealthy, a desert was behind it; but these obstacles, which formerly prevented exploration, now stimulate the traveler. The modern explorations of Africa commenced one hundred years ago, when Mungo Park crossed the Desert of Sahara, and lost his life in descending the Niger. From that time to the

present, travelers in ever-increasing numbers have entered Africa from every side. Some who have entered from the Atlantic or Pacific coasts have been lost in its wilds, and two or three years after have emerged on the opposite coast; others have passed from the coast, and have never been heard from. Zanzibar has been a favorite starting-point for the lake region of Central Africa. Stanley started from Zanzibar on his search for Livingstone with two white men, but returned alone. Cameron set out by the same path with two companions, but, upon reaching the lake region, he was alone. Keith Johnson, two or three years ago, started with two Europeans: within a couple of months he was gone. Probably every second man, stricken down by fever or accident, has left his bones to bleach along the road. Drummond, a recent explorer of Africa, chose a route by the Zambezi and Shire Rivers as healthier and more desirable. Let us hear his experience. Early in his journey, at the missionary station of Livingstonia, on Lake Nyanza, he entered a missionary home: it was spotlessly clean; English furniture in the room, books lying about, dishes in the cupboards; but no missionary. He went to the next house: it was the school; the benches and books were there, but neither scholars nor teacher. Next, to the blacksmith shop: there were the tools and anvil, but no blacksmith. And so on to the next and the next, all in perfect order, but all empty. A little way off, among the mimosa groves, under a huge granite mountain, were graves: there were the missionaries.

The Niger is the only river in all Africa navigable by small steamers from the ocean; but the Niger does not give access to the interior, as it rises within 100 miles of the ocean, and, after making a great bend around the mountains of the Guinea coast, empties into the ocean only about five degrees south of its source, after a course of 2,500 miles. Its main branch, the Benue (or "Mother of Waters"), is navigable 500 or 600 miles above its junction with the Niger. The country through which it flows is thickly peopled and well cultivated; but the natives are fierce and warlike, and have until recently prevented any exploration of the Benue.

The Mountains of Africa.

As mountain-ranges determine the course of rivers, influence the rainfall, and temper the climate, we must understand the mountain system of Africa before we can understand the continent as a whole.

Standing on the citadel at Cairo, and looking south, you see a sandstone ridge which gradually grows in altitude and width of base as it runs far away to the south, even to the Cape of Good Hope at the other end of Africa. Successive ranges of mountains follow the coast, sometimes near, at others two or three hundred miles inland; the land, in the latter case, ascending from the coast. The only breaks in this long chain are where the Zambezi and Limpopo force their way to the Indian Ocean.

In Abyssinia, on the Red Sea, there is a range of snowy mountains 14,700 feet in height. A few hundred miles to the southeast, and near Lake Victoria Nyanza, almost under the equator, is another snow-capped mountain, Kilima Njaro, 18,700 feet high,—the highest mountain in Africa,—and the mountains of Massai-Land, a continuation of the Abyssinian Mountains. Another range, apparently an offshoot of the long range from the Red Sea, forms a wall 100 miles long, and 10,000 feet high, on the east of Lake Nyassa, separating the waters of that lake from the Indian Ocean. This range continues to the Zambezi. South of this river the mountains rise 8,000 to 10,000 feet in height. In Cape Colony are several ranges of mountains. The highest peak is Compas Berg, 8,500 feet. In the eastern center of Africa, in the equatorial region, is an elevated plateau in which is the lake region, then there is a sudden rise, and a gradual descent towards the Atlantic. There are few continuous ranges of mountains on the western coast; but at Kamerun there is a cluster of mountains reaching an elevation of 13,100 feet; and south of Morocco some of the peaks of the Atlas Mountains reach an elevation of 12,000 to 13,000 feet, but they have little if any influence on the rainfall or temperature of the country. It will be seen from this statement that eastern Africa has high mountain-ranges rising into an elevated plateau; that the land in Equatorial Africa gradually descends toward the west and north-west until within one or two hundred miles of the Atlantic Ocean, when the descent is rapid to the low and unhealthy coast-lands. Through equatorial Africa runs the Kongo, the land north of the Kongo gradually rising to an elevation of about 2,000 feet, and then descending to 1,200 feet at Lake Chad. South of the Kongo the land rises to an elevation of 3,000 feet, and retains this elevation far south into the Portuguese territory.

Careful computations have been made to ascertain the average elevation of the continent. The mean of the most careful estimates is a little over 2,000 feet. The interior is therefore elevated above the miasmatic influences of the coast, but exactly what effect this elevation has upon the temperature can only be ascertained after careful investigation and a series of observations. North of Guinea and Senegambia the coast is less unhealthy; but, as the Desert of Sahara extends to the ocean, the country is of little value, and is therefore left to the native tribes, unclaimed by Europeans.

In the International Scientific Series it is stated that there are in Africa ten active volcanoes,—four on the west coast, and six on the east,—but I have not found any corroboration of this report, and think it very doubtful if there are any volcanoes now in eruption. The Kilima Njaro and Kamerun were formerly active volcanoes, for the craters still exist. In the south the diamond-fields are of volcanic ash formation.

Equatorial Africa.

The lake region of Africa stretches from the head waters of the upper Nile three degrees south, to the waters of the Zambezi, fifteen degrees south,—a lake region unequalled, in extent and volume of water, except by our lakes. Here is the Victoria Nyanza, the queen of inland seas, 4,000 feet above the sea-level; and a long series of lakes, great and small, at equal elevation. The more striking are Bangweolo to the south-west, the grave of Livingstone, and Nyassa on the south-east. In their depths the Nile, the Kongo River, and the Shire (the main branch of the Zambezi) have their source.

The great belt of equatorial Africa, situated between the 15th parallel of north latitude and the 15th parallel of south latitude, has continuous rains, is everywhere well watered, and has a rich and fertile soil. Some portions are thickly populated, and it is capable of sustaining a dense population. North and south of this belt there are two other belts of nearly equal width. In each of these belts there are wet and dry seasons, with abundant rain for the crops. The heaviest rainfall in the north belt is in June, while in the south belt it is in December. The rainfall gradually grows less toward the north, and also toward the south, until it ceases in the Desert of Sahara on the north, and in

the Desert of Kalahari on the south. On the edge of these deserts are Lake Chad on the north, and Lake Ngami on the south. North of the Desert of Sahara, and south of the Desert of Kalahari, there is an abundant rainfall, a healthy climate, and fertile soil. Morocco, Algiers, and Tripoli, on the Mediterranean, are in the north region; and Zulu-Land, the Orange Free State, and Cape Colony, in the corresponding region of the south.

That portion of Africa north of the equator is three or four times greater than that south, and the Sahara Desert and Lake Chad are several times greater than the Kalahari Desert and Lake Ngami. The Sahara Desert, the waterless ocean three times as large as the Mediterranean, extends from the Atlantic Ocean to the Red Sea, broken only by the narrow valley of the Nile. It is interspersed with oases, with the valleys of many dry streams, and with some mountains 8,000 feet. It has the hottest climate in the world. Travelers tell us, that, in upper Egypt and Nubia, eggs may be baked in the hot sands; that the soil is like fire, and the wind like a flame; that in other parts of the desert the sand on the rocks is sometimes heated to 200° in the day-time, while in the following night the thermometer falls below freezing-point. In crossing the desert the traveler will hardly need a guide, for the road is too clearly marked by the bones and skeletons that point the way.

Lake Chad receives the drainage of a considerable area of country. In the dry season it has no outlet, and is then about the size of Lake Erie. In the wet season it is said to be five times as large. Its level rises by twenty or thirty feet until it overflows into the Desert of Sahara, forming a stream which runs northward for several hundred miles, and is finally lost in a great depressed plain. In the southern part of Africa the level of Lake Ngami rises and falls in a similar manner.

Through the great equatorial belt runs the Kongo, one of the wonderful rivers of the world. The more we know of this river and its tributaries, the more we are impressed by its greatness and importance. Its principal source is in the mountain-range which separates Lake Nyassa from Lake Tanganyika, between 300 and 400 miles west of the Indian Ocean; thence it runs southerly through Lake Bangweolo. On leaving this lake, it takes a north-west course, running from 12° south latitude to 2° north latitude, thence running south-westerly to the ocean, nearly 3,000 miles. The river Sankuru, its principal tributary, empties

into the Kongo some distance above Stanley Pool on the south. The mouths of the Sankuru were discovered by Stanley, who was struck by the size and beauty of the river, and by the lakes which probably connect it by a second outlet with the Kongo; but he little realized the magnitude of the river. Even before the journey of Stanley, Portuguese explorers had crossed several large streams far to the south of the Kongo,—the Kuango, the Kassai, and the Lomami,—and explored them for several hundred miles, but were unable to follow them to their mouths. In 1885 and 1886, Wissman and the Belgian explorers sailed up the Sankuru to the streams discovered by the Portuguese. The next largest branch is the Obangi, now called the Obangi-Welle, which flows into the Kongo on the westerly side of the continent, a little south of the equator. An expedition organized by the Kongo Free State steamed up this river in the winter of 1887 and 1888, and solved the problem so long discussed, of the outlet of the Welle. The expedition left the Kongo in the steamer "En Avant," October 26, 1887. It passed several rapids, and steamed to 21° 55′ east longitude, when it was stopped by the "En Avant" running on a rock, and the opposition of hostile natives. Here it was only 66 miles from the westernmost point on the Welle reached by Junker, and in the same latitude, each stream running in the same direction, leaving no room to doubt that the two waters unite.

The Little Kibali, which rises a little to the west of Wadelai in the mountains of Sudan, is the initial branch of this river, which bears successively the name of "Kibali" "Welle" and "Doru," and empties into the Kongo under the name of "Obangi," after a course of 1,500 miles.

The discharge of water from the Kongo is only a little less than that from the Amazon, and is said to be three times as great as the discharge from the Mississippi. Grenfel, the English missionary and traveler, says there is no part of the Kongo basin more than one hundred miles from navigable water. What the railroad does for America, the steamboat will do for the Kongo Free State on its seventy-two hundred miles of navigable water.

Appropriation of Africa by Europe.

The English, French, Germans, and Belgians have within a few years planted colonies in Africa. They believe it is more for their interest to colonize Africa than to permit their

surplus population to emigrate to America. These countries realize the necessity of creating new markets, if they are to continue to advance. In Africa the colonies must depend upon the home country, and open new fields for manufactures and commerce. They know that in equatorial Africa there are more than 100,000,000 people wanting every thing, even clothes.

The whole coast of Africa on the Mediterranean Sea, the Atlantic and Indian Oceans from the Red Sea to the Isthmus of Suez, is claimed by European nations, with the exception of two or three small inhospitable and barren strips of coast. England occupies Egypt, and will hold it for an indefinite period. France has its colonies in Tripoli, Algiers, and Morocco, and on the Atlantic coast its factories in Senegambia. It seeks a route from Algiers across the desert to Lake Chad, and from Senegambia up the Senegal by steamer, thence across the country by rail to the head of navigation on the Niger, and down that river to Timbuctu.

England occupies Sierra Leone, the Gold and Slave Coasts, the delta and valley of the Niger, and its branch the Benue. It has factories on these rivers, and small steamers plying on them, and seeks Timbuctu by the river Niger. It controls almost the entire region where the palm-oil is produced.

Timbuctu, long before Africa was known to Europe, was the centre of a large trade in European and Asiatic goods. Caravans crossed the Desert of Sahara from Timbuctu north to the Mediterranean, and east to Gondokoro, carrying out slaves, gold and ivory and bringing back European and Asiatic goods.

Sandwiched between the English possessions, Liberia struggles for existence, its inhabitants fast degenerating into barbarism.

Joining the English possessions on the Gold Coast, two degrees north of the equator, are the German possessions of Kamerun, with high mountains and invigorating breezes; but the land at the foot is no more favorable to the European than the Guinea coast. One or two hundred miles in the interior of this part of the continent, the land rapidly rises to the tableland of equatorial Africa, rich and fertile, resembling the valley of the Kongo, possibly habitable by Europeans.

Next, the French occupy the Ogowe, its branches, and the coast, to the Kongo, and claim the country inland to the possessions of the Kongo Free State. Under M. Brazza, they have thoroughly explored the country to the river Kongo, and have established factories at Franceville and other places.

The Kongo Free State comes next. It holds on the coast only the mouth of the river, its main possessions lying in the interior. Belgium is the only country that has planted colonies inland. Like all the interior of equatorial Africa, the valley of the Kongo is well watered and has continuous rains. The land is rich and fertile, but is practically inaccessible, and, before any extensive commerce can be carried on, must be connected by railroad with the ocean. The Compagnie du Congo has just completed a survey for a railroad on the south side of the Kongo, from Matadi, opposite Vivi, to Stanley Pool. It did not encounter any unusual difficulties, and has submitted the plans and projects to the King of Belgium for his approval.

South of the Kongo Free State are the Portugese possessions of Angola, Benguela, and Mossamedes. Portugal, the first country to circumnavigate Africa, and the first to colonize it, has for several centuries had factories, and carried on a large trade with Africa, exchanging clothes and blankets for slaves, gold and ivory. It claimed the valley of the Kongo; but the claim has been reduced, and is now bounded for a considerable distance on the north by a line running due east and west on the 6th parallel of south latitude. They have good harbors at St. Paul de Loango, Benguela, and Mossamedes, on the Atlantic coast, and the best harbor of Africa, at Delagoa Bay on the Indian Ocean. The territory claimed will, I believe, prove to be the most valuable in Africa. It is well watered by numerous tributaries of the Kongo and by the Zambezi and its branches. It is higher than the Kongo valley, and is therefore more healthy. Several Portuguese, English, and German travelers have crossed and recrossed this part of the continent, and the Portuguese have some small settlements on the coast and in the interior. The Portuguese of the present generation have not the enterprise and trading spirit of their forefathers, and are doing very little for the settlement of the country.

South of the Portuguese possessions, England claims from the Portuguese possessions on the Atlantic to their possessions on the Pacific, including Namaqua-Land, Cape Colony, the Transvaal, and Zulu-Land.

Namaqua and Damara Land, formerly claimed by the Germans, are now put down on some of the maps as belonging to England. The only harbor on the coast is held by the English; and, from the character of the country, we are not surprised that

the Germans have abandoned it, for we are told that "the coast is sandy and waterless, deficient in good harbors, devoid of permanent rivers, washed by never-ceasing surf, bristling with reefs, and overhung by a perpetual haze."

North of Zulu-Land, the Portuguese claim the coast to Zanzibar. Over Zanzibar, Germany has lately assumed the protectorate, under a treaty with the Sultan of the country, claiming the land from the ocean to the great lakes; then England again, a little to the north and far to the west of Zanzibar, the rival of Germany in its claims. The English have factories west of Zanzibar, and a regular route up the Zambezi and Shire Rivers, with a single portage to Lake Nyassa, and a road to Lake Tanganyika. They have steamers on each of the lakes, and several missionary and trading stations. The latest news from this part of Africa says the route to the lakes has been closed, and the missionaries and merchants murdered.

North of the English possessions, the coast to the Red Sea is barren and inhospitable: it has little rain and no harbors, and is so worthless that it has not been claimed by any European nation. North of this region is Abyssinia on the Indian Ocean and Red Sea,—a mountainous country with deep valleys, rich and fertile, but very unhealthy. Three or four thousand feet above the level of the sea, is a healthier country, inhabited by a race of rugged mountaineers, whom it has been impossible to dispossess of their lands. North of Abyssinia, on the Red Sea, Italy has a small colony at Massaua, and England a camp at Suakin. The only parts of the coast not claimed by Europeans are inhospitable, without population or cultivation of any kind.

The Belgians have spent many millions in the exploration of the Kongo and its tributaries. They have eighteen small steamers making trips from Leopoldville up the river to Stanley Falls, and up its branches, supplying the main stations in the basin of the Kongo. The Kongo Free State, unlike all other African colonies, is free to all. Merchants of any nation can establish factories, carry on trade, and enjoy the same privileges and equal facilities with the Belgians. The valley of the Kongo, and the plateau of the great lakes, have a similar climate and soil; but the Kongo is easier of access, provisions are cheaper, more readily obtained, and the natives are less warlike. The Kongo Free State will therefore be more rapidly settled than any other part of Africa excepting Cape Colony.

The trade with these countries is carried on by European companies under royal charter, with quasi-sovereign powers for ruling the country and governing the natives, as well as for trading with them. England, Germany, and Portugal subsidize steamship companies which make regular trips along the western coast, stopping at the different stations.

From this statement it will be seen that England occupies the healthiest portion of Africa (Cape Colony), the most fertile valleys (the Nile and the Niger), the richest gold-fields (Gold Coast and Transvaal); that Portugal comes next, claiming the most desirable portion of equatorial Africa north of Cape Colony and south of the Kongo, but that it is unable to colonize this country, which will inevitably fall under the control of England; that the French claim Algiers and Senegambia, and are contending with England for the trade of Timbuctu and the upper valley of the Niger; that Germany, after vain attempts to penetrate the interior from Kamerun and Angra Pequena, has planted her flag at Zanzibar, and has determined to contest with England the lake region and the great plateaus of Central Africa; while Italy, imitating the other states, tries in vain to obtain a footing on the Red Sea, worthless if obtained.

Population.

The population of Africa is roughly estimated at 200,000,000, —about 18 to a square mile, as against 88 in Europe. It is supposed that Africa was originally inhabited by the Hottentots, or Bushmen, who are now found only in south-western Africa, and by the Pygmies or Dwarfs scattered about Central Africa, who, some say, belong to the same group. This group is noted for its dwarfed stature, generally under five feet; but whether their size is natural, or due to privation and scanty food, is not certainly known. The Hottentot language is distinct from any other known form of speech. The Bantu occupy the greater part of Africa south of the equator. They probably formerly inhabited north-eastern Africa, but were driven from their homes by the Hamites. The Bantu resemble the Negro in their general character, color, and physique, but their language shows essential differences. There are countless tribes of Bantu, each tribe having its own language, yet there was originally a primeval Bantu mother-tongue, from which all the dialects of this immense region

are undoubtedly derived. The idioms of this family are generally known as the alliteral class of languages. North of the Bantu are the Negroes proper, occupying the greater part of Africa between 5° and 15° north latitude. The negro tribes are multitudinous, and, though alike in their main physical features, are diverse in their speech.

North of the Negro are the Nuba Fulah group, apparently indigenous to Africa, but without any thing in common with the other indigenous groups. Their name, "Pullo," or "Fulah," means "yellow," and their color serves to distinguish them from the Negro. The Hottentot, Bantu, Negro, and Fulah, though distinct, have each of them the agglutinative forms of speech. The Hamites are found along the valley of the Nile, in Abyssinia, and portions of the Sudan. The Shemitic tribes occupy the larger part of the Sudan, bounded on the east by the Nile, and on the north by the Mediterranean and North Atlantic.

About one-half of the population are Negroes proper, one-fourth Bantu, one-fourth Shemites and Hamites, a few Nuba Fulahs and Hottentots. The Negroes and Bantu are Pagans; the Shemites and Hamites, Mohammedans. There are, almost, innumerable tribes, speaking different languages or different dialects. Over six hundred tribes and languages have been classified by Shilo, yet each is generally unintelligible to the other. Practically speaking, there are but two great divisions,—the Negroes and Bantu, occupying equatorial and southern Africa; and the Hamites and Shemites, northern Africa. But there is no clear-cut line even between the Mohammedan and Negro. For many hundred years the Negroes have been taken as slaves, and carried into the north of Africa, and have furnished the harems with wives, and the families with servants. The servants are often adopted into the families, so that the Negro blood now largely predominates even among the Shemites and Hamites.

A broader and more practical distinction than that of language or blood is made by the religion of the African. The Mohammedan religion was probably brought from Arabia by the Shemites. They conquered the country along the coast, and exterminated or pushed to the south the former inhabitants. Then, more slowly but steadily, Mohammedanism forced its way south by the sword or by proselyting. Within the last thirty years it has re-assumed its proselyting character, and is now more rapidly extending than at any previous time.

Its missionaries are of a race nearly allied to the Negro. They live among them, adopting their customs, and often intermarrying with them. They teach of one God, whom all must worship and obey, and of a future life whose rewards the Negro can comprehend. They forbid the sacrifice of human victims to appease the wrath of an offended deity. They forbid drunkenness. They give freedom to the slave who becomes a Moslem, and thus elevate and civilize those among whom they dwell. The Christian missionary is of a race too far above him. He is a white man, his lord and master. He teaches of things his mind cannot reach, of a future of which he can form no conception; he brings a faith too spiritual; he labors with earnestness and devotion, even to the laying-down of his life. Yet the fact remains that Christianity has produced but little impression in civilizing and elevating the people, while the influence of Mohommedanism is spreading on every side.

In passing from the equator south, the tribes become more degraded. Sir Henry Maine enunciated the theory of the evolution of civilization from the lowest state of the savage. In Africa he could have found all stages of civilization; in the lowest scale, man and his mate, living entirely on the fruits of the earth, in a nude condition, his only house pieces of bark hung from the trees to protect him from the prevailing wind; the vulture his guide to where, the previous night, the lion had fallen on his prey, leaving to him the great marrow-bones of the elephant or the giraffe; his only arms a stick; belonging to no tribe, with no connection with his fellow-men, his hand against every man, the family relation scarcely recognized. It is the land of the gorilla, and there seems to be little difference between the man and the ape, and both are hunted and shot by the Boers. In ascending the scale, the family and tribal relation appears,—a house built of cane and grass or the bark of the tree; a few flocks; skill in setting traps for game; the weapon a round stone, bored through, and a pointed stick fastened in the hole. Then come tribes of a low order of civilization, that cultivate a little ground, having a despotic king, who has wives without limit, numbering in some cases, it is said, 3,000; wives and slaves slaughtered at his death, to keep him company and serve him in another life. With them, cannibalism is common. Then come tribes of a higher civilization, where the power of the chief is limited, where iron, copper, and gold are manufactured, and trade is carried on with foreigners,

where fire-arms have been substituted for the bow and spear; next the Mohammedan; and last of all, on the shores of the Mediterranean, the civilization of the French and English.

It is a curious fact that many tribes that had made considerable advance in manufacturing iron and copper, have for some time ceased manufacturing; that others have retrograded, and have lost some of the arts they formerly possessed. This decline apparently took place after the Mohammedans had conquered North Africa, and sent their traders among the Negro tribes, who sold the few articles the Negro needed cheaper than they could manufacture them, and therefore compelled them to give up their own manufactures. Such was the effect of free trade on interior Africa. The Mohammedans also manufacture less than formerly, depending more and more upon European manufactures. The enterprise of the white race defies native competition, and stifles attempts at native manufactures: there is therefore among the natives a great falling-off in the progress of outward culture, and the last traces of home industries are rapidly disappearing.

Slave-Trade.

One of the departments of this society is the geography of life. At the head of all life stands man: it is therefore within our province to investigate those questions which more intimately concern and influence his welfare.

Slavery and the slave-trade have, within the last two hundred years, affected African life more than all other influences combined; and this trade, with all its sinister effects, instead of diminishing, is ever increasing. It has had a marked effect not only on the personal and tribal characters of the inhabitants, but on their social organization, and on the whole industrial and economic life of the country. It has not only utterly destroyed many tribes, but it has made the condition of the other tribes one of restless anarchy and insecurity. It has been the great curse of Africa, and for its existence the nations of Europe have been, and are, largely responsible. The temper and disposition of the Negro make him a most useful slave. He can endure continuous hard labor, live on little, has a cheerful disposition, and rarely rises against his master.

There are two kinds of slavery,—home and foreign. The first has always prevailed in Africa. Prisoners taken in war are

sacrificed, eaten, or made slaves. Slavery is also a punishment for certain offences, while in some tribes men frequently sell themselves. These slaves are of the same race and civilization as their masters. They are usually well treated, regarded as members of the family, to whom a son or daughter may be given in marriage, the master often preferring to keep his daughter in the family to marrying her to a stranger. This slavery is a national institution of native growth. It is said one half of the inhabitants are slaves to the other half. The horrors of the slave-trade are unknown in this kind of slavery.

In the other case the slave is torn from his home, carried to people, countries, and climates with which he is unfamiliar, and to scenes and civilization which are uncongenial, where his master is of a different color and of another and higher civilization, where the master and slave have nothing in common. The Spaniards made slaves of the Indians of America, but they were incapable of work, unfitted for slavery, and rapidly faded away. In pity for the Indians, the Africans were brought to supply their places. Their ability to labor was proved, and they were soon in great demand.

It is impossible to ascertain the number of slaves imported into America. The estimates vary from 4,000,000 to 5,000,000. The larger number is probably an underestimate; but these figures do not represent the number shipped from Africa, for 12½ per cent. were lost on the passage, one-third more in the "process of seasoning;" so that, out of 100 shipped from Africa, not more than 50 lived to be effective laborers.

Livingstone, who studied the question of slavery most carefully, estimated, that, for every slave exported, not less than five were slain or perished, and that in some cases only one in ten lived to reach America. If the lowest estimate is taken, then not less than 20,000,000 Negroes were taken prisoners or slain to furnish slaves to America. No wonder that many parts of Africa were depopulated.

Though the slave-trade with America has been suppressed, thousands are annually stolen and sold as slaves in Persia, Arabia, Turkey, and central and northern Africa. Wherever Mohammedanism is the religion, there slavery exists; and to supply the demand the slave-trade is carried on more extensively and more cruelly to-day than at any previous time. The great harvest-field for slaves is in Central Africa, between 10° south

and 10° north latitude. From this region caravans of slaves are sent to ports on the Indian Ocean and the Red Sea, and thence shipped to Indo-China, the Persian Gulf, Arabia, Turkey in Asia, and even to Mesopotamia, wherever Mussulmans are found. The English at Suakin are a constant hindrance to this traffic; and therefore Osman Digna has so often within the past five years attacked Suakin, desiring to hold it as a port from which to ship slaves to Arabia. Other caravans are driven across the desert to Egypt, Morocco, and the Barbary States. Portuguese slave-traders are found in Central Africa, and, though contrary to law, deal in slaves, and own and work them in large numbers. Cameron says that Alrez, a Portuguese trader, owned 500 slaves, and that to obtain them, ten villages, having each from 100 to 200 souls, were destroyed; and of those not taken, some perished in the flames, others of want, or were killed by wild beasts. Cameron says, "I do not hesitate to affirm that the worst Arabs are angels of mercy in comparison to the Portuguese and their agents. If I had not seen it, I could not believe that there could exist men so brutal and cruel, and with such gayety of heart." Livingstone says, "I can consign most disagreeable recollections to oblivion, but the slavery scenes come back unbidden, and make me start up at night horrified by their vividness."

If the chief or pacha of a tribe is called upon for tribute by his superior, if he wishes to build a new palace, to furnish his harem, or fill an empty treasury, he sends his soldiers, armed with guns and ammunition, against a Negro tribe armed with bows and spears, and captures slaves enough to supply his wants.

The territory from which slaves are captured is continually extending; for, as soon as the European traveler has opened a new route into the interior, he is followed by the Arab trader, who settles down, cultivates the ground, buys ivory (each pair of tusks worth about $500 at Zanzibar or Cairo); invites others to come, and when they have become acquainted with the country, and gathered large quantities of ivory, and porters are wanted to carry the tusks to the coast, a quarrel is instigated with the Negroes, war declared, captives taken,—men for porters, women for the harem,—the villages are burned, and the caravan of slaves and ivory takes its route to the coast, where all are sold. We are told on good authority that during the past twenty years more slaves have been sent out than formerly were exported in a century. Wissmann tells us what he has seen:—

"In January, 1882, we started from our camp,—200 souls in all,—following the road, sixty feet wide, to a region inhabited by the Basonge, on the Sankuru and Lomami Rivers. The huts were about twenty feet square, divided into two compartments, the furniture consisting of cane and wooden stools; floor, ceiling, and walls covered with grass mats. Between the huts were gardens, where tobacco, tomatoes, pine-apples, and bananas were grown. The fields in the rear down to the river were cultivated with sweet-potatoes, ground-nuts, sugar-cane, manioc, and millet. Goats and sheep and fowls in abundance, homestead follows homestead in never-ending succession. From half-past six in the morning, we passed without a break through the street of the town until eleven. When we left it, it then still extended far away to the south-east. The finest specimens in my collection, such as open-work battle-axes inlaid with copper, spears, and neat utensils, I found in this village.

"Four years had gone by, when I once more found myself near this same village. With joy we beheld the broad savannas, where we expected to recruit our strength and provisions. We encamped near the town, and in the morning approached its palm-groves. The paths were no longer clean, no laughter was heard, no sign of welcome greeted us. The silence of death breathes from the palm-trees, tall grass covers every thing, and a few charred poles are the only evidence that man once dwelt there. Bleached skulls by the roadside, and the skeletons of human hands attached to the poles, tell the story. Many women had been carried off. All who resisted were killed. The whole tribe had ceased to exist. The slave-dealer was Sayol, lieutenant of Tippo Tip."

Sir Samuel Baker was largely instrumental in the suppression of the slave-trade, and, while the rule of the English and French in Egypt was maintained, slavery was greatly diminished; but, since the defeat and death of Gen. Gordon, the slave-trade has rapidly increased, and is now carried on more actively than at any other time. The only obstacles to this traffic are the presence of Emin Pacha at Wadelai, the English and American missionaries, and English trading-stations on Lakes Victoria Nyanza and Tanganyika.

The slave-traders unite in efforts to destroy Emin Pacha, and to expel the missionaries and all European travelers and traders, except the Portuguese, and for this purpose excite the hostility

of the Negro against the foreigner. In this they are aided by the Mahdi. The work of the Mahdi is largely a missionary enterprise. The dervishes who accompany his army are religious fanatics, and desire the overthrow of the Christians and Emin Pacha as earnestly as the slave-trader. Religious fanaticism is therefore united with the greed of the slave-trader to drive out the Christians from the lake region.

Aroused by these reports, and influenced by these views, Cardinal Lavigerie, for twenty years Bishop of Algiers and now Primate of Africa, last summer started a new crusade in Belgium and Germany against slavery and the slave-trade. The cardinal has organized societies, and is raising a large fund to equip two armed steamships for Lake Tanganyika and Lake Nyassa, the headquarters of the slave-trade, and offers, if necessary, to head the band himself. The Pope has engaged in the work, has contributed liberally to this fund, and sent three hundred Catholic missionaries to Central Africa. The slave-trade is carried on with arms and ammunition furnished by European traders. Without these arms, the slave-trade could not be successfully carried on, for the Negroes could defend themselves against slave-traders armed like themselves. While the demand for slaves continues, the slave-trade will exist, and will not cease until the factories of European nations are planted in the interior of Africa.

Mineral Wealth of Africa.

We are told in Phillips's "Ore Deposits" that the precious metals do not appear to be very generally distributed in Africa. More thorough research may show that this view is incorrect, and that there are large deposits of iron, copper, gold, and other metals in many parts of the continent. Gold is found on the Gold Coast, in the Transvaal, in the Sudan, and in Central Africa, but is only worked in surface diggings, excepting in the Transvaal; but near all these washings, gold nuggets of large size, and the quartz rock, have been discovered. In Transvaal the mines were worked a long time ago, probably by the Portuguese, then abandoned and forgotten. Recently they have been rediscovered, and worked by the English. In the Kaap gold-field in the Transvaal, three years ago, the lion and zebra, elephant and tiger, roamed undisturbed in the mountain solitudes, where there is now a population of 8,000, with 80 gold-mining

companies, having a capital of $18,500,000, one-third of which is paid up. Barberstown, the chief mining-town, has two exchanges, a theatre, two music-halls, canteens innumerable, several churches and hotels, four banks, and a hospital. A railroad was opened in December, 1887, from the Indian Ocean towards these mines, 52 miles, and is being rapidly constructed 100 miles farther to Barberstown.

There is reason to believe that gold deposits equal to those of Mexico or California will yet be found in several parts of Africa. Copper is known to exist in the Orange Free State, in parts of Central and South Africa, and in the district of Katongo, southwest of Lake Tanganyika, which Dr. Livingstone was about to explore in his last journey. Rich copper ores are also found in the Cape of Good Hope, Abyssinia, and equatorial Africa. Large and excellent deposits of iron ore have been found in the Transvaal and in Algiers, and a railroad 20 miles long has been built to carry it from the Algerian mines to the sea. Very many tribes in equatorial and Central Africa work both iron and copper ores into different shapes and uses, showing that the ore-beds must be widely distributed.

One of the few large diamond-fields of the world is found in Griqua and Cape Colony, at the plateau of Kimberly, 3,000 feet above the sea. The dry diggings have been very productive; this tract, when first discovered, being almost literally sown with diamonds.

Coal has been found in Zulu-Land, on Lake Nyassa, and in Abyssinia. The latter coal-field is believed to be secondary. Iron, lead, zinc, and other minerals, have been found in the Orange Free State. Salt-beds, salt-fields, salt-lakes, and salt-mines are found in different parts of Africa.

Railroads.

The peculiar formation of Africa, its long inland navigation, interrupted by the falls near the mouths of its large rivers, from connection with the ocean, render it necessary to connect the ocean with the navigable parts of the rivers by railroads.

The Belgians will soon construct a railroad on the southerly side of the Kongo, to the inland navigable waters of the Kongo at Leopoldville, following the preliminary surveys lately completed; the French may also construct a road from the coast to

Stanley Pool; and by one or the other of these routes the interior of Africa will be opened.

South of the Kongo, the Portuguese are constructing a railroad from Benguela into the interior. In Cape Colony railroads connect the greater part of the British possessions with the Cape of Good Hope. A railroad is also being constructed from Delagoa Bay to the mines in Transvaal.

Sudan and the upper waters of the Nile can only be opened to a large commerce by a railroad from Suakin to Berber, about 280 miles. Surveys were made for this road, and some work was done upon it, just before Gen. Gordon's death. The navigation of the Nile above Berber is uninterrupted for many hundred miles. Below Berber the falls interrupt the navigation. The route from Gondokoro down the Nile is by boat to Berber, camel to Assuan, boat to Siut, and railroad to Cairo and Alexandria, making a route so circuitous that it prevents the opening of the Sudan to any extensive commerce.

In Algiers there are 1,200 miles of railroad, and more are being constructed. The French are constructing a railroad from the upper part of the Senegal River to the head waters of the Niger. The English have organized a company to construct a road from the Gold Coast to the mines in the interior.

It will thus be seen that the railroad has already opened a way into Africa that is sure to be carried on more extensively.

Stanley Expedition.

There are two methods of exploring Africa. One is where an individual, like a Livingstone, or a Schweinfurth, or a Dr. Junker, departs on his journey alone. He joins some tribe as far in the interior, on the line of exploration, as possible; lives with the tribe, adopting its habits and manner of life, learning its language, making whatever explorations he can; and, when the region occupied by such tribe has been fully explored, leaves it for the next farther on. This plan requires time and never-failing patience; but in this way large portions of Africa have been explored. The other way, adopted by Cameron, Stanley, Wissmann, and the Portuguese explorers, has been to collect a party of natives, and at their head march across the continent.

"An immense outfit is required to penetrate this shopless land, and the traveler can only make up his caravan from the bazaar

at Zanzibar. The ivory and slave-traders have made caravanning a profession, and every thing the explorer wants is to be found in these bazaars, from a tin of sardines to a repeating-rifle. Here these black villains the porters—the necessity and despair of travelers, the scum of slave-gangs, and the fugitives from justice from every tribe—congregate for hire. And if there is any thing in which African travelers are for once agreed, it is, that for laziness, ugliness, stupidity, and wickedness, these men are not to be matched on any continent in the world." Upon such men as these Stanley was obliged to depend.

Though traveling in this way is more rapid than the other, it is very expensive, and has many difficulties not encountered by the solitary traveler. The explorer always goes on foot, following as far as possible the beaten paths. A late traveler says: "The roads over which the land-trade of equatorial Africa now passes from the coast to the interior are mere footpaths, never over a foot in breadth, beaten as hard as adamant, and rutted beneath the level of the forest-bed by centuries of native traffic. As a rule, these foot-paths are marvellously direct. Like the roads of the old Roman, they move straight on through every thing,—ridge and mountain and valley,—never shying at obstacles, nor anywhere turning aside to breathe. No country in the world is better supplied with paths. Every village is connected with some other village, every tribe with the next tribe, and it is possible for a traveler to cross Africa without being once out of a beaten track."

But if the tribes using these roads are destroyed, the roads are discontinued, and soon become obstructed by the rapid growth of the underbrush; or, if the route lies through unknown regions outside the great caravan-tracks, the paths are very different from those described by Mr. Drummond, for the way often lies through swamps and morass, or thick woods, or over high mountain-passes, or is lost in a wilderness of waters.

The great difficulty in these expeditions is to obtain food. As supplies cannot be carried, they must be procured from the natives. Very few tribes can furnish food for a force of six hundred men (the number with Stanley); and when they have the food, they demand exorbitant prices. Often the natives not only refuse food to the famished travelers, but oppose them with such arms as they have; and then it is necessary, in self-defence, to fire upon them.

The greatest difficulty the explorer meets comes either directly or indirectly from the opposition of the slave-trader. Formerly the slave-trader was not found in equatorial Africa; but, since the explorer has opened the way, the slave-trader has penetrated far into the interior and is throwing obstacles in the way of the entry of Europeans into Africa. When it was decided that Stanley should relieve Emin Pacha, he was left to choose his route. He met Schweinfurth, Junker, and other African travelers, in Cairo. They advised him to go by his former route directly from Zanzibar to the Victoria Nyanza. The dangers and difficulties of this route, and the warlike character of the natives, he well knew. The route by the Kongo to Wadelai had never been traveled, and he thought the difficulties could not be greater than by the old route; and, beside, he proceeded much farther into the interior by steamer on the Kongo, which left a much shorter distance through the wilderness than by the Zanzibar route. On arriving at Zanzibar, he made an arrangement with Tippo-Tip, the great Arab trader and slave-dealer, for a large number of porters. They sailed from Zanzibar to the Kongo, where Stanley arrived in February, 1887. He then sailed up the Kongo, and arrived in June at the junction of the Aruvimi with the Kongo, a short distance below Stanley Falls. Stanley believed that the Aruvimi and the Welle were the same stream, and that by following up this river he would be on the direct route to Wadelai. Subsequent investigations have shown that he was mistaken. About the 1st of July he left the Kongo, expecting to reach Emin Pacha in October, 1887. No definite information has been received from him from that time to the present. He left Tippo-Tip in command at Stanley Falls, and expected that a relief expedition would follow. There were great delays in organizing this expedition, from the difficulty of obtaining men, and it was thought that Tippo-Tip was unfaithful. The men were finally procured, and the expedition left Aruvimi in June, 1888, under command of Major Barttelot. A day or two after they started, Major Barttelot was murdered by one of his private servants. The expedition returned to the Kongo, and was re-organized under Lieut. Jamieson. He was taken ill, and died just as he was ready to start, and no one has been found to take his place; and that relief expedition was abandoned. Reports say that Stanley found the route more difficult than he anticipated; heavy rainfall, rivers, swamps, and marshes ob-

structed the way; that the season was sickly, and a large part of his followers died long before he could have reached Emin Pacha.

The reports of his capture, and of his safe return to the Aruvimi River, are known to all. These may or may not be true. Although we have not heard from Stanley for a year and a half, yet it by no means follows that he is dead; for Livingstone, Stanley, and other explorers have been lost for a longer time, and have afterward found their way back to the coast. No man has greater knowledge of the country through which his route lay, or of the character of the natives, or the best manner of dealing with them. Emin Pacha was encamped quietly for nearly two years at Wadelai; and Stanley, in like manner, may have been compelled to remain at some inland point and raise his own provisions.

The Future of Africa.

It is impossible to prophesy the future of any country, much less that of Africa, where the physical features have left so marked an impression upon its inhabitants, and where the animal life is so different from that of the other continents. It is rather by differentiating Africa from other countries that we obtain any data from which to form an opinion of its future.

Africa, as we have seen, is surrounded by a fringe of European settlements. What effect will these settlements have upon Africa? Will the European population penetrate the interior, and colonize Africa? Will it subjugate or expel the Africans, or will they fade away like the Indians of our country? If colonization by Europeans fail, will the African remain the sole inhabitant of the country as barbarian or civilized?

Egypt is now controlled by the English, but its climate is too unhealthy, and its surrounding too unfavorable, for Englishmen; and we may safely assume that their occupation will be temporary, or, if permanent, not as colonists. They will remain, as in India, foreigners and rulers, until the subjugated people rise in their power and expel them, and return to their old life. The English rule, though possibly beneficial to Egypt, is hated by the natives, who demand Egypt for the Egyptians.

Leaving Egypt, we pass an uninhabitable coast, until we come to the French colonies of Algiers. It is nearly sixty years since

the French took possession of Algiers. There has been a large emigration from France; but the climate, while excellent as a winter climate for invalids and others, is unfavorable for a permanent habitation, especially for infants. The births in one year have never equalled the deaths. When Algeria was first conquered by the French, it was a wilderness, but is now a garden. The cultivation of the grape has been most successful, and extensive iron-mines have been opened. The French are gradually pushing their way from Algiers across the desert to Timbuctu, and also from Senegambia to Timbuctu. The expense of maintaining Algeria has greatly exceeded any revenue derived from it. Though many doubt the political wisdom of retaining it, yet the French have too much pride to acknowledge that the enterprise has been in any way a failure; and they will undoubtedly hold it, and perhaps found an empire. Senegambia and the coast of Guinea, claimed by the French and English, are low and moist, filled with swamps and lagoons, which will prevent any European colonization.

South of the Kongo, the Portuguese claim a wide section of country running across Africa. They have occupied this country over two hundred years. They have done little towards colonizing, and only hold a few trading-posts on the coast and in the interior, dealing principally in slaves, ivory, and gold; and it may well be doubted whether they have the stamina or ability to colonize this country, or to produce any permanent impression upon it.

The south portion of Africa, from the 18th parallel on the Atlantic to the 26th parallel on the Indian Ocean, is generally fertile; and the climate is favorable to Europeans, and is capable of sustaining a large population. The growth of Cape Colony has been very slow, but a more rapid growth is anticipated. We believe it will be permanently occupied by the English, who will dispossess the aborigines, and form a great and permanent English State. The coast of Zanzibar, occupied by the Germans and English, is rich and fertile, the climate unhealthy; but when the mountain-ranges are crossed, and the elevated plateaus and lake regions are reached, the interior resembles the Kongo region. Massaua and Suakin, on the Red Sea, are unhealthy and worthless, unless connected by railroad with the upper Nile.

There remains equatorial Africa, including the French settlements on the Ogowe, the region about Lake Chad, the Kongo

and its tributaries, and the lake region. The more we learn of equatorial Africa, the greater its natural advantages appear to be. The rivers open up the country in a favorable manner for trade and settlement. Its elevation from 2,000 to 3,000 feet will render it healthy, though this elevation is only equal to from ten degrees to fourteen degrees of north latitude. Here all the fruits of the torrid zone, the fruits and most of the grains of the temperate zone, cotton, India-rubber, and sugar-cane, are found.

The country has been unhealthly, a great many Europeans have died, and few have been able to remain more than two or three years without returning to Europe to recuperate. These facts seem to show that the climate is not healthy for Europeans. But the mortality has been much greater than it will be when the country is settled and the unhealthy stations have been exchanged for healthier localities. Every new country has its peculiar dangers, which must be discovered. When these obstacles are understood and overcome, Europeans will probably occupy all this region, and it will become a European colony.

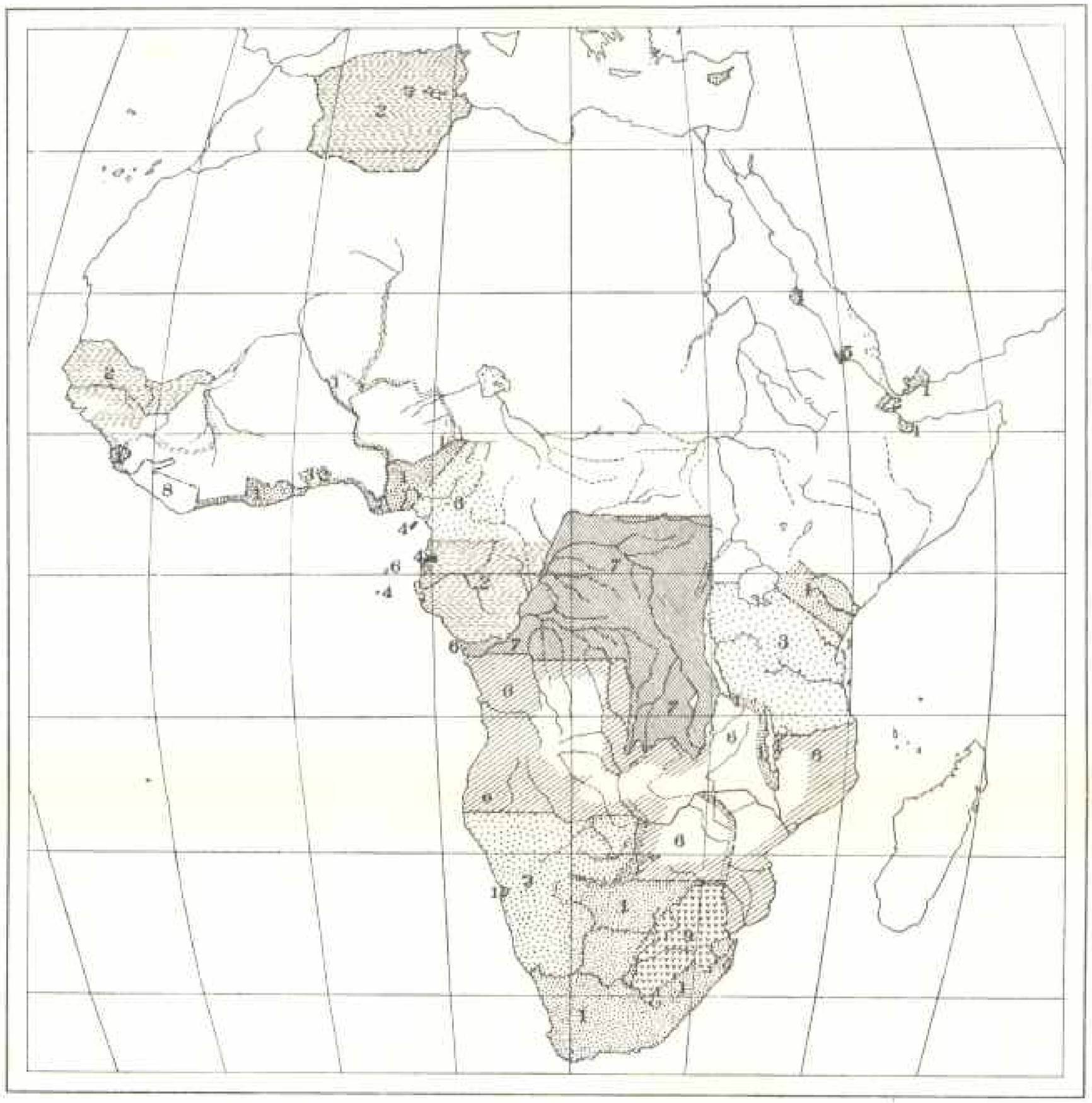
If European colonization is successful, European civilization will come into contact with African barbarism. Where such a contest is carried on in a country where the climate is equally favorable to the two races, it can only result in the subjugation or destruction of the inferior race. If the climate is unfavorable to the white population, then, unless the inferior is subjected to the superior, the white population will fail in colonizing the country, and the Negro will either slowly emerge from barbarism, or return to his original condition.

The Negro has never developed any high degree of civilization; and even if, when brought into contact with civilization, he has made considerable progress, when that contact ceased he has deteriorated into barbarism. But, on the other hand, he has never faded away and disappeared, like the Indian of America and the natives of the Southern Archipelago.

Nature has spread a bountiful and never-ending harvest before the Negro, and given to him a climate where neither labor of body or mind, neither clothing nor a house, is essential to his comfort. All nature invites to an idle life; and it is only through compulsion, and contact with a life from without, that his condition can be improved.

In Africa a contest is going on between civilization and barbarism, Christianity and Mohammedanism, freedom and slav-

ery, such as the world has never seen. Who can fail to be interested in the results of this conflict? We know that Africa is capable of the very highest civilization, for it was the birthplace of all civilization. To it we are indebted for the origin of all our arts and sciences, and it possesses to-day the most wonderful works of man. Let us hope that Africa, whose morning was so bright, and whose night has been so dark, will yet live to see the light of another and higher civilization.



APPROPRIATION OF AFRICA BY EUROPEANS.

REPORT—GEOGRAPHY OF THE LAND.

By Herbert G. Ogden.

In preparing this first report as one of the vice-presidents of the Society, I have been obliged to interpret the intent of our by-laws in the requirement that the vice-presidents shall present at the end of the year summaries of the work done throughout the world in their several departments. The amount of information that can be accumulated during twelve months, if referred to in detail, is simply appalling; to compile it for the Society would be a great labor, and when completed it would be largely the duplication of the work of others, already accessible in the journals of other societies, and in special publications devoted to this and kindred subjects. That such a detailed historical journal should be maintained by the Society hardly admits of a question. I had hoped to see one inaugurated during the first year of our work that would have embraced all the departments of the Society: but must confess with some disappointment, to having been too sanguine and to have over-estimated the interest that might be excited in the members of a new organization. We need a journal of the kind for reference; for our associates, ourselves, and our many friends we hope to attract by the information we may supply them. But it cannot well be compiled by one man engaged upon the every-day affairs of life, and I have not made any attempt in that direction, even in those matters circumscribed by the section of the Society under my charge.

I have found little in the affairs of Europe that it seems necessary to bring to your attention; indeed, the past twelve months seem quite barren of any great events in the progress of Geographic knowledge. This, perhaps, is to be expected at intervals of longer or shorter periods, as it is governed by peoples of the most advanced civilization, who have availed themselves of all the progress of science to explore and develop the land on which they live, until there is little left of nature to be learned, unless science shall determine new truths to bind by stronger links the truths already found. We may look for the greatest changes here, both now and in the future, in the work of man pressing on

in the eager strife to improve his condition above others less fortunately situated; seeking advantage in the peculiarities of his environment to open new channels of trade that will divert the profits from the older routes.

Of many schemes suggested in furtherance of such ends, there are few that develop into realities within a generation. Nature may be against them when the facts are fully learned, the profit may not warrant the outlay, and political considerations may keep in abeyance that which otherwise may be admitted to be good. Thus the grand scheme to make an inland sea of the Desert of Sahara is impossible of execution from the fact that the desert is many hundreds of feet higher than the ocean. The long talked of project to cut the Isthmus of Corinth, now accomplished, was a theme of discussion for twenty centuries or more. And the later project to tunnel the English Channel we have seen defeated through the fears of a few timid men. Perchance the grander one, now introduced with some seriousness, to bridge the channel, may meet with a better fate.

The route for the ship canal to connect the Baltic and the North Seas, is reported to have been determined upon and the preliminary work of construction to have been commenced. And we learn that a proposition is being discussed to connect the Danube with the Baltic Sea by way of the Vistula. However chimerical such a project may seem to us, we cannot at this time discredit those who believe in it. It shows that restless spirit that predominates the age, striving for the mastery of the commercial world. Politically, Europe has seen no geographical change, but those conversant with affairs apprehend a military catastrophe at no distant date, that will probably embroil the stronger nations and endanger the existence of the weaker ones.

Having practically acquired a knowledge of their territories, the people of these nations are diligently seeking to develop greater things in the study of all the earth, and we have thus seen formed as a means to this end, what is now known as the International Geodetic Association. The primary object of this Association is to determine the form of the earth. It is an inquiry of absorbing interest, and the geodetic work in America must eventually contribute an important factor in its solution. We may therefore hope that the bill now before the Congress authorizing the United States to have representation in the Association, will become a law. The free interchange between the continents

that would thus be established, would be of incalculable benefit to both in the prosecution of this important scientific labor.

If we turn to the adjoining continent of Asia, there is still open a large field for Geographic research. Peopled as it has been, largely by semi-civilized races for many centuries, we might have expected that the book of nature that might be opened would long since have been spread before us; but the exclusiveness of this semi-civilization has been a stumbling-block, until it may be said that the wise men of her nations have lived only that the masses should not learn. Of the Political Geography of this great region we have a fair conception, and of the Physical conditions it may be said we know them generally. Enlightened men have been hammering at the borders with the powerful support of progressive nations, and a few have even passed the confines of exclusiveness and brought back to us marvellous tales of ancient grandeur. Men have sought disguise that they might tread on the forbidden ground, and many have lost their lives in efforts to gain the secrets that have been so persistently guarded. But the march of civilization is not to be thwarted by the semi-barbarous; they may yet impede it, as they have in the past, but it can be only for a time; the impulse is sure to come, when the thirst for knowledge and power by the antagonistic races will sweep all barriers before it, however strong. The contemplated railway across the continent to Vladivostock may be the culminating step in overcoming these refractory peoples and opening their territories to the march of progress. We have seen on our own continent the potent influence of these iron ways, and it is not too much to believe that even in the strange surroundings of the Orient they will exercise a power against which exclusiveness and superstition will be forced to give way.

In Africa we find still different conditions. A great continent believed to contain immense resources, but peopled with dark-hued native races, barbarous in their tendencies, and frequently deficient in intellect, and yet withal showing at times a savage grandeur that excites the admiration of the man, while it attracts the interest of the student. We may recall Carthage and Alexandria, and all the wonders of ancient Egypt that live to the confusion of our own day, while those who patterned them have been lost beyond the bounds of even the most ancient history: and look with trembling awe upon the degradation that has followed, the boundless dissipation of the learning of ages, until we are left

only such remnants that our most cultivated imaginations can scarce build a superstructure worthy to raise upon the ruins.

But a new era is opening, the intelligence of later years is spreading over these once fruitful fields, and slowly but surely modern ideas are advancing into the midst of the unknown chaos, and in time will restore the great advantages that have lapsed in the ignorance of ages. The nations of Europe vie with one another to extend their possessions, and in the mad race for precedence are reclaiming even the waste places as footholds by which they hope to reach the power and wealth they see may be developed in the future. Explorers have brought back wondrous tales that have excited the cupidity of those who profit in the barter of nature's products, until vast schemes have been projected to seize the wealth believed to be within easy grasp.

Daring spirits discover new countries, and through the reports of the marvels they have seen, inspire their more cautious countrymen to venture into unknown fields in the hope of gain. The discontented, too, seek isolation and fancied independence in new regions, and thus is formed the nucleus that parent countries seize upon, encourage, and develop into colonies, that in time may revolutionize a continent, and seek a place among the nations of the world. This sequence of events has been gradually progressing in Africa, and has been greatly accelerated by the discoveries of recent years. A large section of the interior has now been opened to trade and colonization in the formation of the "Congo free State." It marks an era in the development of the continent that promises to be fruitful of rapid advance. The Geographic journals have contained many pages of notes during the year, showing the activity of explorers in supplying the Geographical details of the more accessible regions. But there is an area nearly half as large as that of the United States through which the explorer has not yet penetrated; a field of great interest to Geographers, but they may have years yet to wait, before they may read the story.

In the East Indies and among the islands of the Pacific there is still work for the Geographer of the most interesting character, and, indeed, for the explorer too. Those who depend upon charts of the great ocean realize too frequently the imperfect determination of the positions of many of these isolated landmarks, and the dangers surrounding them. This is more properly work for governments than for individuals, and we may hope the day is

not far distant when American officers may again roam the seas in Geographic research, and bring fresh laurels to crown the enterprise of our people.

The great American continent, the New World as it is called, presents an example of progress of which history affords us none similar—a marked instance of the power of intelligent perseverance to conquer in new fields and bring under man's dominion for his use and welfare even some of the elements themselves. The last century has shown a branch of one of the old parent stocks, divorced from many of their traditions and left to themselves, imbued with a spirit of progress that has advanced with such giant strides, that in a generation we have seen more strange things than had come upon the world before in centuries. At the birth of our nation the now populous district on the Ohio and the Great Lakes was the "far west," roamed over by native tribes. The great northwest of to-day was marked upon the maps as "unexplored," and the confines of the continent on the Pacific were known more on the faith of good reports than the knowledge of observation; while that vast territory west of the Mississippi was not known at all, or only through the legends transmitted from the "Fathers" who had partly occupied it in following their holy calling. And yet within half a century explorers have traversed nearly every square mile, science has discovered in it treasures of knowledge that have taught the world; and instead of a vast region of wandering tribes, we find a civilization, energetic, progressive, and still pressing on to reclaim even that which has been considered waste. Indeed, so rapidly have the choice areas been occupied, that it may be but a few years when none will be left, and the question of over-population may press upon us as to-day it presses upon older nations. While this state of affairs may not excite present alarm, it is a matter of congratulation that the Congress at its last session provided the initial step for an exhaustive examination of the great arid region, to determine what portion of it may be reclaimed by irrigation.

And in Alaska the desirability of a better knowledge of our possessions has been emphasized by the fear of international complications on the boundary, which has resulted in a small appropriation by the Congress for surveys, with a view to obtaining a better knowledge of the country, whereby a more reasonable delimitation of the boundary can be made.

It is gratifying to note that the Bureaus of the Government service devoted to the practical development of the economic resources of our great territory, have been conducted during the year with the energy that has marked their progress heretofore. But it is yet too early to place a value upon the special results of the year's work, and I will leave their consideration, therefore, to my successor.

I look upon the publications of the Topographical Surveys of the States of New Jersey and Massachusetts as the most noteworthy Geographic productions in this country of recent years. Massachusetts has been the first State to avail herself of the full facilities offered by the General Government in preparing maps of their territories on working scales, although New Jersey was earlier in the field and obtained all the assistance that could be rendered by the laws in force at the time. The expense of the Survey in Massachusetts has been borne about equally between the State and United States, exclusive of the trigonometrical work; and the total cost to the State being so light, we may hope eventually to see similar, or even more detailed work, undertaken by all the States of the Union. The atlas sheets thus far produced are most pleasing specimens of the cartographer's art, each feature or class of detail having been given a weight that permits easy reading without producing undue prominence in any. In the atlas sheets of New Jersey, published by the State, the same admirable effects have been produced, but in a different style of treatment, the questions involved being more complicated through the introduction of greater detail. Massachusetts is also in the lead in prosecuting a precise determination of town boundaries by a systematic reference of all corner marks to the stations of the triangulation that now covers the State territory. The expense of this work is borne by the State, with the exception of a small amount in salaries to United States officers detailed to execute portions of the work under existing laws. The total cost will probably approximate the total cost of the Topographical Survey, but it is claimed that when completed the great advantages to be derived from it will result in large savings to the people of the State.

Our neighbors in the Dominion of Canada have been active of late years in developing their resources. The completion of the Canadian Pacific Railway has opened a large fertile territory for settlement, and the railway itself promises to become a route for

international traffic in serious rivalry with the transcontinental roads in the United States. Projects have also been formed for a short rail connection to Hudson's Bay, with a view to shipments during the summer direct to Europe—but there seems to be reasonable question of the practicability of such a route. During the past two seasons Canada has also been engaged upon extensive explorations in the Northwest territory, along the boundary line of Alaska. The parties, I learn, are only just returning from their last summer's labors, and it will probably be some time in the winter before we can supplement the chapter of a year ago from this interesting region.

But little advance has been made during late years in solving the mysteries of the Arctic. In the past summer a party has crossed the southern part of Greenland, but advices have not yet come to hand that would indicate the value of the exploration. A second party was organized to follow the east coast of Greenland to the northward, that we may hear from at a later date, although reports already received, if true, would indicate the effort had been baffled by adverse weather. A few months ago an expedition was seriously contemplated by Europeans to the frozen seas of the Antarctic. As it was to have been backed by energetic business men it doubtless would have been amply fitted for its purpose, and we may, therefore, sincerely regret the rumor that the project has been postponed—if not abandoned.

In the Central American States a Congress has been assembled to consider the unification of the States under one general government—a union, the possibility of which has long been discussed, but from the jealousy of rival factions has heretofore seemed impossible of accomplishment; but there is some hope that the labors of the Congress now in session will prove more successful.

Our greatest Geographic interest in these States is centered in the projects for interoceanic canals. The scheme to cut the Isthmus of Panama, undertaken by the eminent French engineer, De Lesseps, has been beset with many difficulties, not the least of them arising from the improvident management of those having immediate charge of the works. It is impossible to foresee the eventual outcome of this great work, as all reports expressing decided views on the subject are suspected of a coloring from the personal opinions of the authors of them. The original plans have been modified to include locks for crossing "a summit level."

This is stated to be only a temporary expedient to secure the opening of the canal at an early date, and that eventually the work will be completed on the original plan of a "through cut." It seems evident from the latest reports that work will be continued as long as money is forthcoming to meet the expenses, and as the modified scheme to overcome the high land by locks instead of a through cut, greatly simplifies the engineering problems, there is a probability of the canal becoming an accomplished fact. A second route by way of the San Juan River and Lake Nicaragua, that has also been under discussion for many years, has recently been energetically advocated by American engineers, with the result of the actual location of a line and careful cross-sectioning during the past year. A company has been formed and obtained a charter from the State of Vermont, and as it is represented to be backed by abundant capital, we may, ere many years, have the gratification of seeing an interoceanic canal opened under American auspices.

Many speculations have been indulged in as to the probable effect of a canal through this Isthmus on the carrying trade of the world, the impetus it might give to the opening up of new commercial relations, and even the effect it may have in advancing our civilization to distant nations. Such speculations are hardly pertinent to this report, but we may well reflect upon the changes that have been wrought since the opening of the canal through the Isthmus of Suez, and conceive, if we can, the leveling up that may accrue to the political divisions of the western world from the same influences that will cut the channel through her Isthmus.

South America has been free from serious agitation until a recent date; although some of the States have not failed to show the usual internal dissensions in political affairs. Late advices intimate a possible difficulty between Venezuela and England relative to the control of a large territory embracing the mouth of the Orinoco River, which, should it result in the permanent occupation of the disputed territory by the European power, may wield a marked influence in the development of this section of the continent.

A project that has long been agitated, to construct a continental railway that would give direct rail communication with the northern continent, has recently been resumed, and we can but hope with an earnestness that will lead to its accomplishment.

Large areas of this interesting country have not yet been revealed to us, nor can we expect to acquire a full knowledge of its Geographic wonders until the means of internal communication have become more assured.

The recent inauguration of a Geographical Society in Peru is also an important step towards our acquirement of more detailed information, and doubtless will redound to the credit of its founders in the interest it will stimulate in kindred societies over the world.

Geology is a science so intimately connected with Geography that I should feel delinquent did I not include a reference to it in this report, however inadequate my remarks may be to do justice to the subject.

To Geographers the origin of the varied distribution of the land and water, the cause and growth of mountains, plains, oceans, lakes and rivers, the great changes that have taken place on the face of the earth in times past, is of absorbing interest, rivaled only by their desire for perfect knowledge of that which may be seen to-day. Had the prehistoric man been gifted with the intelligence of his descendants in the present epoch, he would have left for us a record that would have been valuable indeed and cleared our way of much that now is speculation, and but too often food for words. True it is, however, that if the mysteries of the past were revealed to us we should lose the pleasures their study affords and perhaps there would follow a degeneration of species through the loss of stimulus they now provide. How long ago man lived and might have made a record is still a disputed question, but one that involves too, the record of the earth herself. The association of human remains in the Glacial drift brings that epoch in the earth's history nearer to us by several hundred thousand years, and instead of speculating upon it as having occurred nearly a million years ago, geologists must consider whether it was not probably coincident with the most recent eccentricity of the earth which astronomers teach us happened about ten or fifteen thousand years ago. Geology must also fit her facts to mathematical science if we give credence to latest computations. A mathematician has now advanced the theory that at the average depth of about five miles below the surface there is a belt of "no strain," the result of opposing forces above and below it, a belt that from the nature of the case is impenetrable, through which, what is above cannot pass to what is below, and what is below cannot pass to what is above, a condition that

would confine the origin of all seismical and volcanic disturbances and their consequent Geographical changes, to a mere shell of the crust.* The result of the computation is certainly interesting and we may hope will not be lost sight of in future discussions, however it may share in gaining support or opposition. It is based upon an assumption of the temperature when the earth began to cool, to assume a lower temperature draws the belt nearer to the surface and a higher temperature is believed to be inconsistent with our knowledge of what heat may effect. This belt is stated to be gradually sinking, however, and the computation, therefore, involves a term representing time, and I venture to suggest as estimates of Geologic time are generally indefinite and seem to be inexhaustible, an abundance can probably be supplied to sink the belt deep enough for all theoretical purposes.

More interesting to Geographers are the conceptions of ancient forms suggested by the views recently advanced by Prof. Shaler in a late number of Science (June 15, 1888), on "The Crenitic Hypothesis and Mountain Building." To let the imagination have full play, we may conceive that where we now have extensive mountain ranges, there were formerly great plains of sedimentation, and where we see the process of sedimentation active to-day there may be great mountains in the future. And also in his inquiry into the "Origin of the divisions between the layers of stratified rocks" (Proced. Boston Soc. Nat. Hist., vol. xxiii), we may be carried away with the immensity of the changes suggested. The recurring destruction of submarine life to contribute in the building of the rocks of the Continents: the apparently endless cycles of emergence of the land and subsidence of the waters, to leave the Geographical conditions we see to-day, furnish additional evidence of the wonders of the past and force upon us anew the realization of how little in the great evolution is the epoch in which we live.

American Geologists have advanced the knowledge of the world; only recently the American methods of Glacial study have enabled Salisbury to interpret the terminal moraines of Northern Germany (Am. Jour. Science, May, 1888), and that the Science is active among our countrymen is evidenced by the formation of a Geological Society and the establishment of a magazine de-

* In the American Geologist for February, 1888, Prof. Reade protests against the construction of the theory of a "belt or level of no strain" placing the foci of earthquakes and other disturbances in the strata above the belt.

voted exclusively to its interests. America, too, contributed largely to the Geologic Congress recently held in London, and it is pleasing to note that the next session of the Congress is promised for Philadelphia.

At the suggestion of one of our associates I call the attention of the students of the science, and indeed all interested in it, and also of Geographers, to a recent publication entitled, "The Building of the British Isles," by Jukes-Browne (Scribner & Welford, N. Y.). It has been characterized as the best treatise on the evolution of the land areas which has yet appeared; from the Geologist point of view it is the book of the year. Another associate recommends to most attentive consideration the recent articles on "Three formations of the Middle Atlantic slope," by W J McGee (Am. Journal Science, Feb.-June, 1888), as one of the most original essays of recent years.

It also gives me great pleasure to bring to your attention an article on the "Physical Geography of New England," by Wm. M. Davis, in a book on the "Butterflies of New England," by S. H. Scudder. It is hardly necessary to recommend this publication to your perusal, as I doubt not being from the pens of our Associates, it will excite a lively interest in those devoted to these sciences.

In conclusion permit me to refer briefly to the "National Geographic Magazine," published by the Society, the first number of which has recently been placed before you. It is the desire of the Committee having charge of this publication to make it a journal of influence and usefulness. There is abundant material in the Society to furnish the substance, if those who have it at command will make legitimate use of their opportunities. It would be unfortunate if the text should be confined to the papers presented to the Society. It was not the intention of the Board of Managers that such should be the case, when the publication was determined upon. On the contrary, it was the expectation that there would be original communications from many sources: essays, reviews and notes on the various subjects of the five Departments in which the Society is organized, not necessarily from the members, but also from their friends interested in these divisions of the general subject. While this expectation has been realized in a measure, there is room for improvement and it is hoped the future will show an increasing interest and more generous contributions.

December, 1888.

REPORT—GEOGRAPHY OF THE SEA.

By George L. Dyer.

In presenting to the National Geographic Society this first annual summary of work accomplished in the domain of the Geography of the Sea, I find it impossible satisfactorily to limit the range of subjects that may be assigned to it. The great ocean is so large a factor in the operations of Nature, that the attempt to describe one of its features speedily involves the consideration of others lying more or less in that shadowy region which may be claimed with equal force by other sections of the Society. It is to be understood, therefore, that the following account merely touches upon several of the characteristics of the oceanic waters, and is not in any sense an attempt to treat them all.

This being the first report to the Society it has been thought advisable to give a brief outline of the progress made in our knowledge of the sea since 1749, when Ellis reported depths of 650 and 891 fathoms off the north-west coast of Africa. Even at that time an apparatus was employed to lift water from different depths in order to ascertain its temperature. It does not appear that this achievement gave impetus to further efforts in this direction, for, except some comparatively small depths and a few temperatures recorded by Cook and Forster in their voyage around the world in 1772–75, and in 1773 by Phipps in the Arctic, at the close of the last century there was but little known of the physical conditions of the sea.

At the beginning of the present century, however, more activity was shown by several governments, and expeditions sent out by France, England and Russia, in various directions, began to lay the foundation of the science of Oceanography.

Exploration of little known regions was the main purpose of most of these expeditions, but attention was paid also to the observation and investigation of oceanic conditions, so that accounts of soundings, temperatures of sea water at various depths, its salinity and specific gravity, the drift of currents, etc., form part of their records.

The first to give us a glimpse of the character of the bottom at great depths was Sir John Ross, the famous Arctic explorer.

While sounding in Ponds Inlet, Baffin Bay, in 1819, by means of an ingeniously constructed contrivance called a deep sea clam, he succeeded in detaching and bringing up portions of the bottom from depths as great as 1,000 fathoms. The fact that this mud contained living organisms was the first proof of life at depths where it was thought impossible for it to exist. The truth of this discovery, however, was not generally accepted, many eminent men of science on both sides of the Atlantic contending for and against it, and the question was not finally settled until long afterward, in 1860, when, by the raising of a broken telegraph cable in the Mediterranean, unimpeachable evidence of the existence of life at the greatest depths in that sea was obtained. The science, however, remained in its infancy until about 1850, when Maury originated his system of collecting observations from all parts of the globe, and by his indomitable energy aroused the interest of the whole civilized world in the investigation of the physical phenomena of the sea.

Through Maury's efforts the United States Government issued an invitation for a maritime conference, which was held in Brussels in 1853 and attended by representatives of the governments of Belgium, Denmark, France, Great Britain, Netherlands, Norway, Portugal, Russia, Sweden and the United States. The main object of the conference, to devise a uniform system of meteorological observations and records, was accomplished. According to the agreement, ships' logs were to have columns for recording observations of the following subjects: latitude, longitude, magnetic variation, direction and velocity of currents, direction and force of wind, serenity of the sky, fog, rain, snow and hail, state of the sea, specific gravity and temperature of the water at the surface and at different depths. It was also proposed that deep-sea soundings should be taken on all favorable occasions, and that all other phenomena, such as hurricanes, typhoons, tornadoes, waterspouts, whirlwinds, tide-rips, red fog, showers of dust, shooting stars, halos, rainbows, aurora borealis, meteors, etc., should be carefully described, and tidal observations made when practicable.

The practical results of this conference were great. The systematic and uniform collection of data by men of all nations is going on uninterruptedly to-day, and is furnishing the means for the solution of many of the problems relating to the Geography of the Sea.

An epoch in the progress of this science is marked by the appearance of Maury's Wind and Current Charts, his Physical Geography of the Sea, and his Sailing Directions, which contain the record of the first deep soundings taken by United States vessels; and to the United States, through Maury's efforts, belongs the honor of having inaugurated the first regular cruise for the purpose of sounding in great depths.

Under the instructions of Maury the U. S. brig Dolphin, commanded by Lieutenant Lee, and subsequently by Lieutenant Berryman, was detailed in 1851–3 to search for reported dangers in the Atlantic, and to sound regularly at intervals of 200 miles going and returning. The Dolphin was provided with Midshipman Brooke's sounding apparatus and with it succeeded in obtaining specimens of the bottom from depths of 2,000 fathoms. About the same period the U. S. ships Albany, Plymouth, Congress, John Adams, Susquehanna, St. Louis and Saranac also made soundings in various localities, and to the U. S. S. Portsmouth, in 1853, belongs the honor of having reported the first really deep-sea sounding obtained in the Pacific, 2,850 fathoms, in about 39° 40′ N., and 139° 26′ W.

The practicability of this work was thus fully demonstrated, and, although some of the earlier results, through defective appliances and lack of experience, were not entirely trustworthy, its character and success will always be a tribute to American enterprise and ingenuity.

With the advent of the submarine telegraph the investigation of the depth and configuration of the ocean bed became of vital importance, and the work of sounding for that purpose was taken up with activity; one of the first voyages in the interest of these projects was that of the U. S. S. Arctic, under the command of Lieut. O. H. Berryman, in 1856, between St. Johns, Newfoundland, and Valentia, Ireland.

The civil war naturally put a stop to these operations by United States ships. The U. S. schooner Fenimore Cooper was about the last engaged in this work, sounding in 1858–59 in the Pacific to 3,400 fathoms, and also reporting a sounding of 900 fathoms only ¾ of a mile west of Gaspar Rico Reef, in about 14°41′ N. and 168° 56′ E.

The work so well begun by the Americans was quickly taken up by other governments, and we find from that time to the present, the records of a large number of expeditions for diverse scien-

tific observations in all parts of the world. Continued improvements in the appliances and instruments have made the results more precise than was possible in the earlier times, and, as the data accumulate, the bathymetric charts of the oceans are becoming more accurate. Not until this work is much further advanced, however, shall we be able to arrive at an estimate of the depths and weights of the oceans at all comparable to our knowledge of the heights and weights of the various great land masses above sea level.

Other important results of these expeditions have been the verification of many reported elevations of the ocean bed formerly considered doubtful, the discovery of new ones, and proof of the non-existence of others, which had been reported as dangers to navigation.

The Geography of the Sea reached a decidedly more advanced stage by the inception of several great scientific expeditions, of which that of the Lightning, in 1868, to the Hebrides and Faroe Islands, under the superintendence of Professors Carpenter and Wyville Thompson, was the forerunner. This was followed by the three years' cruise of the Challenger (Br.) in 1873–75, the Tuscarora (Am.) in 1874, and the Gazelle (Ger.) in 1875, by those despatched under the authority of the U. S. Coast Survey and of the U. S. Fish Commission, and others of lesser importance, sent out under the auspices of European governments, and by private individuals. All of these have contributed in an eminent degree to the progress of the science by giving us a better understanding of the physical and biological conditions of the sea at all depths. Special mention must be made of the splendid work that is being done continually by the expeditions sent out by the U. S. Fish Commission. This branch of the United States service, originally established for the investigation of the causes of the decrease in the supply of useful food fishes and of the various factors entering into that problem, in pursuance of these objects has been prosecuting a detailed inquiry, embracing deep-sea soundings and dredging, observation of temperatures at different depths, transparency, density and chemical composition of sea-water, investigation of surface and under currents, etc.; in other words, making a complete exploration of the physical, natural and economic features of the sea, besides collecting a large number of specimens of natural history. The expeditions sent out by this Commission have brought to light from the deep beds of the ocean an ex-

traordinary variety of animal life, previously unknown to science. Few vessels have furnished a greater number of deep-sea soundings than the F. C. S. Albatross. This steamer has explored fishing grounds on the east and west coasts of the continent; and since the beginning of last year has made a cruise from the North to the South Atlantic along the east coast of South America, through Magellan Strait, and northward along the west coast to Panama and the Galapagos Islands, and thence to San Francisco and Alaska; the scenes of her latest operations have been the plateau between the Alaskan coast and Unalaska and the banks off San Diego, California.

A large share in the progressive state of the science of the Geography of the Sea must also be credited to the systematic collection of marine observations by the Hydrographic Offices and other institutions all over the world. This forms the stock from which, as I have already indicated, must be drawn, through intelligent reduction and deduction, a better knowledge of the intricate laws governing the various phenomena of the sea and air.

Oceanic Circulation.

The existence of currents in certain localities was known at a very early date, and navigators in their voyages to the new world soon discovered the Gulf Stream and other currents of the Atlantic. The first current charts were published more than two hundred years ago. Theories were soon advanced to explain the causes, one group of scientific men attributing the origin of currents to differences of level produced by an unequal distribution of atmospheric pressure over the oceans, another set connecting the tidal phenomena with the cause of ocean currents, and still another finding in the rotation of the earth a sufficient reason for their existence. The polar origin of the cold deep water found in low latitudes has long been considered probable, and has given rise to a theory of a general oceanic circulation in a vertical and horizontal direction, produced by differences of temperature and density. Recent theoretical investigations, however, seem to indicate that these causes alone are incapable of producing currents, and, to-day, the theory that the winds are mainly responsible for all current movements very largely predominates. Benjamin Franklin was probably the first who recognized in the trade winds the cause of the westerly set in the tropics, and Ren-

nel soon after made the division of drift and stream currents. The objections which have appeared against the wind theory have been met with the reply that the present state of oceanic movements is the result of the work done by the winds in countless thousands of years.

Current phenomena is briefly summarized as follows by one of the latest authorities on the subject :

1. The greater portion of the current movement of the ocean must be regarded as a drift, produced by the prevailing winds, whose mean direction and force are the measures for the mean set and velocity of the current.

2. Another group of currents, and in fact a fraction of all currents, consists of compensating or supply streams, created by the necessity of replacing the drifted water in the windward portion of the drift region.

3. A third group results from drifts deflected by the configuration of the coasts ; these which are denominated free currents, quickly pass into compensating streams.

4. The deflecting force of the rotation of the earth is considered as of subordinate importance, but may have some influence on currents that are wholly or in part compensating or free.

Late investigations of the Gulf Stream by the U. S. Coast Survey give interesting facts in regard to that notable current.

A satisfactory explanation of the cause of the stream has not yet been found, but many believe, with Franklin, that the powerful trade drift entering the Gulf of Mexico through the broad channel between Yucatan and Cuba presses the water as a strong current through Florida Strait, where the stream is turned to the northward along the coast. Since 1850 American naval officers have added greatly to our knowledge of the characteristics of this stream, particularly within the last decade, during which notable investigations have been carried on by Commanders Bartlett and Sigsbee and Lieut. Pillsbury, U. S. N., under the direction of the U. S. Coast Survey, and by Lieutenant Commander Tanner, U. S. N., in the Fish Commission steamer Albatross.

Of special importance are the valuable and interesting results in regard to tidal action in the stream obtained by Lieut. Pillsbury, U. S. N., in the Coast Survey steamer Blake, from observations begun by him in 1885 at the narrowest part of Florida Strait, between Fowey Rocks and Gun Cay (Bah.), and continued

since between Rebecca Shoal and Cuba, and between Yucatan and Cape San Antonio (Cuba), and off Cape Hatteras.

During the past year Lieut. Pillsbury extended the field of operations to the passages between the islands encircling the Caribbean Sea, and in order to study the Atlantic flow outside the limits of the trade drift a station was to have been occupied about 700 miles to the north-east of Barbados; this, however, was unfortunately prevented by bad weather.

The deductions from the observations in Florida Strait showed very clearly a *daily* and a *monthly* variation in the velocity of the stream, the former having a range of 2¼ knots, and reaching a maximum on the average about $9^h\ 9^m$ before and $3^h\ 37^m$ after the moon's upper transit, and the monthly variation reaching its maximum about two days after the maximum declination of the moon. The variations in this section were found greater on the western than on the eastern side of the strait, and the axis of the stream, or position of strongest surface flow, was located by Lieutenant Pillsbury 11½ miles east of Fowey Rocks, and, farther north, about 17 miles east of Jupiter Light. The average surface current at this section was 3⅞ knots, the maximum 5¼ knots, and the minimum 1¾ knots per hour. The results also indicate that when the current is at its maximum the surface flow is faster than at any depth below it, but when at its minimum the velocity at a depth of 15 fathoms or even down to 65 fathoms is greater than at the surface, and that there is at times a current running south along the bottom in all parts of the stream except on the extreme eastern side.

The results of the investigations in 1887 and 1888 have not yet been published, but from information kindly furnished by the authorities of the Coast Survey, I am able to give a brief outline of the more prominent facts ascertained.

In the section between Rebecca Shoal and Cuba the daily variation in velocity was found as prominent as in Florida Strait, the mean time of eight maxima corresponding to $9^h\ 18^m$ before, and that of three maxima to $3^h\ 25^m$ after the moon's transit. The axis of the stream in this section was found near the center of the current prism, and the flow was easterly and inclined on either side toward the axis. The axis seemed to occupy a higher level than other parts of the stream, and this appears to be borne out by the fact that about half the number of the current bottles thrown out in Florida Strait on the west side of the axis were re-

covered along the east coast of Florida, while of those thrown out east of the axis not a single one was heard from. As a rule it was found that the stronger the current the more constant the direction and the deeper the stratum. Remarkable fluctuations in the flow near the axis were noted, the velocity increasing sometimes one knot in ten or fifteen minutes, and then as suddenly decreasing again. Lieutenant Pillsbury attributes this, however, to a serpentine movement of the maximum flow, which would sometimes strike the station occupied by the Blake. The edge of the stream was found at about 30 miles south of Rebecca Shoal light-house.

Between Yucatan and Cape San Antonio the stream was found flowing about north, and the line of maximum velocity corresponds on the average to 10^h before and to $2^h\ 20^m$ after the moon's transit. The excessive variations were like those in Florida Strait, on the west side of the stream, and the maximum velocity of 6¼ knots was found about 5 miles off the 100-fathom line of Yucatan Bank. The eastern edge of the stream lies about 20 miles west of Cape San Antonio, and between this edge and the island, eddy currents exist. At the time the easternmost station in this section was first occupied, the declination of the moon was low and the set of the surface current north-easterly. At a high south declination of the moon the surface current was found south-easterly in direction, and east or south-east below the surface. The normal flow below the surface was in each case from the Gulf into the Caribbean Sea, and this makes it probable that the station was situated inshore of the average limit of the stream. On Cape San Antonio Bank the currents are tidal, flood running northward and ebb southward. On the Yucatan Bank the currents were also tidal, but as the edge of the bank is approached the stronger flow of the Gulf Stream predominates. The monthly variation in velocity, which was found clearly defined at the first two sections occupied, appeared at this section to be obliterated by anomalies not existing at the former.

Off Cape Hatteras the Blake accomplished the remarkable feat of remaining at anchor in 1,852 fathoms, and this with a surface current of over 4 knots. Two stations were occupied, and similar variations in velocity were observed as at the other stations. The notable feature at this station was the discovery of tidal action beneath the Gulf Stream, the currents at 200 fathoms depth changing their direction very regularly, the average current flow-

ing about S. S. E. ½ E. for 7 hours and N. N. W. ¼ W. for a little over 5 hours.

The first section investigated in 1888 was in the equatorial drift between Tobago and Barbados, where seven stations were occupied. The axis of the stream was found west of the middle, or nearer the South American shore, and the average direction was towards the north. At none of the stations did the current set in the direction of the wind, although the trades were blowing at all times with a force of from 2 to 7. The daily variation was also here very pronounced, the average time of maximum flow occurring about 5^h 58^m after the moon's transit. At 65 and 130 fathoms depth the current, at three of the stations occupied, was north-westerly; at one south-easterly. The velocity at 130 fathoms was greater than at 65 fathoms, and greater at the surface than at 15 and 30 fathoms.

At all of the three stations between Grenada and Trinidad tidal action was observed, with deflections due to local influences.

The passage between Santa Lucia and St. Vincent appears to be in the line of the equatorial stream. At each of the five stations in this passage tidal action was pronounced, the currents setting in and out of the Caribbean Sea at some depth. The daily variation in this passage reaches a maximum at about 6^h 3^m after the moon's transit, and a minimum when the moon is on the meridian. The currents entering the Caribbean Sea through this passage are but 100 fathoms in depth, but there is probably an almost equal volume flowing out below that depth.

Between the Windward Islands the currents flow generally westward, but tidal action is everywhere apparent.

To the east of Desirade the currents at all observed depths have a northerly direction, fluctuating between about N. E. by E. to N. W. by N.

In the eastern part of the Anegada Passage the surface current flows into the Caribbean Sea in directions varying between S. S. W. and S. E., but the submarine current down to 130 fathoms flows in a direction lying between north and east.

In the more western part of the passage the currents are more complex, apparently on account of the greater variations in depth in the vicinity of the station occupied.

In the Mona Passage no regular currents were perceptible. Between Mona and Puerto Rico the currents observed set out of the Caribbean Sea, varying in direction from about W. by N.

to E. N. E., except at 65 fathoms depth, where there appeared to be an inward flow. On the western side of the passage, near Santo Domingo, the direction of the currents was between S. S. E. and S. W. by W. But few observations could be taken on account of unfavorable weather.

In the Windward Passage, on the western side the currents from the surface down to 130 fathoms set in the directions lying in the S. E. quadrant, and at 200 fathoms the direction changed to W. by S. On the eastern side the surface current varied between E. N. E. and E. S. E., with about ½ knot velocity. Variations in the direction similar in extent characterized also the subsurface currents in the middle and on the eastern side of the passage.

The average of the observations at these three stations gives but a small volume of water passing in either direction.

In the old Bahama Channel, at the station north of Cayo Romano (island off the north coast of Cuba) the currents at and near the surface set south of east; at 65 fathoms, however, the direction varies from about N. W. to E. The deeper current of great volume flowed continually to the north of west with a velocity of over 1½ knots at depths of 130 and 200 fathoms.

Outside the Bahamas, to the north of Great Abaco, a slight current flows about N. W. on the surface and down to 30 fathoms; at 65 fathoms depth the direction changes to a point more westerly, and at 130 fathoms to a point more easterly than the set of the surface current. The maximum in the daily variation at this station occurs about 12^h after the moon's transit.

The observations so far as completed by Lieutenant Pillsbury furnish the most valuable data we have at present concerning the Gulf Stream, and it is hoped that further investigation and the analytical treatment of these observations will clearly develop the dynamic laws involved and lead us to a correct theory of current phenomena in general.

Tidal Phenomena.

The causes for many of the inequalities in the tidal elements observed at different places have not yet been satisfactorily explained. The phenomena are dependent on many purely terrestrial conditions. While we are able to ascertain with tolerable accuracy from certain constants, derived from observation, the times and heights of the tides, the problem to compute theoret-

ically the tides of an ideal ocean of known depth and configuration remains still unsolved. According to Ferrel our present knowledge of tidal phenomena is comparable to that possessed 2,000 years ago of the science of astronomy.

Temperature of the Sea.

The temperature of sea water had already been observed by Ellis, in 1749, in the Atlantic, and subsequent expeditions have furnished a great number of temperature observations in various seas and for various depths. The diversity of instruments and of methods employed by the earlier observers, and the faulty methods of recording, have made the uniform reduction of many of these observations difficult or impossible. The most complete and valuable collection of these older observations up to 1868, with an account of the instruments and methods used by each observer, was published by Prestwich, in 1876, in the Philosophical Transactions, Vol. 165.

With the advent of the great scientific expeditions, which were supplied with modern and refined instruments, our knowledge of the thermal conditions of the sea has progressed immensely, and we are now able to construct charts of all the oceans, showing the distribution of the isotherms with considerable accuracy.

The annual average surface temperature has been found higher in the Indian Ocean than in either the Atlantic or Pacific; the North Atlantic is slightly warmer than the North Pacific, but the South Pacific is warmer than the South Atlantic; this holds generally good also for the temperatures between surface and bottom.

The temperature generally decreases more or less rapidly from the surface down to about 500 fathoms, at which depth it is quite uniformly between 39° and 40° F. From that depth it decreases slowly towards the bottom: in the Polar seas to between 27° and 28° F.; in the middle and higher latitudes of the northern hemisphere and at depths of 2,000 to 3,000 fathoms, to between 34° and 36° F.; at the equator and in southern latitudes it remains in the neighborhood of 32° F.

The low temperatures at the bottom are thought to be due to a steady but slow circulation of water from the Polar seas towards the equator, and, where the circulation is most free and unobstructed, as in the South Atlantic, South Pacific and Indian Ocean, the bottom temperature is slightly lower than in the North Atlantic and North Pacific, both of which are connected with the Polar Sea by comparatively narrow and shallow straits.

The theory of this circulation from the Polar seas is greatly strengthened by the facts appearing from the investigation of the bathymetric isotherms in inclosed seas, i. e., seas which are separated from the deep oceans by submarine barriers. In such seas the temperature decreases slowly from the surface down to the depth of the barrier, and from there on remains constant to the bottom.

The influence of currents on the surface temperature is very marked, cold currents bending the isothermal lines towards the equator, and warm currents bending them towards the poles. The seasonal changes in surface temperatures are considerable, being the least in the tropical zones.

In the *Atlantic Ocean* the maximum surface temperature lies near the coast of South America, between Para and Cayenne, and another maximum occurs near the west coast of Africa, between Freetown and Cape Coast Castle.

The *Pacific Ocean* shows the peculiarity that the surface temperatures on the western side are lower than those on the eastern side. Between 45° N. and 45° S. the temperature does not fall below 50°, but between those parallels and the poles it remains most always below that figure.

The warmest water is found in the *Red Sea* where the surface temperature has been recorded as high as 90°. North of the equator the mean annual temperature is considerably above 80°, but south of it, to about the parallel of 25°, it varies from 80° to 70°.

Chemical Composition, Salinity and Density of Sea Water.

In this branch of inquiry great progress has been made, and sea water is now known to contain at least 32 elementary bodies. Its chief constituents are found to consist of the chlorides and sulphates of sodium, magnesium, potassium and calcium. It also contains air and carbonic acid.

The salinity and density of sea water have been investigated very thoroughly, particularly in the Atlantic. As the salinity of the sea water is an index of its density, changes in the former naturally affect the latter. The salinity has been found generally to decrease in the neighborhood of coasts, where rivers discharge their water into the sea, and it is a maximum in the trade zones, and a minimum in the equatorial rain belt. The salinity is

affected by the degree of evaporation and by the frequency of rainfall, and is now recognized as an important factor in the biologic conditions of the sea.

Of the three great oceans, the Atlantic, with a salinity of 3.69 per cent., shows a slight preponderance over that of the Pacific and Indian Ocean, whose average salinity is 3.68 and 3.67, respectively.

In the trade belts the great evaporation augments the salinity, and hence, also, the density, and in the polar zones the formation of ice brings about the same result, though in a lesser degree. In the equatorial calm region the frequent rainfall diminishes salinity and density through the dilution of the salt water. Density and salinity are thus in a certain degree subject to seasonal changes.

In the *Atlantic* the density increases in general from the higher latitudes towards the equator, but the maxima are separated by a zone of lesser density. The maximum in the North Atlantic ocean is found between the Azores, the Canaries and the Cape Verde Islands, and the minimum between the equator and 15° N.

In the South Atlantic two maxima occur, one to the north of Trinidad, and the other near St. Helena and between that island and Ascension.

Taking pure water at 4° C. for unity, the maximum density in the Atlantic is 1.0275 and in the Pacific, 1.0270.

In the *North Pacific* the maximum density occurs between 30° and 31° N., and the minimum in about 7½° N., in the equatorial counter current, where it was found as low as 1.02485.

In the *South Pacific*, which has a slightly greater density than the North Pacific, the maximum has been found in the vicinity of the Society Islands.

The density of the waters of the *Indian Ocean* is not yet as well known as that of the Atlantic and Pacific, but the results ascertained indicate a lesser density in its northern part, with a maximum in the region between 20° and 36° S. and long. 60° to 80° E.

In the vicinity of Java and Sumatra, probably on account of the extreme humidity of the atmosphere and of frequent rainfall, the density has been found as low as 1.0250.

In regard to the density of the water at various depths, it has been ascertained that as a general rule it decreases from the surface down to about 1,000 fathoms, after which it increases again

slowly to the bottom. In the equatorial calm regions, however, where the heavy rains dilute the surface water, the density decreases from the surface down to between 50 and 100 fathoms, after which it follows the law found for other parts of the ocean. The bottom densities of the South Atlantic and Pacific have been found about alike, varying only from 1.02570 to 1.02590; those of the North Atlantic, however, show a greater value, varying from 1.02616 to 1.02632.

Greatest Depths of the Oceans.

Atlantic.—Rejecting some of the earliest soundings as untrustworthy, the greatest known depth in the North Atlantic is to the north of the island of Puerto Rico, in about latitude 19° 39′ N., longitude 66° 26′ W., found by the C. S. S. Blake, Lieut. Commander Brownson, U. S. N., in 1882–83, 4,561 fathoms.

The deepest known spot in the South Atlantic is 3,284 fathoms, in about latitude 19°·55′ S., longitude 24° 50′ W., sounded by the U. S. S. Essex, Commander Schley, in 1878.

The general run of the soundings indicates that greater depressions exist nearer the western than in the eastern or middle part of the Atlantic, North and South.

Pacific.—In the North Pacific the greatest depression has been found by the U. S. S. Tuscarora, Commander Geo. E. Belknap, U. S. N., in 1874, 4,655 fathoms, in latitude 44° 55′ N., longitude 152° 26′ E. The next deepest sounding in the North Pacific was located by the Challenger in 1875, 4,475 fathoms, in latitude 11° 24′ N., longitude 143° 10′ E. As in the Atlantic, the greater depths appear to exist in the western part and particularly off the coasts of Japan.

In the South Pacific the greatest depths were supposed, up to a recent period, to be in the eastern part. Within the last two years, however, the British surveying vessel Egeria has discovered greater depressions in the western part of the South Pacific, one spot sounding 4,430 fathoms in latitude 24° 37′ S., longitude 175° 08′ W., and another, 12 miles farther south, 4,298 fathoms.

Indian Ocean.—In this ocean the greatest depths appear to exist to the north and west of the Australian continent, where there are more than 3,000 fathoms in a number of widely separated spots, indicating a depressed area of considerable extent.

In the most southerly part of the Indian Ocean, or rather in the

Antarctic region, the Challenger obtained, in 1874, a maximum depth of 1,073 fathoms, in latitude 65° 42′ S., longitude 79° 49′ E.

ARCTIC OCEAN.—The greatest depth was sounded by the Sofia in 1868, 2,650 fathoms, in latitude 78° 05′ N., longitude 2° 30′ W.

In the minor seas the maximum depths so far as ascertained are:

Caribbean Sea	3,452 fms.,	south of Great Cayman.
Gulf of Mexico	2,119 "	(Sigsbee Deep).
Mediterranean	2,170 "	
North Sea	375 "	
Baltic	178 "	
China Sea	2,100 "	
Coral Sea	2,630 "	
Sulu Sea	2,550 "	
Celebes Sea	2,600 "	
Banda Sea	2,800 "	

January, 1889.

REPORT—GEOGRAPHY OF THE AIR.

By A. W. Greely.

In presenting to the National Geographic Society a summary of geographic advance as regards the domain of the air, the Vice-president finds a task somewhat difficult. The traveler passes from the east to the west coast of Africa, and his very efforts to struggle across that great continent, impress in his memory an abiding picture of the physical features of the country over which he has passed, and of the distribution of plants and animal life. So, too, a vessel sails from one coast to another, casting here and there a sounding lead, from which measurements it is possible to give quite a definite idea of the relief features of the bottom of the sea.

Small as are the traces which serve to indicate the character of the sea bottom, yet they are infinitely greater than those which enable us to give a description of the air. Atmospheric disturbances are so vast, and their action is so rapid, that it requires the attentive care of thousands of observers before one can well hope to draw the roughest figure of a passing storm. To note changes in the force and direction of the wind, to note the depth of the rain, the increase and decrease of temperature and the varying changes of aqueous vapor, either in visible or invisible form, requires millions of careful, systematic observations, and then when these are made, the task of collating, elaborating and discussing them seems almost too great for any man. Fortunately the value of meteorological work has impressed itself not only upon governments, which have assisted liberally by appropriations and organization, but yet more upon the isolated observer, thousands of whom over the face of the earth give of their time and labor, and add their mite to the wealth of universal knowledge.

In connection with all great physical questions, there is at times a tendency to application to special phases somewhat to the exclusion of others. While it can hardly be said that scientific and theoretical discussion of meteorology has been unduly neglected during the past year, yet it is evident that the greatest activity of meteorologists has been devoted to climatological investigation, and compilations of this character have been par-

ticularly numerous during the past year—not in the United States and Europe alone, but throughout the whole world.

The growing practical importance of meteorological researches has been lately evidenced perhaps in no more striking way than in the establishment in Brazil of a most extensive meteorological service, created by a decree of the Imperial government on April 4, 1888. A central meteorological institute, under the Minister of Marine, is to be the centre for meteorological, magnetic and other physical researches, and observations are to be made at all marine and military establishments in the various provinces, on the upper Amazon, in Uruguay, and on all subsidized government steamers. This service should soon be fruitful in results, as the meteorology of the interior of Brazil is almost absolutely unknown.

Another vast scheme has originated in Brazil in the Imperial Observatory of Rio Janeiro. Señor Cruls, its director, contemplates a dictionary of the climatology of the earth, giving monthly means and extremes of pressure, temperature, rainfall, wind, etc. This scheme, of course, can be successful only by international co-operation. The United States Signal Service has pledged its aid as regards this country.

The former tendency among Russian meteorologists to devote their greatest energies to climatological compilations has gradually given way to other practical work in connection with weather and storm predictions, as shown by the institution by the Russian government of a system of storm-warnings for the benefit of vessels navigating the Black Sea.

Blanford has put forth an important paper, which partially elucidates the very intricate question of diurnal barometric changes, particularly bearing on the relation of the maximum pressure to critical conditions of temperature, cloudiness and rainfall. The question viewed in a negative light by Lamont, as to whether the maximum barometric pressure could be attributed to the greatest rate of increase in the temperature of the air, due, it is supposed, to the reactionary effect of the heated and expanding air, has been re-examined by Blanford, whose conclusions are somewhat in favor of this theory.

S. A. Hill has treated of the annual oscillation of pressure, so noticeable in India, and in so doing has investigated the changes of pressure for three levels, up to a height of 4500 meters. The reduction of monthly barometric means at high levels, hav-

ing regard to the vertical distribution of temperature, shows a double oscillation in the annual curve at the level of Leh, which becomes a single one at the height of 4500 meters, while this is substantially the reverse of the oscillation observed below.

The subject is also treated in another way by Mr. Hill, through analysis of normal monthly means for all India, whereby he succeeds in presenting a formula, the first periodic terms of which represent the two principal factors of the oscillation.

Mr. Hill has also discussed elaborately the anomalies in the winds of northern India in their relation to the distribution of barometric pressure. The anomalies are:—(1) in the hot season the wind direction frequently shows no relation to the barometric gradient; (2) the winds over the plains show little or no relation to pressure gradients, but an obvious one to temperature, being greatest where the temperature is highest.

It is pointed out as highly probable that the copious snowfalls of the late winter in the northwest Himalayas not only produce low temperatures on the Himalayan ranges, but subsequently cause dry northwesterly winds over northern and western India, and on this supposition, reliable forecasts of the character of the coming rainy monsoons have been made for a number of years. Convection currents between upper and lower air strata, it is suggested by Koppen, explain diurnal variations in wind velocity and direction. At low stations the maximum velocity occurs at the time of the highest temperature, while at high stations the reverse obtains. Hill has examined into an important point connected with this subject, that is, the great local differences in the vertical variation of temperature. Hill concludes by saying that high pressures at low levels are the result of low temperatures, and in connection with the fact that wind directions are largely influenced by the irregular distribution of pressure at high levels, it is more important to know the abnormal variations of pressure at the highest hill stations in India than those in the plains.

Overbeck has lately published a paper on the apparent motions of the atmosphere, in which he clearly and admirably outlines the treatment of the dynamics of the air by his predecessors. He comments on the mode of treatment of Ferrel, as well as those of Guldberg and Mohn. Overbeck then sets forth his own method, and elaborately discusses the influence of the earth's rotation with reference to the resistances which oppose the motion of the atmosphere. He touches on the effect produced by rapidly moving

fluid entering fluid at rest, the development of discontinuous (so called by Helmholtz) currents, the tendency of parallel currents of unequal velocities towards similar velocities, the effect of friction arising from contiguous currents of different velocities, upon the coefficient of friction, of the temperature distribution over the surface of the earth, etc. He derives three very simple expressions for the motions of the air; the first giving the velocity in a vertical direction at any point, in terms of latitude, and a constant and factor depending on the distance of the point above the surface of the earth. The other expressions give the velocities in a north or south direction, and in an east or west direction, also in terms of constants and latitude. The velocity when charted from Overbeck's equations indicate an ascending vertical current from the equator to 35° north, and thence a descending current to the pole. The meridional current at the equator and pole are zero, and have a maximum value at latitude 45°.

Ciro Ferari, from long and important investigations of thunder-storms, shows that these phenomena invariably attend motionless areas of low pressure, and believes the surest elements for predicting such storms will be found to be the peculiarities in distribution of temperature and absolute humidity. He observes that the storm front invariably tends to project itself into the regions where the humidity is greatest, and that hail accompanies rapidly moving storms of deep barometric depression. Ferari considers the chief causes of thunder storms to lie in the connection of high temperature and high humidity. Grossman believes that ascending moist-laden currents are the cause of thunder storms, and hence they are most frequent when the temperature diminution with altitude is very great, so that the over-heating of the lower air strata in the warmest part of the day is the cause of the primary maximum of thunder-storm frequency.

Abercromby and Hildebrandsson have renewed their recommendations for a re-classification of clouds in ten fundamental types, in which the first part of the compound name, such as cirro-stratus, cirro-cumulus, etc., is to be in a measure indicative of the height of a cloud.

Hildebrandsson has charted the differences of monthly means of air pressure for January, 1874 to 1884. In January, 1874, the values at nearly all the stations in the Northern Hemisphere, were plus, and those in the Southern, minus. It is to be hoped that such general discussions of this important meteorological element may be continued.

General A. Von Tillo has determined, by means of the planimeter, the distribution of temperature and pressure from Teisserene de Bort's charts. The mean pressure over the Northern Hemisphere for January, he finds to be 29.99 inches (761.7 millimeters), and the temperature 46°.9 (8.3 C.); in July, 29,806 (758.5 mm.) and 72°.7 (22°.6 C.). In Russia he finds an increase of one millimeter of pressure to correspond with a decrease of 1°.6 C. in temperature.

Doberck, after investigation of September typhoons at Hong Kong, attributes their appearance to the relatively low pressure then existing between Formosa and Lyon.

The valuable and elaborate investigation of American Storms, by Professor Elias Loomis has been completed. Loomis has thoroughly discussed barometric maxima and minima areas as presented by the maps of the Signal Service, from which it appears that these areas are in general elliptical, with the longest axis nearly twice that of the shortest in the high areas, while the difference is less in low areas. He has also investigated the winds relative to baric gradients, thus affording valuable data for proving various meteorological theories. Loomis' researches regarding the movement of maximum areas verify those which have been set forth from time to time in Signal Service publications; wherefrom it appears that high areas have a more southerly movement than low areas.

Van Bezold has put forth a memoir on thermodynamics, while Helmholtz, Oberbeck, and Diro-Kitso have contributed valuable memoirs on motions caused by gravitation and the varying density of the air. These furnish meteorologists with important results as to the laws of fluid or gaseous motions. It is gratifying to Americans to note that the valuable results obtained by Ferrel in his many memoirs are confirmed by these later investigations.

Undoubtedly the most important meteorological event within the past year was the discontinuance, on January 1, 1888, of the system of International Simultaneous Meteorological reports inaugurated in accordance with the agreement of the conference at Vienna in September, 1873. As the charts of storm tracks, based on these observations, have been published by the United States Signal Service one year behind the date of the observations, the completion of this work in printed form for the general public should occur about December 31, 1888.

A few remarks in connection with this unparalleled set of observations may not be out of place. The congress which agreed upon this work, met in accordance with invitations issued by the Austrian Government in September, 1873. The co-operation decided upon at this congress took practical shape January 1, 1874, at which date one daily simultaneous report was commenced from the Russian and Turkish Empires, the British Islands, and the United States: the energetic co-operation of those nations being assured through Professor H. Wild for Russia; Professor A. Coumbary for Turkey; Mr. Robert H. Scott for Great Britain; and Bvt. Brig. General A. J. Meyer, for the United States. Concurrent action followed shortly after on the part of Austria, through Professor Carl Jelinek; Belgium through Professor E. Quetelet; Denmark through Capt. Hoffmeyer; France through Monsieurs U. J. Leverrier, Marie Davy, and St. Claire Deville; Algiers by General Farre; Italy by Professor Giovanni Cantoni; the Netherlands by Professor Buys Ballot; Norway by Professor H. Mohn; Spain by Professor A. Aquilar; Portugal by Professor F. de Silveira; Switzerland by Professor E. Plantamour; and the dominion of Canada by Professor G. T. Kingston. Within a year the average number of daily simultaneous observations made outside the limits of the United States increased to 214. Later, the co-operation of the Governments of India, Mexico, Australia, Japan, Brazil, Cape Colony, Germany, and Greece, was obtained, and also of many private observatories at widely separated points throughout the Northern Hemisphere.

In the sixteen years during which simultaneous meteorological observations were continued, reports were received from nearly fifteen hundred different stations, about one-half being from land stations, and the others from vessels of the navies and the merchant marine of the various countries.

The total number of storm centers, counting one for each 5-degree square over which the centre has been traced from the International Simultaneous observations of 1878 to 1887, inclusive, aggregates over forty-two thousand, an annual average of over four thousand two hundred. Less than $\frac{1}{10}$ of 1 per cent. of these storms occurred south of the parallel of 10°, and only $\frac{1}{4}$ of 1 per cent. south of the parallel of 15°. In marked contradistinction to this freedom of the equatorial regions from storms, there is to be noted the excessive prevalence of these phenomena between the parallels of 40° and 60°, north; in which

regions substantially two-thirds of the storms of the Northern Hemisphere occurred ; while between the parallels of 45° and 55°, north, 36 per cent. of the entire disturbances are recorded. The most remarkable belt of storm frequency on the Northern Hemisphere is that extending from the Gulf of Saint Lawrence westward to the extreme end of Lake Superior, as nearly 8 per cent. of all the storms of the Northern Hemisphere passed over this limited region ; the maximum frequency (1.2 per centum) occurring over the 5-degree square northeastward of Lake Huron.

As regards longitudinal distribution, an unusually large proportion of storms prevailed between the 50th meridian and 105th meridian, west ; 37 per cent. or one-third of all the storms of the Northern Hemisphere occurring within this region. A second belt of comparative storm frequency obtains from the meridian of Greenwich eastward to the 30th meridian ; over which region 15 per cent. of the entire number of storms occurred.

Only four hundred, or less than 9 per cent. of the entire number of storms, entered the American continent from the Pacific ocean, while about thirteen hundred storms, excluding the West India hurricanes, passed eastward off of the American continent. Over nine hundred storms entered Europe from the Atlantic ocean, of which probably four hundred and fifty, or ten per cent. of the whole number recorded, were developed over the Atlantic ocean. Probably not thirty storms, or less than three per cent. of those which entered Europe from the Atlantic, crossed over the continents of Europe and Asia to the Pacific ocean. Fully two-thirds of the storms which enter Europe from the Atlantic are dissipated as active storm-centres before they reach the Asiatic frontier.

The tendency of great bodies of water, when surrounded wholly or largely by land, to generate storms or facilitate their development, is evident from the unusual prevalence of storms over the great lakes, the St. Lawrence bay and the Gulf of Mexico in North America ; over the North and Baltic seas, Bay of Biscay and the Mediterranean in Europe ; the Bay of Bengal, and over the China and Okhotsk seas.

Undoubtedly a considerable proportion of these storms are drawn towards these regions owing to the effect of evaporation upon the humidity and temperature of the superincumbent atmosphere, so that a very considerable proportion of the storms credited to these squares have not originated therein, but have been drawn up from

neighboring quarters. This tendency is marked in North America, as storms pass over the lake region and St. Lawrence valley, whether they have originated in the Gulf of Mexico, along the central slope of the Rocky mountains in the United States, or further north in the Saskatchewan country. In like manner storms pass southeastward to the Mediterranean from the Bay of Biscay, and northeastward from the Atlantic ocean to the same sea, and then later show a very marked tendency to pass over the Black and Caspian seas.

This tendency of storms originating in diverse sections to move toward the lake regions in the United States, is very evident from the normal storm-track charts for April, May, June, August, November and December.

The opinion that gales rarely, if ever, occur upon the equator is confirmed by these storm-tracks. The most southern storm in the North Pacific ocean, developed in July, 1880, between the Island of Borneo and Mindanao, an excellent account of which is given by Pere Mark Dechevrens, S. J., in the Bulletin Mensuelle of Zi-Ka-Wei Observatory. The most southern storm over the North Atlantic ocean, in November, 1878, was remarkable for its origin, duration, length of its path, and its enormous destruction of life and property. It was central on the 1st, as a violent tropical hurricane near Trinidad, the barometer being 29.05, the lowest ever recorded there, and, from its intensity and velocity, it is more than probable that it originated considerably to the eastward, and possibly somewhat to the southward of that island. The storm was described in the U. S. Monthly Weather Review for September, 1878.

The writer looks with considerable interest to the results which may follow from a discussion of the annual fluctuation of the atmospheric pressure as shown by the mean monthly pressures deduced from the ten years' International observations. As far as these means have been examined they show that the periodicity of atmospheric pressure is largely in accord with the results set forth in 1885 in The Report of the Lady Franklin Bay Expedition. The conviction expressed in that year is still adhered to—that, at no distant day, the general laws of atmospheric changes will be formulated, and that later, from abnormal *barometric departures* in remote regions may be predicted the general character of seasons in countries favorably located.

The success of long-time predictions of this class for India, has been set forth in a previous part of this report. It is believed

that a further discussion of meteorological phenomena on a broad basis, by means of International Weather Charts, both in daily and monthly form, must eventually result in important and fundamental discoveries. It is gratifying to American pride to know that in this international task of outlining the geography of the air, the United States has liberally provided the labor and means for presenting these ten years' meteorological data in such tabular and geographical forms as to render them available for study by all.

Acknowledgment is due to Professor Thomas Russell, for valuable translations, especially from the German; which translations have been of material value in preparing this report.

December, 1888.

REPORT—GEOGRAPHY OF LIFE.

C. Hart Merriam.

During the year now drawing to a close not a single work which I conceive to fall legitimately within the scope of the department of Geography of Life has appeared in any part of the world, so far as I am aware. It being manifestly impossible, then, to comply with the requirement of the By-law calling for a summary of the work of the year, I may be pardoned for digressing sufficiently to speak of what seems to be the *function* of this Society in its relations to biology.

The term '*Geography of Life*,' applied without limitation or qualification to one of the five departments of the Society is not only comprehensive, but is susceptible of differeut if not diverse interpretations. Indeed, without great violence it might be construed to comprehend nearly the whole domain of systematic botany, zoology, and anthropology. As a matter of fact, I believe it was intended to include everything relating directly to the distribution of life on the earth. Thus it would naturally embrace all sources of information which assign localities to species. Local lists and faunal publications of every kind would fall under this head, and also the narratives of travelers who mention the animals and plants encountered in their journeys. In the single branch of ornithology, about fifty per cent. of the current literature would have to be included. The most obvious objection to this comprehensivences of scope is the circumstance that a mere bibliographic record of titles alone would fill a journal the size of the National Geographic Magazine.

Hence it may not be amiss to attempt a preliminary reconnoissance, with a view to what my friend Mr. Marcus Baker has recently defined as "a Survey of Class II, for Jurisdictional purposes." Let us seek therefore to run a boundary line about the territory we may fairly claim without trenching on the possessions of others.

Before doing this it becomes necessary to bear in mind certain facts and laws without a knowledge of which it is impossible to think intelligently on the subject. It is a matter of common observation that different groups of animals and plants inhabit different regions, even in the same latitude; that some forms are almost world wide in distribution; that others are restricted to

very limited areas; that the ranges of very dissimilar species are often geographically coincident; and that, as a rule, animals inhabiting contiguous areas are more nearly related than those inhabiting remote areas. The recognition of these facts early led to the attempt to divide the surface of the earth, according to its animal life, into 'faunal' districts. By the term *fauna* is meant the sum of the animal life of a region.

A comparatively meagre supply of information is sufficient to indicate the principal faunal subdivisions of a country, but for mapping the exact boundaries of such areas a vastly greater and more precise fund of knowledge is necessary. The way in which such maps are prepared is by collecting all available authentic records of localities where the particular species has been found. This is done by compiling published records, by examining labels of specimens in various museums and private collections, and by work in the field. The data thus brought together are arranged on cards under authors and regions, and are tabulated under species. The localities are then indicated by colored spots on an outline map, the space surrounded by the spots being washed in with a paler tint of the same color. A separate map is devoted to each species.

Faunal maps are made by combining a large number of species maps. In making such combinations it is found, as a rule, that a considerable percentage of the species maps fall into certain well defined categories whose color patches are essentially coincident. The composite resulting from the coördination of these maps may be held to represent the natural faunal areas of a country. Several such areas may be characterized by the common possession of species not found elsewhere, and may be combined to constitute a faunal province; several provinces, a region; and several regions a realm or primary zoö-geographical division of the earth's surface.

Having ascertained the actual extent and limitations of the natural faunal districts, it remains to correlate the facts of distribution with the facts of physiography.

My own convictions are that the work of this Society in Geographic Distribution should be restricted to the generalization of results: that we should deal with philosophic deduction rather than with detailed observations and the tedious steps and laborious methods by which they are made available. Our aim should be to correlate the distribution of animals and plants with the

physiographic conditions which govern this distribution, and to formulate the laws which are operative in bringing about the results we see. In other words, we are to study cause and effect in the relations of physiography to biology.

The kind of works meriting discussion in the annual report of the Vice-president of this section are such philosophic treatises as those of Humboldt, Dana, Agassiz, DeCandolle, Engler, Darwin, Huxley, Peizeln, Sclater, Wallace, Baird, Verrill, Allen, Cope, and Gill. As it is seldom that more than one or two such works appear in any single year, there is likely to be ample opportunity for profitable discussion.

January, 1889.

ANNUAL REPORT OF THE TREASURER.

FOR THE YEAR ENDING DEC. 27, 1888.

THE TREASURER, in account with the NATIONAL GEOGRAPHIC SOCIETY.

1888.				
Dec. 27.	To cash received from life members			$100 00
	" " for annual dues year 1888			1025 00
				$1125 00
1888.				
Apr. 18.	By Cash—M. F. Peake & Co. (20 chairs)			$ 60 00
	" Paid Columbian University, rent of hall			20 00
Oct. 31.	" Paid Tuttle, Morehouse & Taylor, for printing and binding vol. I of Magazine	$ 190 56		
	" Norris Peters, for lithographing storm plates for Magazine	58 00		
	" Sundry expenses of Magazine	6 35		254 91
Dec. 27.	" Paid Cosmos Club, rent of hall			18 00
	" " for miscellaneous expenses:			
	" " " Printing	74 50		
	" " " Stationery	28 35		
	" " " Postage	29 15		
	" " " Sundries	13 39		145 39
Balance on hand (Bank of Bell & Co.)				626 70
				$1125 00

C. J. BELL,
Treasurer.

December 28, 1888.

To the National Geographic Society:

The undersigned, having been appointed an Auditing Committee to examine the accounts of the Treasurer for 1888, have the honor to make the following report:

We have compared the receipts with the official list of members and find complete agreement. We have compared the disbursements with the vouchers for the same and find them to have been duly authorized and correctly recorded. We have examined the bank account and compared the checks accompanying the same. We have compared the balance in the hands of the Treasurer as shown by the ledger ($626.70) with the balance as shown by the bank book ($644.70) and found them consistent, the difference being explained by the fact that a check for $18 drawn in favor of the Secretary of the Cosmos Club has not yet been presented for payment. We find the condition of the accounts entirely satisfactory.

Very respectfully,

S. H. KAUFMANN.
G. K. GILBERT.

ANNUAL REPORT OF THE SECRETARIES.

The first step toward the organization of the National Geographic Society was the circulation of the following invitation, on Jan. 10, 1888.

"Dear Sir: You are invited to be present at a meeting to be held in the Assembly hall of the Cosmos Club, Friday evening, January 13, at 8 o'clock, for the purpose of considering the advisability of organizing a society for the increase and diffusion of geographical knowledge.

Very respectfully yours,

GARDINER G. HUBBARD, HENRY MITCHELL,
A. W. GREELY, HENRY GANNETT,
J. R. BARTLETT, A. H. THOMPSON,
and others."

In response to this invitation 33 gentlemen met at the appointed place and time. The meeting was called to order by Prof. A. H. Thompson, who stated its objects and nominated Capt. C. E. Dutton as chairman. The formation of a geographic society was discussed by Messrs. Hubbard, Bartlett, Thompson, Mitchell, Kennan, Gannett, Merriam and Gore.

The following resolution, introduced by Prof. Thompson, was adopted:

Resolved, 1. As the sense of this meeting that it is both advisable and practicable to organize at the present time a geographic society in Washington:

2. That this society should be organized on as broad and liberal a basis in regard to qualifications for membership as is consistent with its own well being and the dignity of the science it represents.

3. That a committee of nine be appointed by the chairman to prepare a draft of a constitution and plan of organization, to be presented at an adjourned meeting to be held in this hall on Friday evening, January 20, 1888."

A committee was appointed by the chair, consisting of Messrs. Hubbard, Greely, Bartlett, Mitchell, Kennan, Thompson, Gore, Tittman and Merriam for formulating a plan of organization.

A subsequent meeting was held on January 20, at which it was decided to incorporate the society, and the same committee was continued to carry out that purpose. On January 27 the society was incorporated, the following gentlemen signing the certificate of incorporation:

Gardiner G. Hubbard,	J. W. Powell,
C. E. Dutton,	Henry Gannett,
O. H. Tittman,	A. H. Thompson,
J. Howard Gore,	A. W. Greely,
C. Hart Merriam,	Henry Mitchell,
J. R. Bartlett,	George Kennan,
Rogers Birnie, Jr.,	Marcus Baker,

Gilbert Thompson,

and upon the same day the first meeting of the society was held in the Assembly hall of the Cosmos club, when it was organized by the election of the following list of officers and the adoption of the by-laws:

President,

Gardiner G. Hubbard;

Vice-Presidents,

Herbert G. Ogden,	A. W. Greely,
J. R. Bartlett,	C. Hart Merriam,

A. H. Thompson;

Treasurer,

Charles J. Bell;

Recording Secretary,

Henry Gannett;

Corresponding Secretary,

George Kennan;

Managers,

Cleveland Abbe,	W. D. Johnson,
Marcus Baker,	Henry Mitchell,
Rogers Birnie, Jr.,	W. B. Powell,
G. Brown Goode,	James C. Welling.

The number of members who joined the society at its organization was 165. Since that date 45 have been elected to membership.

The society has lost one member by death during the year, Mr. James Stevenson.

The present number of members is 209.

The society has held 14 meetings, 13 of which have been devoted to the presentation of papers. It has published the first number of a magazine, copies of which have been distributed to the members of the society, to others interested in geography and to the geographic societies throughout the world for purposes of exchange.

The society has also undertaken the preparation of a Physical Atlas of the United States, upon which some progress has been made.

Very respectfully submitted,

HENRY GANNETT,
GEORGE KENNAN,
Secretaries.

Washington, D. C., December 28, 1888.

NATIONAL GEOGRAPHIC SOCIETY.

CERTIFICATE OF INCORPORATION.

This is to Certify that we whose names are hereunto subscribed, citizens of the United States, and a majority of whom are citizens of the District of Columbia, have associated ourselves together pursuant to the provisions of the Revised Statutes of the United States relating to the District of Columbia, and of an act of Congress entitled: "An Act to amend the Revised Statutes of the United States relating to the District of Columbia and for other purposes," approved April 23, 1884, as a Society and body corporate, to be known by the corporate name of the National Geographic Society, and to continue for the term of one hundred years.

The particular objects and business of this Society are: to increase and diffuse geographic knowledge; to publish the transactions of the Society; to publish a periodical magazine, and other works relating to the science of geography; to dispose of such publications by sale or otherwise and to acquire a library, under the restrictions and regulations to be established in its By-Laws.

The affairs, funds and property of the corporation shall be in the general charge of Managers, whose number for the first year shall be seventeen, consisting of a President, five Vice-Presidents, a Recording Secretary, a Corresponding Secretary, a Treasurer and eight other members, styled Managers, all of whom shall be chosen by ballot at the annual meeting. The duties of these officers and of other officers and standing committees, and their terms and the manner of their election or appointment shall be provided for in the By-Laws.

GARDINER G. HUBBARD,	J. W. POWELL,
C. E. DUTTON,	HENRY GANNETT,
O. H. TITTMAN,	A. H. THOMPSON,
J. HOWARD GORE,	A. W. GREELY,
C. HART MERRIAM,	HENRY MITCHELL,
J. R. BARTLETT,	GEORGE KEENAN,
ROGERS BIRNIE, JR.,	MARCUS BAKER,

GILBERT THOMPSON.

OFFICERS.

1889.

President.

GARDINER G. HUBBARD.

Vice-Presidents.

HERBERT G. OGDEN.
GEO. L. DYER.
A. W. GREELY.
C. HART MERRIAM.
A. H. THOMPSON.

Treasurer.

CHARLES J. BELL.

Secretaries.

HENRY GANNETT. GEORGE KENNAN.

Managers.

CLEVELAND ABBE.
MARCUS BAKER.
ROGERS BIRNIE, JR.
G. BROWN GOODE.
C. A. KENASTON.
W. B. POWELL.
O. H. TITTMANN.
JAMES C. WELLING.

BY-LAWS.

ARTICLE I.

NAME.

The name of this Society is the "NATIONAL GEOGRAPHIC SOCIETY."

ARTICLE II.

OBJECT.

The object of this Society is the increase and diffusion of geographic knowledge.

ARTICLE III.

MEMBERSHIP.

The members of this Society shall be persons who are interested in geographic science. There may be three classes of members, active, corresponding and honorary.

Active members only shall be members of the corporation, shall be entitled to vote and may hold office.

Persons residing at a distance from the District of Columbia may become corresponding members of the Society. They may attend its meetings, take part in its proceedings and contribute to its publications.

Persons who have attained eminence by the promotion of geographic science may become honorary members.

Corresponding members may be transferred to active membership, and, conversely, active members may be transferred to corresponding membership by the Board of Managers.

The election of members shall be entrusted to the Board of Managers. Nominations for membership shall be signed by three active members of the Society; shall state the qualifications of the candidate; and shall be presented to the Recording Secretary. No nomination shall receive action by the Board of Managers until it has been before it at least two weeks, and no candidate shall be elected unless he receive at least nine affirmative votes.

ARTICLE IV.

OFFICERS.

The Officers of the Society shall be a President, five Vice-Presidents, a Treasurer, a Recording Secretary and a Corresponding Secretary.

The above mentioned officers, together with eight other members of the Society, known as Managers, shall constitute a Board of Managers. Officers and Managers shall be elected annually, by ballot, a majority

of the votes cast being necessary to an election; they shall hold office until their successors are elected; and shall have power to fill vacancies occurring during the year.

The President, or, in his absence, one of the Vice-Presidents, shall preside at the meetings of the Society and of the Board of Managers; he shall, together with the Recording Secretary, sign all written contracts and obligations of the Society, and attest its corporate seal; he shall deliver an annual address to the Society.

Each Vice-President shall represent in the Society and in the Board of Managers, a department of geographic science, as follows:

Geography of the Land,
Geography of the Sea,
Geography of the Air,
Geography of Life,
Geographic Art.

The Vice-Presidents shall foster their respective departments within the Society; they shall present annually to the Society summaries of the work done throughout the world in their several departments.

They shall be elected to their respective departments by the Society.

The Vice-Presidents, together with the two Secretaries, shall constitute a committee of the Board of Managers on Communications and Publications.

The Treasurer shall have charge of the funds of the Society, shall collect the dues, and shall disburse under the direction of the Board of Managers; he shall make an annual report; and his accounts shall be audited annually by a committee of the Society and at such other times as the Board of Managers may direct.

The Secretaries shall record the proceedings of the Society and of the Board of Managers; shall conduct the correspondence of the Society; and shall make an annual report.

The Board of Managers shall transact all the business of the Society, except such as may be presented at the annual meeting. It shall formulate rules for the conduct of its business. Nine members of the Board of Managers shall constitute a quorum.

ARTICLE V.

DUES.

The annual dues of active members shall be five dollars, payable during the month of January, or in the case of new members, within thirty days after election.

The dues of members elected in November and December shall be credited to the succeeding year.

Annual dues may be commuted and life membership acquired by the payment of fifty dollars.

No member in arrears shall vote at the annual meeting, and the names of members two years in arrears shall be dropped from the roll of membership.

ARTICLE VI.

MEETINGS.

Regular meetings of the Society shall be held on alternate Fridays, from November until May, and excepting the annual meeting, they shall be devoted to communications. The Board of Managers shall, however, have power to postpone or omit meetings, when deemed desirable. Special meetings may be called by the President.

The annual meeting for the election of officers shall be the last regular meeting in December.

The meeting preceding the annual meeting shall be devoted to the President's annual address.

The reports of the retiring Vice-Presidents shall be presented in January.

A quorum for the transaction of business shall consist of twenty-five active members.

ARTICLE VII.

AMENDMENTS.

These by-laws may be amended by a two-thirds vote of the members present at a regular meeting, provided that notice of the proposed amendment has been given in writing at a regular meeting at least four weeks previously.

MEMBERS OF THE SOCIETY.

---

a., original members.
l., life members.
* Deceased.
In cases where no city is given in the address, Washington, D. C., is to be understood.

ABBE, PROF. CLEVELAND, *a. l.*,
Army Signal Office. 2017 I Street.

ABERT, S. T. (Sylvanus Thayer),
810 Nineteenth Street.

AHERN, JEREMIAH,
Geological Survey. 804 10th Street.

ALLEN, DR. J. A. (Joseph Asaph),
American Museum Natural History, New York.

APLIN, S. A., JR. (Stephen Arnold),
Geological Survey. 1513 R. Street.

ARRICK, CLIFFORD, *a.*,
Geological Survey. 1131 Fourteenth Street.

ASHBURNER, PROF. CHARLES A.,
Pa. Geol. Survey, Hamilton Bldg., Pittsburg, Pa.

ATKINSON, MISS E. S. (Emma Seccombe), *a.*,
Washington Normal School. 918 Massachusetts Avenue.

ATKINSON, W. R. (William Russum), *a.*,
Geological Survey. 2800 Q Street.

AYRES, MISS S. C. (Susan Caroline), *a.*,
Pension Office. 502 A Street SE.

BAKER, PROF. FRANK, *a.*,
Light House Board. 1315 Corcoran Street.

BAKER, MARCUS, *a.*,
Geological Survey. 1125 Seventeenth Street.

BALDWIN, H. L. (Harry Lewis), *a.*,
Geological Survey. 125 Sixth Street NE.

BARNARD, E. C. (Edward Chester), *a.*,
Geological Survey. 1715 G Street.

BARTLE, R. F. (Rudolph Francis),
947 Virginia Avenue SW.

BARTLETT, COMDR. J. R. (John Russell), U. S. N., *a.*,
Providence, R. I.

BASSETT, C. C. (Charles Chester), *a.*,
Geological Survey. 929 New York Avenue.

BELL, A. GRAHAM (Alexander Graham), *a.*,
1336 Nineteenth Street.

BELL, CHAS. J. (Charles James), *a.*,
1437 Pennsylvania Avenue. 1328 Nineteenth Street.

BIEN, JULIUS, *a.*,
139 Duane Street, New York, N. Y.

BIEN, MORRIS, *a.*,
Geological Survey. Takoma Park, D. C.

BIRNIE, CAPT. ROGERS, JR., U. S. A., *a.*,
Ordnance Office. 1341 New Hampshire Avenue.

BLAIR, H. B. (Herbert Buxton), *a.*,
Geological Survey. 1831 F Street.

BLODGETT, JAMES H. (James Harvey), *a.*,
Geological Survey. 1237 Massachusetts Avenue.

BODFISH, S. H. (Sumner Homer), *a.*,
Geological Survey. 58 B Street NE.

BOUTELLE, CAPT. C. O. (Charles Otis), *a.*,
Coast and Geodetic Survey.

BRAID, ANDREW, *a.*,
Coast and Geodetic Survey. 807 E. Cap. Street.

BRENT, L. D. (Lawrence Decatur),
Geological Survey. 1334 Q Street.

BREWER, H. G. (Harrison Gaston), *a.*,
Hydrographic Office. Meridian Avenue, Mt. Pleasant.

BREWSTER, WILLIAM,
Cambridge, Massachusetts.

BROWN, MISS E. V. (Elizabeth Virginia),
1312 S Street.

BURTON, PROF. A. E. (Alfred Edner), *a.*,
Massachusetts Institute of Technology, Boston, Mass.

CARPENTER, Z. T. (Zachary Taylor), *a.*,
1003 F. Street. 1009 Thirteenth Street.

CHAPMAN, R. H. (Robert Hollister), *a.*,
Geological Survey. 1307 L Street.

CHATARD, DR. THOS. M. (Thomas Marean), *a.*,
Geological Survey. 516 Park Avenue, Baltimore, Md.

CHRISTIE, PETER H. (Peter Harrison),
Geological Survey.

CLARK, A. HOWARD (Alonzo Howard),
National Museum. 1527 S Street.

CLARK, E. B. (Elias Buckner), *a.*,
Geological Survey. Laurel, Md.

COLVIN, VERPLANCK, *a.*,
Albany, New York.

COURT, E. E. (Emil Edward),
Hydrographic Office. 431 Q Street.

CUMMIN, R. D. (Robert Dodge), *a.*,
Geological Survey. 1710 I Street.

CURTIS, W. E. (William Ellery), *a.*,
613 Fourteenth Street. 1424 Q Street.

DALL, MRS. CAROLINE H. (Caroline Healey), *a.*,
1603 O Street.

DARWIN, CHAS. C. (Charles Carlyle), *a.*,
Geological Survey. 1907 Harewood Avenue, Le Droit Park.

DAVIDSON, PROF. GEORGE, *a.*,
Coast and Geodetic Survey. San Francisco, Cal.

DAVIS, A. P. (Arthur Powell), *a.*,
Geological Survey. 314 M Street.

DAVIS, MRS. A. P. (Elizabeth Brown Davis),
314 M Street.

DAVIS, PROF. WM. M. (William Morris),
308 Walnut Street, Philadelphia, Pa.

DAY, DR. DAVID T. (David Talbot),
Geological Survey. 621 Thirteenth Street.

DENNIS, W. H. (William Hooper), *a.*,
Coast and Geodetic Survey. 12 Iowa Circle.

DILLER, J. S. (Joseph Silas), *a.*,
Geological Survey. 1804 Sixteenth Street.

DOUGLAS, E. M. (Edward Morehouse), *a.*,
Geological Survey. Takoma Park, D. C.

DOW, JOHN M.,
Pacific Mail S. S. Co., Panama.

DUKE, BASIL,
Geological Survey. 457 C Street.

DUNNINGTON, A. F. (Abner F.), *a.*,
Geological Survey. 504 A Street SE.

DURAND, JOHN,
16 Rue Littre, Paris.

DUTTON, A. H. (Arthur Henry), *a.*,
Hydrographic Office. 1305 H Street.

DUTTON, CAPT. C. E. (Clarence Edward), U. S. A., *a.*,
Geological Survey. 2024 R Street.

DYER, LIEUT. G. L. (George Leland), U. S. N.,
Hydrographic Office. 1415 Twentieth Street.

*DYER, G. W. (George Washington), *a.*,
1003 F Street. 1325 Vermont Avenue.

EDSON, J. R. (Joseph Romanzo), *a.*,
1003 F Street. 1335 Corcoran Street.

ELLIOTT, LIEUT. W. P. (William Power), U. S. N., *a.*,
Navy Department. 1801 Q Street.

FAIRFIELD, G. A. (George Albert), *a.*,
Coast and Geodetic Survey. 1418 Fifteenth Street.

FAIRFIELD, WALTER B. (Walter Brown), *a.*,
Coast and Geodetic Survey.

FERNOW, B. E. (Bernhard Eduard), *a.*,
Department of Agriculture. 1704 Nineteenth Street.

FINLEY, LIEUT. J. P. (John Park), U. S. A., *a.*,
Army Signal Office. 1006 Twenty-fourth Street.

FISCHER, E. G. (Ernst George), *a.*,
Coast and Geodetic Survey. 436 New York Avenue.

FITCH, C. H. (Charles Hall), *a.*,
Geological Survey. 3035 N Street.

FLETCHER, L. C. (Louis Cass), *a.*,
Geological Survey. 1831 F Street.

FLETCHER, DR. ROBERT, *a.*,
Army Medical Museum. The Portland.

FORD, W. C. (Worthington Chauncey), *a.*,
State Department. 1735 H Street.

GAGE, N. P. (Nathaniel P., *a.*,
Seaton School.

GANNETT, HENRY, *a.*,
Geological Survey. 1881 Harewood Avenue, Le Droit Park.

GANNETT, S. S. (Samuel Stinson), *a.*,
Geological Survey. 401 Spruce Street, Le Droit Park.

GILBERT, G. K. (Grove Karl), *a.*,
Geological Survey. 1424 Corcoran Street.

GILMAN, PRES. D. C. (Daniel Coit), *a.*,
Johns Hopkins University, Baltimore, Md.

GOODE, G. BROWN (George Brown), *a.*,
National Museum. Lanier Heights.

GOODE, R. U. (Richard Urquhart), *a.*,
Geological Survey. 1900 Sixteenth Street.

GOODFELLOW, EDWARD, *a.*,
Coast and Geodetic Survey. 7 Dupont Circle.

GORDON, R. O. (Rhome O.), *a.*,
Geological Survey. St. Asaph Junction, Va.

GRANGER, F. D. (Frank DeWolf),
Coast and Geodetic Survey.

GREELY, GEN. A. W. (Adolphus Washington), U. S. A., *a.*,
Army Signal Office. 1914 G Street.

GRISWOLD, W. T. (William Tudor), *a.*,
Geological Survey. 1715 G Street.

GULLIVER, F. P. (Frederic Putnam),
Geological Survey. 811 Ninth Street.

HACKETT, MERRILL, *a.*,
Geological Survey. 490 Maine Avenue.

HARRISON, D. C. (Dabney Carr), *a.*,
Geological Survey.

HASBROUCK, E. M. (Edwin Marble),
Geological Survey. 1633 Fourteenth Street.

HASKELL, E. E. (Eugene Elwin), *a.*,
Coast and Geodetic Survey. 1418 Fifteenth Street.

HAYDEN, LIEUT. E. E. (Edward Everett), U. S. N., *a.*,
Hydrographic Office. 1802 Sixteenth Street.

HEATON, A. G., (Augustus George),
1618 Seventeenth Street.

HENRY, A. J. (Alfred Judson), *a.*,
Army Signal Office. 1404 S Street.

HENSHAW, H. W. (Henry Wetherbee), *a.*,
Bureau of Ethnology. 13 Iowa Circle.

HERRLE, GUSTAV, *a.*,
Hydrographic Office. 646 C Street NE.

HERRON, W. H. (William Harrison), *a.*,
Geological Survey. 1008 H Street.

HILL, GEO. A. (George Andrews), *a.*,
Army Signal Office. 2148 Pennsylvania Avenue.

HILL, PROF. R. T. (Robert Thomas),
Austin, Texas.

HINMAN, RUSSELL,
Cincinnati, O. In care Van Antwerp, Bragg & Co.

HODGKINS, PROF. H. L. (Howard Lincoln), *a.*,
Columbian University. 1331 Ninth Street.

HOPKINS, C. L. (Charles Linsley),
Department of Agriculture. 1443 Chapin Street.

HORNADAY, W. T. (William Temple), *a.*,
National Museum. 405 Spruce Street, Le Droit Park.

HOWELL, E. E. (Edwin Eugene), *a.*,
48 Oxford Street, Rochester, N. Y.

HOWELL, D. J. (David Janney), *a.*,
939 F Street. Alexandria, Va.

HUBBARD, GARDINER G. (Gardiner Greene), *a.*,
1828 Connecticut Avenue.

IARDELLA, C. T. (Charles Thaddeus), *a.*,
Coast and Geodetic Survey. 1536 I Street.

JENNINGS, J. H. (James Henry), *a.*,
Geological Survey. 822 H Street NE.

JOHNSON, A. B. (Arnold Burges), *a.*,
Treasury Department. 501 Maple Avenue, Le Droit Park.

JOHNSON, J. B.,
Howard University.

JOHNSON, S. P. (Stuart Phelps),
501 Maple Avenue, Le Droit Park.

JOHNSON, W. D. (Willard Drake), *a.*,
Geological Survey. 501 Maple Avenue, Le Droit Park.

KARL, ANTON, *a.*,
Geological Survey. 1210 B Street SW.

KAUFFMANN, S. H. (Samuel Hay), *a.*,
1000 M Street.

KENASTON, PROF. C. A. (Carlos Albert), *a.*,
Howard University.

KENNAN, GEORGE, *a.*,
1318 Massachusetts Avenue.

KENNEDY, GEORGE G., *l.*,
Roxbury, Mass.

KERR, M. B. (Mark Brickell), *a.*,
Geological Survey.

KIMBALL, E. F. (Edward Fenno),
411 Maple Avenue, Le Droit Park.

KIMBALL, S. I. (Sumner Increase), *a.*,
411 Maple Avenue, Le Droit Park.

KING, F. H.,
University of Wisconsin, Madison, Wis.

KING, PROF. HARRY, *a.*,
Geological Survey. 1319 Q Street.

KING, WILLIAM B.,
1328 Twelfth Street.

KING, MRS. W. B.,
1328 Twelfth Street.

KNIGHT, F. J. (Frederick Jay), *a.*,
Geological Survey. 744 Eighth Street.

KNOWLTON, F. H. (Frank Hall), *a.*,
National Museum.

KOCH, PETER, *a.*,
Bozeman, Mont.

LACKLAND, W. E. (William Eason), *a.*,
Geological Survey. 1305 Corcoran Street.

LEACH, BOYNTON,
Hydrographic Office. 2028 P Street.

LERCH, R. L. (Robert Lee), *a.*,
Hydrographic Office. 809 Twenty-first Street.

LINDENKOHL, ADOLPH, *a.*,
Coast and Geodetic Survey. 19 Fourth Street SE.

LINDENKOHL, HENRY, *a.*,
Coast and Geodetic Survey. 452 K Street.

LONGSTREET, R. L. (Robert Lee), *a.*,
Geological Survey. 1536 I Street.

LOVELL, W. H. (William Henry),
Geological Survey. 2410 Fourteenth Street.

MCGEE, W J, *a.*,
Geological Survey. 1620 P Street.

MCGILL, MISS MARY C.,
336 C Street.

MCKEE, R. H. (Redick Henry), *a.*,
Geological Survey. 1753 Rhode Island Avenue.

MCKINNEY, R. C. (Robert Christian), *a.*,
Geological Survey. 1120 Thirteenth Street.

MAHER, J. A. (James Arran), *a.*,
Johnson City, Tenn.

MANNING, VAN H., JR. (Van Hartrog),
Geological Survey, Branchville, Md.

MARINDIN, H. L. (Henry Louis),
Coast and Geodetic Survey. 1816 Rhode Island Avenue.

MARSH, ENS. C. C. (Charles Carleton), U. S. N., *a.*,
Naval Observatory. 926 Twenty-third Street.

MATTHEWS, DR. WASHINGTON, U. S. A., *a.*,
Army Medical Museum. 1262 New Hampshire Avenue.

MELVILLE, GEO. W. (George White), *a.*,
Engineer in Chief, U. S. N. Navy Department. 1705 H Street.

MENOCAL, CIV. ENG. A. G. (Aniceto Garcia), U. S. N., *a.*,
Navy Department. 2012 Hillyer Place.

MERRIAM, DR. C. HART (Clinton Hart), *a.*,
Department of Agriculture. 1919 Sixteenth Street.

MINDELEFF, COSMOS,
Bureau of Ethnology. 1408 Eleventh Street.

MINDELEFF, VICTOR,
Bureau of Ethnology. 2504 Fourteenth Street.

MITCHELL, PROF. HENRY, *a.*,
18 Hawthorne Street, Roxbury, Mass.

MOSMAN, A. T. (Alonzo Tyler), *a.*,
Coast and Geodetic Survey.

MULDROW, ROBERT, *a.*,
Geological Survey. 1412 Fifteenth Street.

MURLIN, A. E. (Arlington Elliott),
Geological Survey. 1350 Third Street.

MYERS, MRS. IDA. G. (Idalia Gilbert),
1008 I Street.

NATTER, E. W. F. (Ernst Wilhelm Franz),
Geological Survey. 474 Pennsylvania Avenue.

NELL, LOUIS, *a.*,
Geological Survey. 1118 Virginia Avenue SW.

NILES, W. H.,
Massachusetts Institute of Technology, Loston, Mass.

NORDHOFF, CHARLES, *a.*,
1731 K Street.

OGDEN, H. G. (Herbert Gouverneur), *a.*,
Coast and Geodetic Survey. 1324 Nineteenth Street.

PARSONS, F. H. (Francis Henry), *a.*,
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