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VOL. X.

RECENT EXPLORATIONS TO THE SOUTH OF HUDSON BAY.*

By Dr. ROBERT BELL, F.R.S., of the Geological Survey of Canada.

THE existing maps of Canada show a large unexplored region south-east of James bay. My surveys and explorations of 1895 and 1896, in connection with the Geological Survey of Canada, have enabled us to construct a map showing the leading geographical features of the greater part of this large district. Its topography turns out to be very simple, the greater part of the region being comprised within the hydrographic basin of the Noddawai river, which falls into the head of Rupert bay.

Previous to 1895, it was known that a river had its source near the height-of-land in the vicinity of Grand lake, on the upper Ottawa, and that it flowed to Hannah bay, the central bight of James bay. While exploring in the upper Ottawa region in 1887, I sent my assistant, Mr. A. S. Cochrane, across the height-of-land to collect information. He made an approximate survey of about 70 miles of a stream, which the natives believed to be the Hannah bay river. His report on this work is contained in the Secondary Report of the Geological Survey for 1887. During 1894, Mr. H. O'Sullivan, of the Crown Lands Department of Quebec, descended the same stream for about 30 miles beyond the point reached by Mr. Cochrane, but did not determine the destination of the river. In 1895 I crossed the height-of-land, which passes close to the northern extremity of Grand lake, and commenced an instrumental survey of the river from the point reached by Mr. Cochrane in 1887. At about 170 miles from the height-of-land, it was found to discharge into a lake, which the natives call Mattagami. My local Indian guide

* Paper read at the Royal Geographical Society, March 8, 1897. Map, p. 128.
No. I.—JULY, 1897.]

knew nothing of the river that flowed from this lake, but he assured me from hearsay that it did not fall into the sea at Rupert bay, but somewhere further west. The existing sketch-maps represent the upper part of Hannah bay river as flowing across the route which I traversed, in such a way, that, if correct, a traveller following the water-courses could not help being carried to that bay. Waawanipi river, which is reached by the Hudson's Bay Company's people through a chain of lakes from a point on Rupert river, about 70 miles up, falls into the east end of Lake Mattagami. Both it and the river I descended are fully as large as the Ottawa, at the capital. The large river which discharges Lake Mattagami was ascertained by my actual survey to be identical with the Noddawai (= Iroquois), of which the mouth only had been previously located.

From the mouth of the Noddawai I carried the instrumental survey to Rupert's House, the position of which had been already fixed astronomically by Mr. William Ogilvie, of the Dominion Lands Department. The Noddawai appears to be the largest river flowing into Hudson bay, with the exception of the Nelson, which is one of the great rivers of the world. The Big or Fort George river has a longer course, but its catch-basin is much narrower, and the rainfall is apparently less in the region which it drains.

It will thus be seen that the river flowing from the height-of-land at Grand lake to Lake Mattagami, was confounded with the Hannah bay river, and that my survey proved the existence of a second large stream, which ultimately reached the sea at Rupert bay, in addition to the latter, and hence this stream, which was first partly explored by my assistant, and afterwards surveyed by myself, is really new to geography, and for the present I will call it the "new river." It was never indicated upon any map, and there appeared to be no name for it, which is not to be wondered at, as but few of the geographical features in this region possess names, and even these are only temporary. The few Indians who live in this part of the Canadian wilderness are quite indifferent to geographical terms. Rivers and lakes may be called by different names after various Indians who hunt upon them from time to time. Each band or family circle makes use of such designations as may suit its own convenience at the time, and these may not correspond with another limited set of names used by other families. Even these names are changed from time to time, so that an explorer may get from a party of natives a totally different set from those which had been given by other Indians to some previous traveller. They have no idea of a permanent geography and exact maps. The numerous large lakes and rivers of their country are commonplace to them. "Why should they not be large?" they say. "The Great Spirit has made both the land and the waters large." Small features near their favourite camping-places are more apt to receive names than the large ones, the latter being known

as "the big lake," "the long lake," "the round lake," "the big river," "the rapid river," etc.

The fact that this large territory has so few inhabitants is one of the various reasons why geographical names are so scarce. Another reason is that, in accordance with one of their prejudices, these people ignore almost everything which has been in use by other Indians. This applies to camping-grounds, pot-sticks, fire, implements, utensils, canoes, and geographical names, the idea being that it is derogatory to their pride to use anything second-hand as far as their own people are concerned, but not so in regard to white men. There is also the



DRYING OUT AFTER RAIN.

element of jealousy, which forbids them from adopting anything originating with others.

In this and all other wooded regions of Canada, our means of transport is the birch-bark canoe of the natives. This craft is still constructed just as it was before the advent of the white man in America. Nothing but the prehistoric materials enters into its construction. The rind of a mature canoe-birch tree is tough and durable, a roll of it having some resemblance to leather. The inner side is turned out to form the bottom, and the different sheets are sewn together by long split roots of the spruce, which are also used to sew the bark to a narrow frame or gunwale. It is lined inside by long strips of cedar, split as thin as cardboard, placed lengthwise, and held in position by light semicircular ribs of the same wood set closely together, their ends being caught between the inner side of the bark and the gunwale. The seams are made tight by the gum of any coniferous tree, neatly laid on. Canoes of this kind, from 12 to 30 feet

in length, are used on our surveys, and, as they carry a considerable load, we are enabled to take along with us all the "provisions," tents, blankets, clothing, surveying instruments, hunting, fishing, and cooking apparatus, and other things required for several months' operations. Paddles or saïls are used in smooth water, but in rapids setting-poles or tracking-lines are required. The falls on the rivers, and the intervals between the nearest bays of two neighbouring lakes, are overcome by carrying the light canoes and their cargoes on the backs of the voyageurs along the "portages," or trails, which have existed at such places from time immemorial. A small canoe can be readily carried by one man, and the larger ones by two to four men. Everything being in the form of handy packages, the cargo is quickly transferred from one end of the "portage" to the other. The ordinary portage load for a man is 200 lbs., and it is held upon his back by a pack-strap, or "sling," the loop of which is placed upon the forehead.

The white man has invented nothing to equal the Indian canoe for the purposes for which it is used. It is light and durable; it runs well, and is easily repaired; materials like those out of which it is built may be procured to repair damages at almost any place where an accident may happen, and the voyageurs understand how to make these repairs expeditiously. This is the canoe of history and poetry, the canoe of Longfellow's "Hiawatha," the same that was used by Champlain and the other adventurous missionaries who, in Canada's early days, explored the St. Lawrence, the Great lakes, and the Mississippi river. It is still used by most surveyors and explorers for all their transportation, and also by the Hudson's Bay Company to take in their goods and bring out their furs.

Except for the black flies, mosquitoes, and midges or sand-flies, there is much that is enjoyable and even fascinating in exploring the northern wilds of Canada by following the canoe-routes. In toiling up a rapid river, we may at any turn come face to face with a picturesque fall, never before seen by white man. After portaging across a divide, we may on the same day have the enjoyment of descending a swift-flowing stream, varied by the occasional excitement of running a dangerous rapid; or, in following a winding river, we may be surprised by its suddenly opening into a lake, so long that one cannot see the opposite end.

Much of one's success in carrying out these explorations depends upon having good voyageurs. The Indians, if well selected, are the best, although half-breeds are often very good. The party should be as small as possible, since it is easier to take along provisions and other necessaries for a small number than for a larger one. Good voyageurs understand the work so well that few orders require to be given. In the evening, as soon as the head of the party has selected camping-ground, the canoes are quickly unloaded, and turned upside down to

dry. Every man has his appointed work to do, and he sets about it at once. In about one hour from the time of landing, all the tents are up, the blankets spread, and supper is ready. Our beds are made upon the ground with the tips of boughs of the balsam fir, or, in its absence, of the spruce. They are laid in regular order like slates on a roof, the lower surfaces uppermost and the stem ends sloping downward. They form a springy bed with a delightful perfume, which would soothe one to sleep if any help were needed.

It will be seen by the accompanying map that the general course of the new river is in continuation of that of the main body of Grand lake. The latter, in reality, lies in the same physical depression, and its waters flowed to the sea by way of this river at a comparatively recent geological



TYPICAL VIEW DOWN BELL RIVER.

period. The outflow of Grand lake through this depression has been arrested by the silting up of the channel at the spot where the waters now divide, owing to a slow differential elevation of the land to the north-eastward, which is still going on. The northward discharge of Grand lake might be restored by raising its new outlet a few feet, or by a slight excavation through the sand forming the present divide.

Having carefully surveyed the new river and the Noddawai in 1895 as a base for further operations, I spent the first part of the summer of 1896 in making approximate surveys of eleven branches of the former, while the second part of the season was devoted to the region between Gull lake and Rupert river, to be described further on. During the latter year, my assistant, Mr. R. W. Brock, made a track-survey of the Megiskun (Fish-hook) branch of the new river, and of a chain of lakes and streams from thence northward to Lake Waswanipi (Torch lake).

He also made a similar survey of the Waswanipi river, from the lake of the same name nearly to its source, from which he crossed to Lake Mistassini (Big-stone lake) and returned home by Lake St. John and Quebec.

The country explored in the two years measures about 280 miles, in a straight line, from north to south, by about 230 from east to west, and has an area of about 60,000 square miles, which is larger than that of England. The greater part of it is comprised in the hydrographic basin of the Noddawai river and its branches; but it also includes the country drained by a large stream between these waters and the Rupert river, locally known as the Broadback river, which falls into the mouth of the Noddawai. The whole region may be described in a general way as a nearly even plateau moderately elevated above the sea, the surface being broken here and there by isolated hills and ridges of no great height. Starting at the eastern boundary of Ontario, which runs due north and south, the southern height-of-land of the Hudson bay slope runs eastward not far from the upper Ottawa to the source of that river, from which it turns north-eastward and passes close to the east of Lake Mistassini. The portion of this watershed which runs near the Ottawa river has an elevation varying from about 850 to about 1050 feet above the sea. At the northern extremity of Grand lake it is not much more than 900 feet, and the surface of the country slopes gradually northward for 150 miles to Lake Mattagami, where the elevation is about 600 feet. The descent continues to be slight for the next 50 miles toward James bay, amounting to perhaps 150 feet, but in the remaining 80 miles the Noddawai river, and with it the general surface, falls about 450 feet to the head of Rupert bay. This main discharge receives only small tributaries from either side, the drainage of the greater part of the Noddawai basin having flowed together at Lake Mattagami as the central reservoir of the system. This Otchipwé word means "lake where the waters (or branches) meet," and is a very appropriate name. Lake Waswanipi, which is 10 miles long, discharges by the lower section of the river of the same name into this lake, the intervening distance being about 55 miles; but between them are Gull lake 30 miles long and a sheet of water 17 miles in length, which I have called Lake Olga. Navigation is interrupted by a chute known as the Red fall at the outlet of the latter, and by a rapid at the discharge of Gull lake.

My operations between Lake Waswanipi and Rupert river, in the latter part of the season of 1896, included track-surveys of the shores of Gull lake and of four other large sheets of water, besides a number of small ones, which together form a chain extending from it to Lake Namiska on the above-mentioned river. The lakes to the northward of Gull lake all discharge by the Broadback river, and several large streams flow into the chain from the eastward, three of them having their sources near Lake Mistassini. But only small streams are received from the westward, showing that the general slope of the country is from the east

all the way to the Noddawai river, broken only by this chain of lakes. Opatawaga (Sand-narrows) lake is the only one of the chain which has yet received a distinctive name. The largest one is known to the local Indians as "the big lake," and measures 30 miles from north to south; but as there are several other "big lakes" in this region, this is not a sufficient designation, and I propose to call it Lake Evans in honour of Sir John Evans, who is to visit Canada this year as President of the British Association for the Advancement of Science. As distinctive names are indispensable for convenience of description, I would suggest those now placed upon the map for other lakes and rivers to record the names of British scientists of the day. Gull lake is separated by narrows into three parts, of which the southern is the largest, while



ASPEN WOODS ALONG BANK OF RIVER.

Lake Evans is characterized by several long points and bays running north-east and south-west.

The Broadback river approaches within 6 miles of the southern bay of Lake Namiska on Rupert river, and then it turns west and falls into Rupert bay, about 11-miles south of the mouth of this stream. At this bend the Broadback river is flowing at a level of 50 feet below that of the Rupert, 6 miles due north of it, and throughout its course of 60 or 70 miles from this locality to the sea, it runs within a few miles of the latter stream, and descends about 300 feet.

The country between Lake Waswanipi and Rupert river may be described as tolerably level, with some isolated hills and ridges rising to heights of a few hundred feet. The lower or western part of the region between Lakes Waswanipi and Mistassini is also generally level, but as the source of the Waswanipi is approached the country becomes somewhat hilly at a distance from the river.

The plateau which has been described in connection with the new river and the Noddawai rests upon Archæan and eruptive rocks, and it extends far to the south-west of the basin of these rivers and also up the east side of James bay. Near the latter it assumes a steeper slope towards the sea, down which all the rivers descend in a succession of strong rapids. This slope or rim of the basin of James bay crosses the lower parts of the Rupert, Broadback, and Noddawai rivers, causing a rapid section of 60 miles or more in each of these streams. From the Noddawai river it trends inland to the south-westward, leaving a widening margin of low land as it recedes from the bay. The slope is marked by falls and strong rapids on the Abitibi, the Mattagama, and the Missinaibi branches of Moose river. At the crossing of the Missinaibi, this slope or rim has reached a distance of 150 miles south-west of the head of James bay, and, continuing thence to the westward and northward, it strikes the Albany river at 250 miles from the west coast of the bay and the Attawapiskat river rather further inland. This distinct rim of the basin of James bay is an important feature in the topography of the region. The low land between it and the southern and western shores of the bay is underlaid by nearly horizontal Devonian and Silurian rocks.

My surveys and explorations in the region to the south-east of James bay prove that its geography is quite simple, being principally that of one great river, which corresponds with the Moose to the south-west of the bay, so that we have here, as it were, twin basins of about equal area, with the Hannah bay or Washahow river occupying a narrower trough between the two. It will be observed by the map that the Waswanipi or east branch of the Noddawai divides into a number of branches spreading over a wide area, while the new river pursues a tolerably straight general course, which is continued by that of the main body of Grand lake, and by a chain of lakes connected by streams for about 40 miles still further southward. The portion of the drainage of the upper Ottawa which has been shut off from this river extends for about 60 miles to the southward and 90 miles to the eastward. Owing to this peculiarity in its recent geological history, the branches of the new river near its present head are as large as those further down, and they flow into the opposite sides of the trunk stream at about the same angles as the latter. The slope of the east side of the wide valley appears to be greater than that of the west. The largest branch is apparently the Megiskun, which, like the other branches from the east, flows with a rapid current down the slope of the main valley.

The former bed of the river on the present divide, at the north end of Grand lake, is occupied by a boggy swamp, and the canoe-route from the latter lies through three small lakes, connected by portages, near its western side to a small sluggish stream which falls into the head of Christopherson lake. Between this sheet of water and Lake Shabogama,

the new river expands into Simon and Obaska (Grassy narrows) lakes, the connecting links being interrupted by several rapids. Lake Shabogama is nearly 30 miles in length, and discharges from its north-western side, its name meaning "side outlet." The Megiskun branch falls in on its eastern shore, 3 or 4 miles from its upper extremity, among large marshes, formed from the silt brought down by this rapid river. Midway between lakes Shabogama and Mattagami, the river gives off a "lost channel" on the west side, which forms Ka-ni-qua-xi-ka, or the Long Island, 16 miles in length. Five falls or rapids occur in the last 18 miles of the river before it enters Lake Mattagami; but above these rapids, about 60 miles of the stream, following its course, would be navigable without interruption for steamers.

Most of the rapids of the new river consist of short chutes, having a descent of from 5 to 40 feet, with intervals of smooth water between them. On sounding the latter, the water was found to be unexpectedly deep, varying from 25 to 40 and even 80 feet. The width was generally from one-fourth to one-third of a mile.

The shores have generally a flooded appearance. The woods usually come to the water's edge, a distinct beach being rare even at low water. Sudden expansions occur at the terminations of narrow rocky parts, and here the water was always found to be very deep, as if each of these expansions had been a pool at the foot of a rapid when the channel was at a lower level, and the descent in the river-bed more rapid. Some of the branches from the south-west have very irregular and non-parallel shores, much divided into points, peninsulas, bays, lagoons, and culs-de-sac, showing a permanently flooded condition, while, on the other hand, old water-marks are found on the rocks at the east end of Lake Mattagami, 13 feet above the highest levels of modern times. On the east side of the northern extremity of the Long Narrows of Grand lake, 6 or 7 miles south of the height-of-land, there is a well-developed sand-spit, pointing north, which must have been formed when Grand lake discharged in that direction. These and other facts appear to be evidences of a differential uplifting of the land towards the north-east, with a corresponding lowering of the grade of the river, which has produced the existing flooded condition and turned aside the connection with Grand lake.

Such a change in the destination of the drainage of a large area could be made only on a nearly level plateau such as this. The height-of-land between the streams falling into Hudson bay and those which flow southward into the St. Lawrence, is not a ridge dividing the one set of waters from the other, but a nearly level strip of land, on which the upper branches interlock and sometimes curve about a good deal, as if undecided which way they should ultimately run. On the various watersheds of the Laurentian area, lakes of double outlet are not uncommon. Among such lakes connected with the Ottawa drainage

may be mentioned Temagami, Keepawa, Whitefish, Lac des Rapides, and one at the source of the Dumoine river.

A short range of greenstone hills, from which the timber has been burnt off, runs along the south side of Lake Mattagami, and forms a conspicuous feature of the landscape. The highest of these, which I have called Mount Laurier, after the present premier of Canada, rises to the height of 670 feet above the lake at its base, and is the highest "mountain" of the district, unless some of the hills south of Gull lake should be found to exceed it.

Lake Mattagami has a length of 25 miles from west to east, while its northern arm measures 16 miles at right angles to this course. Leaving this arm, the voyageur descends a short link of the Noddawai river, with two alight rapids, to Lake Soskumika (Slippery shores), an expansion of the river 33 miles long. In the next 40 miles there are occasional rapids, and a total fall of probably 150 feet. The remaining 50 miles, following the general course of the river, to the head of tide, is almost a continuous rapid, with a total descent of some 450 feet.

The effects of the "shoving" of the ice in spring are well exemplified along the Noddawai river and in the larger lakes of this region. On the river the ice forms to a thickness of 3 feet or more, and when this breaks up by the spring rise, heavy masses of it are shoved out of the water and up the shore by the pressure of the current. These ice-shoves take place at different points in different years according as the conditions are changed by local chance or circumstance. The heavy masses of ice often push before them great quantities of stones and occasionally large boulders, the courses of the latter being marked by deep grooves ploughed in the beach. Where the current is strong, curved points are apt to be formed of ice-shoved stones and boulders at places where the shore above trends in such a way as to favour the ice in shoving the boulders outward into the stream. The up-stream side of such a point shelves gradually up from the water, and is formed of closely packed stones and small boulders, while the down-stream side is steep, owing to the fact that the larger boulders are pushed to its edge and there dumped, so that they become piled upon one another at as high an angle as possible. Thus the point grows higher and higher above the level of the water on the lower side, the longer it increases in length and breadth. The accompanying illustration shows the dump or lower side of one of these points.

Where shoals or small islands occur in the larger lakes at such places as to catch the fields of drifting ice in the spring, boulders are shoved upon them from the surrounding shallows, and become piled as a wall all around above high-water mark. In some cases where a small islet is subject to ice-shoves from all directions, the boulders become pushed up so as to form a conspicuous pile or even a steep

cone. A remarkable instance of the latter occurs on the west side of Lake Evans.

At the Ice portage, the Noddawai river, during the spring flood, spreads to a great breadth, with numerous wooded islands, but at low water it is confined to a few swift narrow channels, while all the rest of the bed of the stream, several square miles in extent, becomes a dry field of boulders. Some of the latter are of great size. One of the largest of them, about 20 feet in height, is shown in the illustration on p. 13.

Middleton island, 15 miles northward from the head of tide, and 11 miles southward from the mouth of Rupert river, may be considered to be at the mouth of Noddawai river. Broadback river falls in just



POINT FORMED BY ICE-SHAVED BOULDERS.

above this island, and it might therefore be considered as a branch of the Noddawai. On account of its depth and strong current, the latter discharges a greater volume of water than might be supposed from its width. From the mouth at Middleton island up to the junction of the Kitchigami river, a distance of 25 miles, it has an average breadth of $2\frac{1}{2}$ miles. Thence, up to the main body of Lake Mattagami, a further distance of about 130 miles, the general width is from one-third to half a mile. The average breadth of Lake Soskumika and the north arm of Lake Mattagami, included in this distance, is 2 miles.

As to the total length of the Noddawai river, although its catch-basin measures only about 280 miles in a straight line, if we allow for the curves in the main stream and those of its branches up to the head of the longest affluent, it has probably a course of about 400 miles or more.

The precipitation over the area which it drains is evidently greater than the average of Canada. One reason for this appears to be that the prevailing warm south-westerly winds of summer carry large quantities of moisture across the height-of-land; which, being chilled as they pass over the continuous and cool evergreen forests of the region, cause the copious rains of which we had unpleasant experience during the past two summers. In winter the snow is said to accumulate to an average depth of about 4 feet. The moss, which grows everywhere in the deep shade of the coniferous trees, retains the water like a sponge after a heavy rain, and allows it to drain away gradually. The brushwood and fallen timber, which obstruct the flow of water in the innumerable small streams all over the country, tend to equalize the water-supply. The generally level nature of the region is also favourable to slow drainage, and the numerous lakes connected with all parts of the river-system form reservoirs to maintain a steady flow. From such reasons as these, the volume of water in the main river does not fluctuate greatly at different seasons like that of the Ottawa.

The region under description promises to be rich in some kinds of economic minerals. The Huronian rocks, which constitute our most productive ore-bearing system, are largely developed within its borders. The great belt of these rocks, mingled with eruptive greenstones and granites, which runs from Lake Superior to Lake Mistassini, attains its maximum width in this region, and measures 150 miles on a line drawn straight north from the head of Grand lake to Lake Mattagami. A considerable proportion of the Huronian system of the district consists of various kinds of crystalline schists and pyroclastic rocks. These and the greenstones are intersected by numerous veins of quartz, many of which have a promising appearance for gold. Iron pyrites in economic quantities, and containing copper, was found in several localities on the Broadback river.

The soil of the greater part of the district appears to be suitable for agriculture. On the lower levels it consists of a thinly laminated brown clay resting on till. This clay is exposed in the banks of nearly all the rivers we explored, while on the higher grounds, sandy, gravelly, and loamy soils prevail. The waters of the Waswanipi are clear, but those of the new river and its branches, as well as of the Noddawai and the lakes of the Broadback, are turbid, from which it may be inferred that the clay prevails over a very wide area. The solid rock is to be seen principally in the hills, at the rapids in the streams, and on the shores and islands of the lakes.

The whole region is well wooded with a variety of our northern species of trees. The white and red pines (*Pinus strobus* and *P. resinosa*) extend to Obaska lake, the black ash (*Fraxinus sambucifolia*) to Gull lake, and the white cedar (*Thuja occidentalis*) to the outlet of Lake Evans. It is a curious fact that only a few clumps of the balsam poplar (*Populus*

balsamifera) are found along the upper part of the new river or in the region around Grand lake, although this tree is abundant for hundreds of miles further north. The area in which it is lacking is a south-westward extension of a very large one in central Labrador, where this tree is not known to occur, although it grows in a wide belt all around it. The staple timbers of our region are the black and white spruces (*Picea nigra* and *P. alba*), which are everywhere the most common. The other conifers, in the order of their abundance, are the Banksian pine (*Pinus Banksiana*), the tamarac or larch (*Larix Americana*), the balsam fir (*Abies balsamea*), and the white cedar (*Thuja occidentalis*). The deciduous trees are the canoe birch (*Betula papyracea*), the aspen (*Populus tremuloides*), the



HUGE BOULDER AT ICE PORTAGE.

black ash already mentioned, the rowan (*Pyrus Americana*), the bird cherry (*Prunus Pennsylvanica*), and, in the northern part, the balsam poplar. Near the streams and lakes many of the white spruce trees attain a diameter of 2 to 2½ feet, and these, like the pines, may be manufactured into sawn lumber, while the smaller spruces will be valuable for making paper pulp. The spruces, Banksian pine, tamarac, and white cedar may be utilized in construction, fencing, etc., for fuel, railway ties, spars, telegraph poles, mine timber, charcoal-making, and a variety of other purposes, while the timber of the deciduous species may be employed for many purposes. The tamarac trees have been mostly killed by an imported saw-fly, but this pest has disappeared, and a new growth will spring up. Both the canoe birch and the balsam fir attain a large size, which is evidence of a good soil. Unlike most of our coniferous forest regions, the timber of this district has suffered comparatively little from bush fires. There is a

burnt tract to the south of Lake Waswanipi, but throughout the rest of the district we saw only a few small spots which had been damaged by fire, so that the region, as a whole, may be considered as clothed with green timber. On passing to the south of the height-of-land, several kinds of trees make their appearance which are not seen to the north of it.

The climate of the region in question is much better than is commonly supposed. Our district extends from latitude $47^{\circ} 45'$ to latitude 51° , the latter being south of that of London. Although it does not enjoy any exceptional advantage for these latitudes, neither does it suffer from the cold current of the western Atlantic, from which it is more than 1000 miles distant. The low altitude of the plateau is greatly in favour of its climate, which may be considered as normal for the above latitudes.

Wheat is successfully cultivated around Lake St. John, at the head of the Saguenay river to the east, and it has been found to ripen on the Abitibi and Missinaibi rivers to the west, where it has been tried on a small scale. If we draw a line connecting these localities, it will pass through the centre of our region, and it may be presumed that wheat will thrive throughout the tract from this line southward, if not to the north of it. Early in the spring of 1896 I sent small quantities of wheat and oats to the gentleman in charge of the Hudson's Bay Company's post on Lake Waswanipi, who is the only white person in the whole district. These samples were sown, and the wheat was nearly ripe when I visited the place in the middle of last August. Barley had been successfully raised at this post for many years. In the garden, peas and beans and all kinds of root crops were thriving well. Potatoes had always been a great success, and timothy grass and two kinds of clover were growing in a field. Indian corn was under trial for the first time, and it had put forth its silk at the above date.

Barley and all kinds of root crops have long been grown at Rupert's House and Moose Factory, which lie beyond the northern limits of the whole district. In untried regions we may be guided, to a great extent, as to the prospects for successful agriculture by the natural flora. It is generally conceded that wheat will ripen wherever the mountain maple (*Acer spicatum*) and the saskatoon (*Amelanchier*) are to be found, and these bushes or small trees extend into the northern parts of the district.

There appears to be little doubt, therefore, that wheat and the coarser grains will ripen over a large portion of this region, and it may be assumed that hay, potatoes, and all the ordinary root crops will grow throughout the whole area. Independently of grain-growing, we have, therefore, in this new region a very large amount of good land that will some day prove valuable for stock and dairy farming, which are now the most profitable branches of agriculture in Canada. At the posts of the Hudson's Bay Company on James bay, splendid cattle have been

raised for more than a hundred years from improved stock imported from England and Scotland.

If two-thirds of the land in the district above described should prove to be good, it would amount to 25,000,000 acres. The region is practically inaccessible without a railway, which, however, might be easily built from Quebec, Montreal, or Ottawa.

The territory I have described is far south of the country of the Eskimos, whose most southern visits only extend to Cape Jones, 300 miles north of the mouth of the Noddawai. The few aborigines who live in the district explored belong to the Northern Cree branch of the widespread Otchipwé, or Cree stock. This tribe, divided into more than



OHUB NEST PARTLY EXPOSED.

twenty branches under as many different names, extends from Newfoundland to the Rocky mountains. In the Labrador peninsula they come into direct contact with the Eskimos, but on the west side of Hudson bay, the Chipewyan tribe intervenes. In the region described in this paper they are very few in number, only some thirty or forty families living in the whole district, or one family to every 1500 or 2000 square miles. They are an honest and inoffensive people, with many polite instincts, and they are very friendly to any white man they may chance to meet, but only one resides in the whole region. They devote most of their time, both summer and winter, to fishing and the pursuit of game for food; but during the winter they also trap furs to trade with the Hudson's Bay Company for such European goods as they require.

As to the fauna of the region, mammals are not abundant, but in

the southern part of the district there are a few moose and Virginia deer, and the caribou, or woodland reindeer, is found in small numbers throughout the whole region; also the black bear, the beaver, musk-rat, Canada porcupine, lynx, wolverine, otter, skunk, fisher, marten, mink, foxes, and wolves. The American hare is the most common and useful mammal. The Indians, as well as some of the wild animals, depend largely upon it for their living in winter. Water-fowl are not plentiful, as they prefer to go to districts where wild rice is to be found. The ruffed, Canada, and pin-tailed grouse occur rather sparingly at all seasons, and the willow ptarmigan migrates southward to this region in winter.

Salmon and trout are entirely wanting, but other fishes abound in the waters, the commonest species being sturgeon, pike, pickerel, gold eyes, fresh-water ling, suckers, and chubs. The last-named fishes are called *awadosi* ("stone-carriers") by the Indians, from their habit of collecting gravel and stones, weighing from less than one ounce up to about one pound, and depositing them in a heap in the bottom of a river at a suitable spot for hatching their eggs, which are placed in this singular nest. This is done in the spring. A larger or smaller number of the fishes, whose bodies would weigh from a pound to three or four pounds, work together to build the nest, the size of which will depend upon the number of workers. They pick up the stones with their mouths, and bring them to the heap, one at a time, from far and near. These nests are made in tolerably shallow water where there is a moderate current, which favours the hatching of the ova. Their form is generally conical, and they contain on an average a cart-load of gravel and stones, but they vary from a wheelbarrowful up to four and five tons. The fact that the stones weigh fully one-third less under water than in the air helps to account for their ability to carry the larger ones, which may be seen in hundreds on these heaps.

It may appear strange that the greater part of this region should have remained unexplored until now. But the reasons are not far to seek. Although its southern border is only 180 miles in a straight line, north of the city of Ottawa, the region is not easy to reach by present means of travel. It had no attraction for any one but government explorers, who were few in numbers, and they had always been fully occupied elsewhere. Fur-bearing animals were not plentiful, and very few aborigines lived in the region; its rivers formed no part of the routes travelled by the Hudson's Bay Company's people. It formed only a small part of the unexplored regions of Canada, which are more extensive than any others in the world at the present time. Owing to this combination of circumstances, it remained unknown to geography, notwithstanding that it was the most southern of our unexplored districts, but it now proves to be a very valuable part of the Dominion.

If a railway were built from Quebec, Montreal, or Ottawa, this

district could be reached in a few hours, and Quebec is within a week's sail by fast steamers from the British islands, so that we have here a large habitable territory which may be opened for settlement, and made easily accessible to immigrants from Europe. One of the advantages offered by this region to the settler is the fact that, notwithstanding its present wild condition, it is well understood that law and order prevail in every part of the Dominion, and that life and property would be as safe in this district as if it formed a part of England itself.

Before the reading of the paper, the Chairman (Admiral WHEARTON) said : We are very glad to welcome here to-night a fellow-Englishman from the great Dominion of Canada, of which we are all so proud as an offshoot of our vast empire. He has been journeying in a part of that vast country not so very far from civilization, but which has rather strangely up to the present day been very little known, and which has proved a very interesting country indeed. I will call upon Dr. Bell to read his paper.

After the reading of the paper, the following discussion took place :—

Colonel HARRIS : It is with great pleasure that I have heard the paper read by Dr. Bell. It may not be known to many of you that in this hall in 1881 Dr. Bell read one of the most important papers ever published, and I recommend any of the Fellows who may be interested in Canada to go to the library and read that paper. With an enlightened mind, it shows the capabilities and wonders of the Dominion of Canada, and it was published in October, 1881. Dr. Bell is not only eminent as an explorer, but he is also eminent as a geologist. To-night we have heard of these great rivers which run into St. James bay, and thence into Hudson bay. In the paper read in 1881 he clearly demonstrated and showed that this was navigable for commercial purposes. Many believe that Hudson straits and bay are frozen over and perfectly useless for commercial purposes. If you read that paper you will alter your opinion ; you will be able to see that these rivers he has spoken of are open to the sea, and can be made commercially valuable. He has told us to-night that the immense forests adjoining James bay clothe this land which he thoroughly explored. Tens of thousands of acres of this magnificent timber can only be made use of by bringing it to England or other places by water. If I am wrong the Doctor will soon set me right. It was only three days ago I read a paper showing the actual work done by Dr. Bell. It said his thirty years' work was now bearing its fruit. In speaking of the mineral riches of Canada, Dr. Bell, as a geologist, has done a great work, and to prove this assertion let me read this report, dated Ottawa, 23rd of last month. "The mineral output of Canada last year was \$23,427,000, an increase of \$1,500,000 over the previous year; the value of the Dominion production has doubled during the last ten years." Dr. Bell has done a great work for Canada as a geologist and explorer; and when you look at him now after thirty years' exertion, I don't think you will find it has done him much harm. I delight to meet him to-night, after many years' hard work for the benefit of mankind. I am sorry time does not permit him to go into the advantages of these rivers flowing into Hudson bay for the conveyance of metals and timbers. I would like to know from him to-night whether he has the same opinion as he had fifteen years ago—if Hudson bay is navigable and Hudson bay is useful for the purposes of navigation for the benefit of mankind.

Dr. BELL : I should have been pleased to speak more at length on the subjects referred to, but did not wish to detain this audience. However, as Colonel Harris

has spoken, I would like to make a few remarks before we separate. He has been good enough to congratulate me on standing the fatigues of exploration for thirty years. I should tell Colonel Harris that I have completed forty years of this sort of thing, and I do not know that I am much the worse for it. I have not suffered much harm from having slept on the ground for forty years. I have not changed my mind in reference to the utility of Hudson bay as a means of reaching the interior. It may seem strange to you that a port on the west side of Hudson bay is nearer Liverpool than Montreal. Quebec is about the same distance from Liverpool as Churchill in Hudson bay. Now, if it is possible to reach this port in a commercial way, you see the advantage to that territory. If we can reach Churchill from the centre of the habitable parts as soon as we can get to Winnipeg, and as Churchill is as near Liverpool as Quebec, we save the whole distance from Winnipeg to Quebec, because Churchill is no further from the centre of the north-west than Winnipeg.

I have said I believe, on the average, the bay and straits might be navigated for four and a half months in the year, from all the information I could obtain when I read that paper, and this is practically all we can do at Montreal and Quebec. For the middle months of the summer it is usually navigable for all kinds of ships, and consequently we have here an easy means of access to the centre of North America. When that route will be opened depends on the pressure of business from within, but the time will come, there is no doubt, when one railroad will not be sufficient to carry the products of that region to market.

Admiral WHARTON: I think, as we look at this map, that it will strike us as very extraordinary that this country which Dr. Bell has explored, and this very large river he has found, have never been examined before, and it shows us what an immense country Canada is, and also, up to the present time, how comparatively sparse the population is. Trade and civilization have followed the broad valley of the St. Lawrence, the Great Lakes, and the rich country beyond, and this country close to Ottawa and Montreal and the earlier settled parts has been comparatively overlooked. The description that Dr. Bell has given us of the country there will, I think, make us rather envy the lot of the Geological Survey officers of Canada. It is most delightful travelling in these woods, of which I have had a little experience, and I look back to those days with the greatest pleasure. One forgets the mosquitos and black flies—perhaps Dr. Bell is so used to them that they do not trouble him any more—but, except for that, these forests of North America are most delightful places to wander about in, whether exploring, fishing, or shooting. Dr. Bell knows the whole of that enormous territory, and no man, as Colonel Harris has said, has done more to open out and find out the capabilities of Canada than Dr. Bell. There are two very remarkable things in what he has told us: one is the number of lakes that have more than one outlet. Take the world at large, it is most unusual to find lakes with more than one outlet, and I suppose it is simply an evidence of the flatness of the country, for where there is a general fall of land, lakes can hardly have more than one outlet. I have never heard that there are in any other district many lakes with more than one outlet. The other is the remarkable fish, which is quite new to me. I wish some zoologist were here to-night to tell us something about this chub that builds piles of stones.

It is a great consolation to hear from Dr. Bell that he thinks the forests of Canada recuperate themselves nearly as fast as they are destroyed by fires. That they are so destroyed is unfortunately well known, and it is a great consolation to know that they are growing up so fast. One of the things we look forward to with terror is when the great forests of the world will have been destroyed, and we shall be hard up for wood.

I am sure you will all join with me in giving Dr. Bell a hearty vote of thanks for his interesting paper.

DR. BELL'S MAP.—The map has been compiled from the Instrumental and "Track" Surveys of Dr. R. Bell in 1895 and 1896, with additions from the maps of the Geological Survey of Canada, the Crown Lands Department of the Province of Quebec, and sketches by Indians of the country. The astronomical positions of Mr. H. O'Sullivan have been adopted. Dr. Bell was assisted by Mr. R. W. Brock in 1896.

A JOURNEY IN WESTERN SZE-CHUAN.*

By Mrs. ISABELLA BISHOP.

My journey of five months in Sze-chuan followed upon eight months of Chinese travel, and in point of interest, variety, novelty, and magnificence of scenery far more than repaid me for the various hardships and difficulties which I encountered, specially in the region inhabited by the supposed aborigines, which appears scarcely to have been touched by either the geographer or the trader. I only regret that my lack of scientific knowledge should make the paper which I have the honour to read before this audience to-night, meagre, and in many respects unsatisfactory.

Leaving I-chang by house-boat on January 31, 1896, I reached Wan Hsien, in Sze-chuan, on February 19. The situation of this city on a sharp bend of the Yangtze, backed at a distance of 30 miles by a range of mountains, built on several temple and pagoda crowned hills, and surrounded by precipitous truncated peaks of sandstone from 700 to 1500 feet in height, rising out of wood and cultivation, and surmounted by the picturesque fortified refuges which are a feature of the region, is superb and impressive. Wan has doubled its population and trade in twenty years. Its fine streets and handsome shops, stately dwellings within large grounds, thriving industries, noble charities, and the fringe of junks for a mile along its river-shore, indicate a growing prosperity, which is characteristic of the cities of Sze-chuan.

For the journey of 900 *li* † to Pao-ning Fu, I engaged three coolies for my open chair—which, being a novelty, was an abomination—and four baggage coolies from a *hong* which was responsible for their good behaviour, and they and all who succeeded them on my land journeys of nearly 1200 miles kept their contracts faithfully, were cheerful and obliging, and showed me many of those kindly attentions which fix themselves in a traveller's memory. My Chinese servant interpreter, of whom I had had previous experience, was efficient, faithful, and plucky.

* Paper read at the Royal Geographical Society, May 10, 1897. Map, p. 128.

† 1 Chinese *li* = 1814 English feet. But the measurement of the *li* varies, as in Korea and Japan, the mountain and the plain *li* differing in length.—I.S.B.

I carried no other stores than curry powder, tea tabloids, and a tin of desiccated soup, and lived as I always do on native food. I left Wan with an escort of four *yamen* runners. This escort (now compulsory in Sze-chuan) was changed at every prefecture, sometimes for two, sometimes for six men, and occasionally for soldiers in gaudy uniforms. These runners, whether civil or military, invariably ran away when I was assailed by hostile mobs. Further, they were apt to hand over the magistrate's letter, which was my nominal protection, to beggars, to



SCENE ON THE SHEN-KIA-CHAO PASS.

whom they paid possibly a third of what they received themselves. Many Sze-chuan inns are good for China, but, as I did not keep to the regular stages, I encountered woeful accommodation in dark mud hovels, my servant, after inspecting it, sometimes coming out with a rueful face, and the information that I should have to sleep in "the pig's room," a statement so far true as that a corner of mine was reserved for these objectionable animals.

I regret that I must hurry over the earlier weeks of my journey

through this magnificent province, which, from its size, population, trade, and productions, may truly be called the empire province. It gave me a greatly enlarged idea of the splendid possibilities for trade which exist in Western China, and a truer perception of the capacities, resourcefulness, and enterprise of the Chinese themselves.

The main road from Wan to Cheng-tu, which I followed for five days is a fine work in good repair, flagged, carried by stone staircases up and down declivities, and over the pass of Shen-kia-chao (2740 feet) by 5000 imposing granite stairs. It was thronged with coolies carrying opium, tobacco, and paper to the port of Wan. Beyond Chai-shih-kiao, where I left it, the roads varied from the slimy path on a rice dyke, not wide enough for two chairs to pass, to the Talu, the imperial road from Peking to Cheng-tu, broad, flagged, and shaded by a superb avenue of cedars for which extreme antiquity is claimed. Many of the stone



SZE-CHUAN FARMHOUSE.

bridges would be regarded anywhere as imposing structures. The earlier part of the route is through beautiful mountain scenery with a redundant wealth of vegetation, the formation chiefly grey sandstone, limestone, and conglomerate. Coal abounds, cropping out even by the roadside, from which the children hack it daily for cooking purposes. The workings are most primitive, and coolies' baskets transport the result. Lump coal, burning with little smoke or ash, is worth 2s. 6d. per ton at the "pit's mouth." Coalfields appear to underlie the whole surface of Central and Northern Sze-chuan. On the Kia-ling river, which entered largely into my route, and which is navigable for boats carrying thirty tons from Kuan Yuen to Chung King, 500 miles, the coal traffic is enormous, and at several points there are coal-yards fully an acre in extent, stacked to a height of 8 feet with coal in large blocks.

In the mountains there are innumerable horseshoe corries with narrow entrances, terraced and exquisitely cultivated, each with its

large and handsome farmhouse and its cedar and cypress groves; and mandarins' country houses, rivalling some of our renowned homes in size and stateliness, are frequent. As the country grows more open there are fortified refuges on rocky heights, great temples with porcelain fronts in rich colouring, distilleries, paper and flour mills, and every town and large village has its special industry—silk-weaving, straw-plaiting, hat-making, dressing hides, iron or brass work, pottery and china, chair-making, dyeing, carving and gilding idols, making the red paper used for religious and festive purposes, and the imitation gold and silver coins burned as offerings, etc. Everything indicates industry and prosperity and a certain security for the gains of labour. There is no winter. Even in February the opium poppy, which is most extensively grown, and which is annually trenching more and more on the rice lands, was 8 inches high, and green crops were in full luxuriance.

After Kyaio this mountain region merges into rolling hills of deep red sandstone, terraced to their summits by nature and art. The road touches the Kia-ling and its affluents many times, passes numerous salt wells on the Shan-rang, and finally, after skirting the Kia-ling for many miles at a great height, under cliffs abounding in recessed temples, in which groups of divinities, carved in the rock, receive hourly worship from wayfarers, enters Pao-ning Fu by a pontoon bridge.

On this journey of seventeen days, the hostility to foreigners was most marked. My entrance into many of the towns was the signal for the assembling of a mob, always the most brutal when led by men of the literary class, howling, hooting, throwing mud and other missiles, striking me from behind with sticks, and yelling, "Foreign devil!" "Child-eater!" "Beat her!" "Kill her!" with other fiendish outcries. At Liang, after a riot of a hideous kind had lasted for two hours, my life was in such serious peril that the mandarin with a number of soldiers came to the rescue, and lined the street with troops the next morning.

Pao-ning Fu, where I spent a week as the guest of Bishop Cassels, of the English Church, though a city of only twenty thousand inhabitants, is important as being a great port of export and the residence of a Taotai and of many retired and expectant mandarins, and its beautiful suburban lanes are full of handsome residences. It is a charming city, embosomed in fine trees and orchards, in a wooded basin, surrounded on three sides by the Kia-ling, which is quayed by quays falling back in twenty-five steps, with a flagged promenade 25 feet broad on the top—a noble work. Pao-ning has a large hospital and dispensary under an English doctor, in connection with the China Inland Mission. I went on to Sin-tien-tsi, my farthest point north, and afterwards resumed my march in a south-westerly direction to Kuan Hsien, 963 *li* distant, at the north-west corner of the Cheng-tu plain, the starting-point of the journey which I am to have the honour of describing to you to-night.

Beyond Sin-tien-tsi, the country, though hilly, abounds in broad

well-watered valleys, sprinkled with towns and villages, and exquisitely cultivated. On this route are the large prefectural cities of Mien-chan, Mien-chu-Hsien, and Pieng-Hsien, the latter celebrated for the excellence of its ironwork, and many other walled towns. At the two first are missionaries of the C.M.S., who received me with unbounded kindness. Two days from Kuan, outside the village of Lao-Kia Ch'eng, an attack was made upon me from the effects of which I have scarcely fully recovered. A very great crowd assembled



TA CHOH PASS.

at some *al fresco* theatricals, catching sight of a foreigner in an open chair in the distance, rushed down a broad, stony, dry river-bed, and assailed me with fiendish howls—a sound once heard which can never be forgotten—uttering worse than the usual execrations, and calling on the chair-bearers to set me down. The river-bed offered an excellent supply of ammunition, and the mob threw volleys of stones, hitting my chair, and the coolies. At this juncture the soldiers of my escort fled. My hat was knocked off, and the next moment a well-

aimed large stone struck me on the back of the head, and I fell forwards stunned. On recovering consciousness, I found the chair set down, and an immense mob hooting and howling round me; but no more stones were thrown, a "reason talker" having represented the riskiness of killing a foreigner; nor, though the howling with ruffianly accompaniments continued for some distance, was there any more actual violence. A lady travelling for two days with me in a closed chair was not molested. Though much hurt and dazed, I reached Pieng Hsien the same evening, a city famous for a pagoda riven into exact halves from base to summit, where we met with a very hostile reception, and my room was attacked by a great mob. Officials with soldiers came to the rescue, and placed a strong guard at my door, and the mandarin's secretary came with an apology, and took down our evidence regarding the riot at Lao-Kia Ch'eng, palliating the brutality of it by saying that an open chair was a novelty to the people.

The last day's journey was over the Cheng-tu plain, the road drawing gradually up to the fine mountains which descend abruptly upon it and form its northern boundary. Later I crossed it twice, and with still greater admiration and wonder. This glorious plain, with its four million inhabitants, its prosperous cities and villages, its innumerable "palatial" farmhouses among cedars, bamboo, and fruit trees, its fine bridges with roofs decorated in lacquer and gold; its stately temples, its enormous wheelbarrow traffic, its water and oil mills, its boundless fertility and wealth, and its immunity for two thousand years from drought and floods, are the monument of the engineering genius of one man, whose temple on a wooded height above the gorge of the Couching Dragon, on the Min, is the most magnificent in China, bearing his motto incised in stone and lettered in gold in every conspicuous place, "*Dig the bed deep, keep the banks low.*" The river was divided, and the gorge through which one branch of it passes cut, B.C. 206, by Li Pin, a prefect in the kingdom of Shu, the present Sze-chuan. A tablet records the story. His son, whose name has been lost, and who is known only as the "Second Gentleman," completed the work, and receives the greater honour, being worshipped annually by thousands of pilgrims in the great Er-lang temple, to which an imperial envoy comes every year with gifts. From the T'sin dynasty in B.C. 255, every Chinese emperor has conferred the title of Wong, or Prince, on the son.

Li Pin's engineering motto has been faithfully adhered to for two thousand years. The stone-faced dykes are kept low and in repair, and the bed of the artificial Min, closed annually by a dam in January, is scoured till an iron cylinder sunk by Li Pin is reached, and the river-bed, allowing a fall, is dug down to this level. The whole plain contributes to this work, and a special official of high rank is responsible for it. In April there is a grand ceremony, sometimes attended by the Viceroy, when the dam is cut, and the Min is liberated to be divided

and subdivided, its strong torrent seized upon by human skill, twisted, curbed by dams and stone revetments, and sent into innumerable streams, small canals, and brooklets, till, aided by a fall of 10 feet to the mile, there is not an acre of the Cheng-tu plain where the musical gurgle of its bright waters is not heard, and the perennial supply of water is so abundant that, though drought may exist all around, this vast oasis remains a paradise of greenery and fertility.

Kuan Hsien, at the north-west corner, is one of the best-placed towns in China, situated where the Min (by the Chinese called the Fu) emerges from its long imprisonment among the mountains through a



ROOF OF ERLANG TEMPLE.

very fine gorge, and the city wall includes hill and forest scenery and several fine temples and pavilions. Kuan is the great northern emporium of the Tibetan trade in wool, furs, hides, musk, hartshorn, rhubarb, and many other drugs, which are there exchanged for tea, cotton, cloth, and silk, as many as five hundred Tibetans, with their yaks, camping outside the walls in winter.

After a visit to Sin-tu Hsien and Cheng-tu, I returned to Kuan, gained all the scanty information which was accessible regarding routes and supplies, and left it on April 18 with a fresh set of coolies, and Mr. Kay, a lay member of the C.M.S., as an additional interpreter. With the exception of a divergence for a short cut over the pass of Nyang-tai-ling (2100 feet), 75 *li* from Kuan, the Tibetan road by Sung-panting, for the 200 *li* to Wei-chan, follows the left bank of the Min or

Fu, with which it is shut in by the cliffs and mountains of the gorge through which the river, from 150 to 200 yards wide, thunders on its stormy course. Villages and small towns occur where space admits of them, but there is little cultivation, and that chiefly of oil-seeds and barley. As far as the head of navigation, 30 li above Kuan and 6300 li above Shang-hai, there are large collieries and limekilns. There are several very fine suspension bridges of bamboo, renewed once a year, as well as bridges consisting of a single bamboo rope stretched across the torrents at a great height. Even women make use of these without fear.

There was a good deal of traffic on the road, altogether Tibetan, large caravans of mules, some of them carrying prayer-flags, loaded with wool and medicinal roots, the rough, uncouth-looking muleteers always cheery and friendly as they each exchanged with us their national salutation, *zho*. After four days of mountain travelling we reached the prefectural town of Wei-chau, at the confluence of the Siao Ho, or Small river, with the Min, the united stream being spanned by a fine suspension bridge. The road to Sung-pan-ting runs northward, alongside of the Min, and the road to the Mantzu country starts from the right bank and follows the Siao Ho. For several li before reaching Wei-chau, the objects of interest are novel and plentiful.

There are villages on hilltops; on rocky peaks, reached by stairs cut in the rock; on ledges of precipices, into which the back rooms of the houses are burrowed, without any obvious means of access; and villages where the houses are three, four, five, and even seven storeys high, clinging to mountain-sides, or hanging on to cliffs above tempestuous streams. These villages are on heights 5000, 7000, and 8000 feet above the sea, and from 2000 to 3000 feet above the Siao Ho. All look more or less like fortifications, all have flat roofs, and all have brown wood rooms, much decorated with rude fretwork, and supported on carved beams projecting from their upper storeys. Each village possesses one or more square stone towers, sloping gently inwards from base to summit, and from 40 to 90 feet high. The bases of some are 30 feet square. The sides are pierced by narrow openings. The doorways are 15 feet and upwards from the ground, and at present there are no means of access. The old men say that each contains a staircase and several rooms. A few have their tops broken off, and others have brown wood projections near the top. They give the romantic villages in the ravines the prosaic aspect of smelting-works. Three and four in a single village is not an uncommon number, and I have seen as many as seven. They are built of blocks of undressed stone.

As the Mantzu say that their fathers and their fathers' fathers never remembered a time when they were free, so they cannot remember having heard any legends regarding the use of these towers, except that in "old times" fires were lighted on their roofs to recall absent villagers to the defence of their homes on the approach of an enemy.

Some think that they were granaries, but the so-called thinking of people in their stage of mental development is of little value. From certain indications in a few cases, I incline to believe that easily removable approaches of stone and earth led to the doors, and that the towers were refuges, in which the cattle were below and the people above, food for man and beast being stored in the same building. Very large earthenware jars, which might have contained water, have been found in some of them.



KANPO.

Along the lower waters of the Siao Ho, the Mantzu villages, with the lands attached to them, were taken possession of by the Chinese after the Tai-ping rebellion, and the number of graves of those who fell in battle shows that the fighting was very severe.

About 45 li from Wei-chau, where the lateral clefts in the rock are dark and precipitous, and rocky peaks crowned with fantastic lamaserais rise abruptly from colossal spurs, the villages on the heights become more numerous, and the presence for the first time of Mantzu inhabitants is denoted by clusters of flags on long poles, inscribed with prayers in

Sanskrit, fluttering in the strong breeze which blows down the canyon at that season from sunrise to sunset. Alluvial fans bearing fair crops of bearded wheat and maize occur, and there are orchards on the lower grounds, with pears, apricots, and poplars. Wooden suspension bridges out of repair, as at the striking village of Kan-po, span the turbulent torrent. The gorge through which it foams and thunders is a split between mountains which are from 8000 to 11,000 feet in altitude, continually walling it in by inaccessible precipices, which now and then swing apart to leave room for a village and a few narrow fields, these precipices being laterally cleft in so remarkable a manner as oftentimes to show on one side the rock corresponding to the cleavage on the other, so that if the sides could be brought together they would be an exact fit.

The road is a great work, being cut, not blasted, for much of the way out of limestone, scaffolded over the river, or carried through galleries, in which are tablets in honour of the man who presented the road to his district, a frequent method of displaying local patriotism. Nitrate of soda exists in such enormous quantities as to check vegetation by its efflorescence, and reduce it to coarse plants of strong constitutions. Sulphur abounds also, and a fairly rich iron ore. There is a nitre manufactory at Wei-chau, but the cost of transit is great, and the sulphur is only used locally for tipping matches. The road crosses the Siao Ho, and ascends by a steep rock staircase into a strikingly situated Mantzu village, now inhabited by Chinese, dominated by a lamaseraï on a peak which looks like an outgrowth of the rock itself, and from thence follows the left bank to Li-fan-ting, through colossal scenery devoid of wood, until the canyon widens into a cavity of irregular shape, surrounded by tremendous mountains and by precipices, which, according to Captain Gill, attain a height of 3000 feet. The river rushes through the town, and is utilized for a number of Lilliputian flour-mills. The wall, which in many places looks like a series of steep flights of stairs, follows the irregular outline of the peak round the base of which the little world's end town clusters, and encloses much vacant space. Li-fan is a small official post with about 150 houses, a remarkable *yamen* which, lacking space for expansion, has developed skywards, a temple on a rock brilliantly coloured, and a fine temple in the single narrow street, rich in effective wood-carving, and possessing a huge bas-relief of the dragon. The town subsists almost entirely on the through trade from Tibet at certain seasons. The rarefied air is singularly dry, continuing so till the pass of Pe-t'eo-shan, 70 *li* to the westward, marks a decided change to humidity. On April 22 and 23 there were four and six degrees of frost during the night.

As soon as I arrived, the usual official visit was paid, and with much politeness of manner obstacles were thrown in the way of my farther progress. Two runners were placed at my door, one of them sleeping

across the threshold. Much consideration for the safety and comfort of a lady was expressed. There were no roads, it was said, and no inns; the people were savages, the tribes were fighting, it was dangerous to proceed. The next morning the prospect of departure was badly clouded over. The veneer of politeness disappeared, and a certain dictatorialness took its place. Senior officials from the *yamen* mounted guard. Runners could not be provided, they said; the mandarin was absent, and no arrangements could be made, and I must wait till the Viceroy of



ROCK TEMPLE AT LI-FAN-TING.

Sze-chuan could be communicated with. Going beyond Li-fan was a thing unheard of. All other foreigners had turned back; they could not be responsible for me any farther. They bullied and threatened my men, and forbade the townspeople to give me supplies or porters. The second morning the hostility was yet more marked, and there was a violent altercation between the officials and Mr. Kay, which did not mend matters, and in which some very strong things were said on both sides. Eventually, as I left the inn, they made an attempt, which was

frustrated, to close the door on me, and then, following us to the bridge, shouted as a farewell, "We wash our hands of you."

From this point there was the pleasurable excitement which attends a plunge into the unknown. Three Russian explorers reached Li-fan but turned back owing to illness. Captain Gill arrived, but returned; and some of the French missionaries have gone up the Siao Ho so far. But I have hitherto failed to learn that either geographical research or commercial ambition has penetrated the country beyond, or that any traveller has given any description of it.

The 60 li from Li-fan to Tsa-ku-lao, along the same river, have much the same character as before. The scenery is magnificent and even more fantastic. Grey sandstone gives place to caverned limestone. Schistaceous rock and conglomerate are met with, and the river, occasionally narrowed to 40 feet, plunges over pink granite ledges in a series of cataracts, or the canyon opens out, and there are smooth green lawns covered with dwarf crimson roses, and the dismal remains of villages destroyed in the Tai-ping rebellion. Some Mantzu villages, though deserted, are ready for re-occupation, and there are others now occupied by Chinese, architecturally striking, each with a feudal castle piled on a rock above it. At one of these, in the late afternoon, we were overtaken by four runners, the Li-fan officials having thought better of it; but, in order to compel us to turn back, a letter had been sent in the early morning to the mandarin of Tsa-ku-lao, directing him to order the townspeople to refuse lodgings and transport, and when Mr. Kay arrived there two hours before me, he looked vainly for accommodation. On my arrival, however, a very good inn received us.

Tsa-ku-lao, the outpost of Chinese officialism, is superbly situated on a height above a sharp bend of the river, and the western exit drops abruptly down through a picturesque gateway, by 500 feet of steep stone steps, to a bridge which connects the trading with the official town. Above the former, where the houses are piled on ledges of rock in picturesque disorder, is an imposing lamaserai, with a very curious pagoda temple on a height above it. The yamen is an interesting-looking building in Tibetan style, with a Mantzu tower 60 feet high adjoining it. One clean narrow street lined with shops, vending gaily coloured articles of Chinese manufacture, cuts the town in twain. The houses are two and three storeys high, with quaint carved, projecting upper rooms, and peaked roofs with deep eaves, from which depend carved wooden drops.

A last effort was made to hinder my farther progress with a vehemence which was almost piteous, entreaties being resorted to when threats failed, but the opposition collapsed suddenly when a certain clause in my special passport was pointed out. The coolies had heard such reports of the road that they engaged mules to carry their loads, the bamboo across the shoulder, with its dependent burdens, being

unsuited to the exigencies of mountain-climbing. The curiosity of the people, for the first time in a journey of two years, was tempered by politeness, for each batch of would-be sightseers sent in advance to know if I would receive them, and they always left after visits of conventional brevity, remarking that I must be tired! The population is mixed, and many of the children show an agreeable departure from the Chinese physiognomy. The red woollen habit and peaked hats of the red lamas, the varied costumes of the tribesmen who were in the town for purposes of trade, and the many styles of hats, the most interesting being made of a species of lichen, were a very agreeable variety.

Superb weather favoured our departure. The heat of the sun melted the snows towards midday, adding volume to the thunderous roll of the Siao Ho, above which the bridle-track is carried over steep spurs and abutments of limestone. There is a very decided change after leaving Tea-ku-lao. The river, no longer hemmed closely in by the walls of a tremendous cleft, is broader and stiller, there are shingle banks and stretches of cultivated land, and it makes its way through the ranges instead of following their chasms. There are great openings giving glorious views of high, conical, snow-clothed peaks, heavily timbered below the snow; one group, called by the Chinese "the Throne of Snow," consisting of a great central peak with nine others of irregular altitudes surrounding. After crossing, at a height of 9750 feet,* the spur known as the Pe-t'eo-shan pass, the aridity and sparse vegetation of most of the road up to that point are exchanged for humidity and a wealth of small trees and flowers, and the ranges above the right bank are wooded with coniferæ. A marked feature of this stretch of the Siao Ho is the singularly abrupt bends which it makes, and that at most of these a conical peak, forest-clothed below and naked rock above, rises direct from the river-bed, possibly to an altitude of from 2000 to 3000 feet.

After Pe-t'eo-shan, with its summit thick with flags on poles in honour of the spirit of the pass, and its magnificent view of some of the loftier snow-peaks, the river broadens considerably, and breaks up into several channels, till it narrows again at a point where a suspension bridge is thrown across it from two natural piers of rock. There a very dirty Chinese village of mud hovels faces a Mantzu village of towers and lofty stone houses. It was hot and dusty, and children and pigs were both aggressive. After a halt, we crossed to the right bank of the river, and shortly entered Paradise. Near the bridge is a showy detached temple, the only one in the territory, the household or lamaserai

* Unfortunately, I had sent my aneroid to England, and a pony had rolled on my hypsometer, rendering it useless. The heights given are by a borrowed aneroid, the error of which I was unable to have estimated. I constructed a rude hypsometer, and took the altitude of some by boiling-point thermometer, but I am under the impression that accurate observation might reduce the other altitudes considerably.—I.S.B.

house of worship from henceforth taking the place of the public temple. Close beside it the road passes under an arch, where there are twelve prayer-cylinders, revolving by the pressure of the hand, on either side, and near it is a much-decorated "prayer-wheel" in a house by itself, worked by water-power, the lama in attendance receiving so much for each revolution. The cylinder is 12 feet high, with a diameter of 4 feet, and is said to contain 100,000 repetitions of the mantra "*Om mani padme hum.*"

Two *li* farther on, the main branch of the Siao Ho, descending from the north-west, is joined by streams of nearly equal size from the south and north, coming down through canyons full of superb vegetation, above which rise peaks of unsullied snow, mostly in groups. The vegetation above this meeting of the waters is tropical in its luxuriance. Mosses and ferns soften the outlines of boulders, and drape the trunks of fallen trees. Tree-stems are almost hidden by ferns and orchids, only one of which, a purple and brown spotted *dendrobium*, was in blossom. A free-flowering four-leaved white clematis looped the trees together, arching the road with its snowy clusters, and a white daphne filled the air with its heavy fragrance. The ground, concealed by mosses, a crimson-cupped lichen, and the hare's-foot fern, was starred with white and blue anemones, yellow violets, primulas, and lilies. White and yellow jasmine and yellow roses entwined the trunks of trees, and the flowering shrubs were innumerable. The foliage of the maple lighted up the gloom of holly and ilex with its spring colouring of pink and red, a species of poplar rivalled it in lemon-yellow, the delicate foliage of the golden-barked birch was copper red, and every shade approaching green was represented, from the glaucous blue of the balsam pine and the dark blue-green of its coniferous brethren to the pale *aqua marine* of deciduous trees in clumps among the pine woods below the snow. For, piled on the forest-clothed cliffs and precipices which wall in the river, and blocking up the head of every lateral opening, were countless peaks or splintered ranges, cleaving the blue sky with an absolute purity of whiteness. High up, in extraordinary situations of dubious access, are Mantzu villages, much like fortifications, with their cultivated patches and human interests and flutter of prayer-flags lending life to the scene. The river sympathetically adapts itself to its changed surroundings. Its colouring is a vividly transparent green, to which it would be an injustice to liken an emerald. It descends in rapids, falls, and cataracts, in sheets and glints of foam, under bending trees and long trailers of clematis and red roses, pausing now and then for a moment's rest in deep green pools, in whose mirrors roses, clematis, and snow-peaks meet, its thunder music, echoing from gorge and precipice, pausing never. After 30 *li* of beauty, which it is a luxury to recall, the odorous air grew damp, the peaks flushed, the shadows on the road deepened, the canyon swung open, and on a low hill, bearing

traces of cultivation, there was a solitary Mantzu dwelling. The frequency with which such occur indicates the general security of the country.

The host, as a relation of the courteous and intelligent young lama, my muleteer, made us very welcome; but his wife, a handsome woman, on coming in from the hill with a load of wood, looked astonished to find a foreign woman and twelve men in possession of her house. This typical dwelling has two roofs, one above the other, each reached by a deeply notched tree-trunk, exactly like those used by the Ainu of Yezo. The large, dark, and smoky lower rooms are occupied by the family. The fire and "cooking-range" are on a raised hearth in the centre of the floor of one of them, and the smoke finds various outlets in the absence of a chimney. In the better houses, however, a hole in the roof, into which a hollow log is cemented, offers it a more conventional exit. These people know the reality of a fireside, and possess the term *hearth-side*. The women are very far from being secluded, and husband, wife and children spend the dark evenings round the fire, and take their meals there together.

With much politeness, I was escorted up the notched timbers to the threshing-floor on the second roof, where I slept in an open shed, which indicates that the part so sheltered is the granary. The sharp air after the day's heat was elixir, and the red gold of sunset and the rose pink of sunrise on the snows which enclosed the valley and its blue gloom of pines, made a night in the open air very delightful. These hospitable folk will not receive payment for their hospitality. The roof, or the guest-room, if there be one, is at the disposal of any reputable wayfarer. Fortunately, I had needles, scissors, and reels of coloured silk with me, which made the hearts of many women glad.

The next day, April 28, there was much additional snow on the mountains, and the higher pine woods were hoary. The road still pursues the right bank of the river, along a wider valley, and for the whole day's journey seven snow-peaks are an apparent barrier. In the woods near the road there were fourteen species of pines and firs, and eight of maples, besides cedars, juniper, yew, elm, holly, oak, alder, ilex, plane, birch, etc. A white honeysuckle added its exquisite fragrance to the aggregate of sweet odours. The woods were full of white peonies—the roots of which are an expensive drug in China—sky-blue larkspur and aconite abounded, and yellow roses revelled in the sunshine on the smooth green lawns by the river, which are the camping-grounds of the Tibetan traders.

After crossing and re-crossing the Siao Ho on suspension bridges, we come upon Ku-ri-keo, a village piled on an abrupt height at a point where a lateral gorge with a tributary stream opens on the river. This is remarkable as being the last point to which I was attended by Chinese officialism, and the first where there was a representative of

the T'u-ssu of Somo, the territory on which I had now entered. There the soldiers from Tsa-ku-lao delivered the mandarin's letter to the "T'eoren," or headman, and returned. A Mantzu official escort was at once provided, consisting, not of armed and stalwart tribesmen, but of two handsome laughing girls, distaff in hand, fearless and full of fun, who enlivened the way as far as Chuti. Nor was this fascinating escort a sham. Before starting, each of the girls put on an extra petticoat. Had any molestation been seriously threatened, after protesting and calling on all present to witness the deed, they would have taken off the additional garments, spreading them solemnly on the ground, there to remain till the outrage had been either atoned for or forgiven, the nearest man in authority being bound to punish the offender. Mr. Baber mentions a similar custom amongst the Lolos of Yunnan.

On that day's march we passed several Mantzu villages, and at each all the people came out and brought us wooden cups of cold water, and indulged in much fun with my men, several of them being able to speak Chinese. Nearly all the women were handsome. They were loaded with silver and coral ornaments, plied the distaff as they joked, and were free, not to say bold, in their manners. Chuti, spoken of as a metropolis, consists of two Chinese houses on the right bank of the river, a suspension bridge, and a large Mantzu house on the left bank.

This stone dwelling, arranged, as are all the better class of houses, apparently for defence, possesses three floors, reached by steep stairs inside. Cattle, mules, fodder, and agricultural gear and implements, occupy the first; the family the second; and the family temple and two guest-rooms the third—on which is also the flat roof or threshing-floor, which is the gathering-place for the family and their friends, the wrestling-ground, and the place where the women weave woollen stuff for their clothing. The irregular roofs of the temple and guest-rooms are resorted to by the men when they play cards, and a game resembling *go*. All well-to-do-people have a temple on the roof, with images of the Buddhist triad against the wall, an altar with the usual emblems and offerings, a drum, horn, cymbals, and other musical instruments, and as many of the insignia of Buddhism as their means allow them to obtain. The householder is the priest, but every man and woman can present his or her own invocations and offerings, and in Mantzu homes there is scarcely an hour from sunrise to sunset in which the dull beat of the drum, and "*om mani padme hun*" reiterated in a high-pitched monotone, are not heard. On all roofs, even of the poorest class, there is, at the eastern corner, a small clay furnace with a chimney, called the "altar of incense." In this at each sunrise the householder, looking eastwards, burns a bundle of the green twigs and leaves of the yew, of which two species are accessible. No other tree can be used for this purpose. Is not this curious custom a relic of a nature-worship anterior to Buddhism?

The host, a brother of our muleteer, received us hospitably, and I was provided with a clean room on the roof, with a window in which was fixed a prayer-cylinder revolved by the wind, which whirred monotonously by day and night. Many of the people from a village on a height, accessible only by a series of ladders, spent the evening on the roof with much frolic and merriment. Of the foreigner they had no notion. They thought I was a Mantzu of another tribe. Some of the women were beautiful, and even in middle life they do not lose their good looks and fine complexions.

The first 30 li between Chuti and Mia Ko are as entrancingly beautiful as the earlier part of the journey; then the canyon opens out



MANTZU VILLAGE OF TOL MI.

into a broad valley full of shingle beds, either absolutely bare, or covered with the *Hippophæ rhamnoides* and a species of tamarisk. The receding mountain sides are gashed by summer torrents, and the vegetation by comparison is scanty. One of my chair-bearers became seriously ill, and I had to walk while he was carried, and the last part of the day's journey was very fatiguing. Chinese brutality came out strongly with regard to this coolie's illness. The others were quite willing to leave him to die under a tree, and, though the water he craved for was only a few yards off, they did not care to give it to him. They laughed at his sufferings, at me for bathing his head, and above all at my walking to let him ride. "Let him die," they said; "he's of no use."

After we crossed to the right bank of the dwindling river, a great number of Mantzu men and women joined us and escorted us up to the large and imposing village of Mia Ko, with its many-storied houses, its feudal castle, and its large unpicturesque lamaserai with one hundred and fifty monks. The great hillsides are well suited to agriculture, and though the altitude is over 9000 feet, wheat ripens in July. The soil is sandy, and potatoes, which have been introduced by the Chinese, grow well. There are many large villages scattered over the hills, and the people have great flocks of brown goats and sheep, the latter a long-haired, hornless, flop-eared breed, with fat tails weighing from three to six pounds. They also breed herds of *dzo*, a very valuable hybrid between the cow and yak, and capable of carrying eighty pounds more than either the horse or mule. The male *dzo* is used for ploughing, and the female gives more milk than any other of the bovine race. Of it they make butter, which, as in Tibet, appears to become more valuable with years, and which is largely used along with salt and soda in the preparation of tea, which is churned in a wooden churn till it is as thick as chocolate. From the hair of the *dzo* and yak the Mantzu prepare a heavy felt used for boots and for circular cloaks, worn in cold or wet weather. As far as the Great Divide, snow only lies for a few days at a time on the ground, and, judging from description, the cold is never severe.

Drought is the chief enemy of agriculture, and the crops in this great valley were in urgent need of rain. In the late afternoon a long procession of men and women, each carrying a heavy burden on the back, wound slowly up the hill to a point where it was reinforced by a similarly burdened company from Mia Ko, and the united force was met by a large body of lamas in their sacred vestments, chanting Sanskrit prayers. The burdens consisted of the Buddhist scriptures, which, when complete, weigh ninety pounds, and to carry this sacred load is regarded as an acceptable act of merit. Almost before the prolonged service ceased, there was "a sound of abundance of rain;" the wind rose, the rain fell in torrents, and the thirsty soil of disintegrated granite imbibed it as if it never could be satisfied.

We were received in the house of the T'eo-ren, the father of our muleteer, who had a patriarchal establishment of married sons and daughters with their children, and farmed on a large scale. But neither there nor at any other place in the Mantzu country would the people sell us any food, and a detention of a few days at Mia Ko made a great inroad on the supplies of rice and flour brought from Tsa-ku-lao, and caused me some anxiety, though I was always assured that everything could be got at Somo. I had to leave the sick coolie behind to be cared for by these people, and two days were spent in inducing an unwilling baggage-porter to take his place. The mules were lost on the hills, and stories of a famous robber on a part of the

route to be traversed made the Teo-ren averse to our travelling without an escort of ten men, who had to be hunted up in the adjacent villages. It had been a relief to be free from Chinese officialism, runners, showing passports, and the like, and the appearance at Mia Ko of a mounted Chinese officer, a "captain of a thousand," with baggage and a mounted servant, and orders to keep me in view—whether to help or hinder I knew not, but strongly suspected the latter—was very unwelcome. He and his servant carried swords and revolvers.



CASTLE NEAR CHUTE.

The main branch of the Siao Ho makes a preposterous turn above Mia Ko, and we left it there to take a short cut over the pass of Shi Tsu Ping (10,117 feet), rejoining it 20 *li* later. Sleet fell the evening before, which turned to heavy snow in the night, whitening many of the lower hills, and lying heavily on the superb coniferæ of the pass, where red and white rhododendrons and a large pink azalea were blooming profusely. At that elevation the mercury was at 24° at 6 a.m., and, as a strong north-east wind was blowing, the cold was intense. At noon, 2000 feet lower, the mercury stood at 72° . From this summit

there is a glimpse of a long snowy range with a blunt and wavy outline, on which five peaks, evidently of great altitude, are superimposed. Hitherto the mountains in the neighbourhood of the Siao Ho had not reached the majesty of eternal snow, but on this range the guide said "it was all the year as it was then." He said that the peaks were known as the "Snowy mountains," and that the great Gold river rose among them. Chinese maps contain a good deal of freehand drawing, but I think that this range is possibly identical with one put down as "Snowy mountains" running in a south-west direction between 29° and 32° N. lat., and 101° to 103° E. long. Captain Gill found the snow-line in May, in the same latitude and about 3° to the eastward, to be 13,000 feet, and the limit of perpetual snow to be from 14,000 to 15,000 feet above the sea. By a rough estimate the peaks of this range cannot be much under 17,000 feet, and many of those seen on the journey, which certainly were not then much less than 2000 feet above the very definite snow-line, must attain altitudes of about 14,000 feet. Taking the snow-line about the middle of May as a rough basis of calculation, the timber-line must lie at a height of about 12,500 feet.

A steep descent of three hours brought us again to the Siao Ho, there a full-watered, clear green torrent about 50 yards wide, compressed within a narrow canyon, tumbling among gigantic boulders in glorious cataracts, forest trees of larger size than had been seen hitherto bending over it, festooned with climbing roses and white and sulphur-yellow clematis, while all lovely things which revel in moisture and warmth—ferns, mosses, selaginellas, and the ethereal *Trichomanes radicans*—flourished in perfection along the margin of its turbulent waters. One feature of the vegetation between Mia Ko and Somo is the presence of a pea-green trailer (possibly *Lycopodium Sieboldi*) with pendants 8 and 10 feet long, which takes possession of coniferous trees, dooming them to a slow death, but replacing their dark needles by a tint which in masses is very attractive. This plant is used by the Mantzu for hats much worn by lamas. Some of the red trunks of the conifers, branchless frequently for 50 or 60 feet, measured from 19 to 21 feet in girth at 6 feet from the ground, hollies 7 feet, and a very umbrageous species of poplar from 17 to 20 feet. In places the height of the canyon walls, rising forest-clothed tier above tier, cannot be less than 3000 feet, and their luxuriant covering embraced every tint of gold, red, and green.

After several hours' travelling, the canyon broadens into a valley, closed at its western end by the great range and pass of Tsu-ku-shan, and the yak and *dzo* fed in large numbers on the luxuriant pastures which confer prosperity on the Mantzu hamlet of Hang-kia. This should have been the halting-place, but owing to unpropitious circumstances not worth narrating, in which my European interpreter lost both his head and temper and got into very hot water with the Chinese official, my better judgment was overborne, and in spite of the fact that snow was falling

heavily on the pass, that it was then 3 p.m., and that the coolies and I had not tasted food since 10 a.m., we started for Matang, and reached the foot of the pass at 6.30. There the Siao Ho, the largest tributary except the He Shui, which the Min receives till the Talu unites with it at Kia-ting Fu, rises in a spring under a rock.

We ascended to a considerable height by a number of steep zigzags, meeting many Mantzu, armed with lances and short swords, travelling in companies from dread of the celebrated bandit, some of my own men having armed themselves with lances. The noses of the coolies had been bleeding at intervals for several days, and as at that altitude the



A HE-SHUI FAMILY.

hæmorrhage became profuse, after stumbling in the snow for a short time in the darkness, they set down my chair, very reasonably, I thought, and no arguments of Mr. Kay's, addressed either to mind or body, induced them to carry it another step. It was then 8.30, and very dark. A snowstorm came on, dense and blinding, accompanied by a strong wind. The snow drifted heavily; the guide continually disappeared, and was with difficulty recalled. I sank several times in drifts up to my neck, and was so exhausted as to be dragged rather than helped along by two men. My servant, a big strong fellow, fainted and fell down in the snow, but was re-animated by pouring brandy down his throat. The coolies called on their gods, and made expensive vows, which were afterwards fulfilled by burning cheap incense sticks, and as we staggered through the blinding drifts, I at one time doubted whether Tsu-ku-shan

would not be the journey's end. After four hours of this work, the moon rose, the snow ceased, and soon after midnight we reached the top of the pass. When I recrossed it, 124 snow-peaks were visible from its summit. Its approximate altitude is 13,017 feet. It is the great divide of the region, a long, bare, unimpressive mountain wall, the waters on the east seeking the Min, and those on the west the Yalung.

A steep descent on foot for an hour brought us to a forest of superb pines glorious in the moonlight, which was then brilliant. Mr. Kay and the guide went on to look for shelter, and my coolies declined to carry me, and wanted to leave me there, and it was only after a tiresome half-hour's altercation between them and my servant, during which my wet clothing froze hard, that they took up the chair. The track was soon lost in the snow, not to be recovered till at 2 a.m. we emerged on great grassy slopes; and an hour later the whole party—exhausted, starving, shivering, drenched to the skin, and in clothes then frozen hard—after travelling for twenty-one hours, found a wretched shelter in the one room of a Chinese hovel with a sloping floor on the bleak boulder-strewn hillside, on which the forlorn village of Matang stands at an altitude of over 10,000 feet.

On the same day we moved to an inn, consisting of a stable 90 feet long, with stalls 7 feet high for human beings on both sides, in one of which I was thankful to find solitude, a firebowl, and necessary rest for two days. The innkeeper and his wife, Kansu Mohammedans, were kind, and asked me to sit by their own fire, on the ground that we were worshippers of the same God. Matang is a forlorn village of twenty-eight houses, intersected by a stream of the same name rising on the pass above. Its population of 170 includes a number of Chinese. It is a wretched, unpicturesque-looking place of low stone cabins, with rough plank roofs kept down by stones. Snow lies there for six weeks. But in July and August the scene changes. The inn is crammed with men and horses; yaks and Tibetan tents cover the grassy slopes; Chinese dig on the mountains for medicinal roots, which are also brought from Tibet in incredible quantities; broken silver, the only currency accepted, passes freely from hand to hand; goods are bartered, and for two months Chinese and Tibetans do a large trade in wool, hides, cattle, horses, sheep, musk, rhubarb, hartshorn, and much besides.

There were several beautiful Mantzu women whose photographs I should have been delighted to exhibit, and twice secured a giggling group in front of the lens of my camera; but I no sooner put my head under the focussing-cloth, than there was a stampede, and they fled like hares, so I must ask you to take their beauty on trust.

After being detained by a heavy snowstorm and difficulties regarding transport, I left Matang early in May, accompanied by the Chinese official and ten stalwart tribesmen from Mia Ko, who had joined me there, carrying spears. Crossing the Matang river by a good bridge

near its junction with a vigorous stream descending from the north-west, we followed the united waters down to their junction with the Rong Kia, crossing several mountain spurs clothed with forests of pine, birch, ibex, and elæagnus. The scenery on that day's journey was perhaps the loveliest of all. There is one fine waterfall, and many abrupt turns give as many delightful surprises. A long and severe ascent brought us to the top of a spur crowned by a village and lamaserai above the confluence of three valleys and as many streams, which unite to form



CANYON OF THE RONG KIA.

the Rong Kia, a broad, rapid river tending to the south-west, and bridged in several places. The first view of the Rong Kia valley, sleeping in the soft sunshine of a May noon, is one not to be forgotten. It is fully 1 mile wide and 12 miles long, and is closed by snow-peaks at its distant extremity. All along the "silver water" were wheat-fields in the vivid green of spring; above were alpine lawns, over which were sprinkled clumps of pine and birch, gradually thickening into forests, clothing the skirts of mountains, snow-crested, and broken up here and there into pinnacles of naked rock. At short distances all down the

valley there are villages with towns and lamaserais on heights, and villages among the fair meadows by the river with houses mounted on the tops of high towers and overhanging them, their windows 40 and 50 feet from the ground, and stretching halfway across, then purple against a sky of gold, a lofty rocky spur, developing into a fine double-towered castle, the residence of the T'u-ssu of Somo, the lord of this fair land. In the late afternoon it looked like a region—

“Where falls not rain or hail or any snow,
Or ever wind blows loudly.”

The warm spring sunshine blessed it, the river flashed through it in light, the sunset glory rolled up it in waves of gold; it was unique, and its beauty left nothing to be longed for.

The castle gained rather than lost as we approached it by a bridge near one of the ancient towers. It occupies a spur or bluff 390 feet above the river, so precipitous on the east side as to be approached with difficulty by any one carrying a burden. A few houses are built on the edge of the precipice outside the castle wall. Our reception was not a cordial one. The T'u-ssu had provided most miserable accommodation for us in a Chinese hovel—one room for the whole party, and it was not till two hours had passed that I obtained a good room on the roof of a Mantzu house within the castle wall. Though Somo was nominally the goal of my journey, as the travelling season was nearly ended, I had cherished a project of working my way down to Ta-chien-lu by a route supposed only to have been traversed by one European, involving a journey of twenty-one days. On making careful inquiries, however, I learned that a tribal war had broken out, and that the bridges over the Rong Kia had been destroyed, a fact which Mr. Kay verified by personal investigation. This involved two long days' marches on foot over a difficult mountain, and I was all but entirely prostrated by the severe night on the Tsu-ku-shan pass. In addition, the coolies were breaking down from fever one after another, the stock of rice was nearly exhausted, and an order had been given that supplies and transport southwards were to be refused. My state of weakness rendered it impossible for me to make a resolute attempt to overcome these difficulties, and every traveller here will understand the indescribable reluctance with which I abandoned the Ta-chien-lu project. After it was given up, the T'u-ssu sent a welcome present, consisting of salted goat, flour, honey, and ancient and hairy butter, which enabled me to give my men a good meal, at the same time inquiring if I knew how to repair pianos, as he had one with some broken strings! Later he sent a watch to be put in order.

At this point, the scanty information which I was able to gather concerning the Mantzu may be welcome. I only give as facts, statements on which several persons agreed, and confine my remarks to the

four tribes of the Somo territory, estimated at twenty thousand souls, who are unified under one ruler, the T'u-szu of Somo.

The designation Mantzu, which appears to be simply Chinese for barbarian, is accepted by these people. When questioned, however, they divided themselves into Somo, Cho-ko-ki, He-shui, and other tribes, and on being pressed further, they declared themselves Shan-shan-ren, or mountain people. They said that they had heard that in ancient times their fathers came from the setting sun, but they knew



ANCIENT TOWER, SOMO.

of no days when they and the Chinese did not live among each other. The tribal spirit is completely broken among the tribes, who have accepted one ruler; but the Somo people hate the Sifans to the north-east and the Cho-ko-ki men to the south.

The head of one or more tribes is called a T'u-szu, or lord of the soil. He is appointed directly by the Emperor of China, and for life; but a long-established custom has made the office practically hereditary, and in the absence of a son a daughter may be invested with it, as in the case of Somo, where in recent years, and for a considerable time,

a woman sustained the dignity of the position. It is only in a case of flagrant misconduct that the Emperor would exercise his right of removing a Mantzu ruler. The T'u-ssu has absolute authority over his own tribesmen, including the power of life and death. The land is his, and the cultivator pays the heavy tax of 30 per cent. of the produce, out of which he contributes the annual tribute to China. The tribesmen are free to build anywhere without paying ground rent. Chinese under Mantzu rule have to obtain permission to build, are not allowed to make charcoal, and pay ground rent. In the case of the murder of a Chinese, the murderer may be taken into Chinese territory to be tried by a mandarin, but actually he is rarely caught, and the crime is usually compromised by the payment of blood-money by his relations. If a Chinese wishes for a Mantzu wife, he must pay the T'u-ssu thirty taels (about £4 10s.) for the privilege.

Under the T'u-ssu, and appointed by him, are village headmen or T'eoren, who usually hold office for life, and are frequently succeeded by their sons. They collect taxes, settle disputes, try small cases by tribal law, and meet the T'u-ssu once a month at his castle to report what has been going on and to discuss what has to be done, and once a year to choose the tribal representatives who are to carry the tribute to Peking. China has done wisely in fringing her borders with quasi-independent tribes whose autonomy is guaranteed, and whose love of the freedom they enjoy would convert men and women into a respectable guerrilla force in case of invasion.

The religion of the Mantzu is Buddhism or Lamaism of the Tibetan type. Except in Western Tibet, I have never seen a country in which the externals of religion are so prominent. Nearly all the larger villages have lamaserais on heights above them; rock Buddhas and Buddhas in relief on tablets are numerous; poles 20 feet long, with narrow prayer-flags of nearly the same length, flutter from every house-roof; groups of prayer-flags in memory of the dead are planted beside every village; a temple is prominent on the roof of every well-to-do house; and prayer-cylinders turned by water-power or hand are common near the roads. Daily offerings are made in all dwellings; every second son is a lama; the formula, "*om mani padme hun*," is everywhere heard; the presence of lamas is essential for every act in the round of social and agricultural life; and literature is wholly confined to the Buddhist classics. Prayer-wheels revolved by the wind are common in windows; and when people grow old and dread such an unfortunate re-birth as a reappearance in the body of a horse, dog, or mule, a prayer-cylinder, revolved by swinging it, is constantly in their hands.

The lamas receive large sums for prayers, and for such ceremonies, in cases of illness, as the reading of the Buddhist scriptures in the house, accompanied by chanting, blowing of great horns, and beating of drums. A death is their great harvest, for, besides the fees paid to

them for the services customary at death and burial, any good clothing which the deceased person has possessed is their perquisite, as well as the silver and coral head-ornaments of the women, which go to help to pay the expense of opening a passage for the soul into the other world. According to the wealth of the deceased is the time occupied in this arrangement. It may be three months or longer. In the case of the poor, three days is the limit. A re-birth into the Western Heaven is reserved for lamas.

They dispose of bodies after death by rules of their own. In a few very rare cases, where the horoscope of life, death, and the future is favourable, the corpse is buried "earth to earth" without coffin or clothing. Throwing the body into the river, or exposing it on a mountain-side to the fowls of the air, is also practised at their bidding; but cremation, accompanied by the recitation or chanting of the scriptures, is the usual method. Afterwards the ashes are placed in an earthen pot, which is buried, a prayer flag or flags being erected on the spot. On the days of death and burial, as well as during the interval, there is weeping, but it is not prolonged or repeated, and ancestral worship is not practised.

Among the noteworthy characteristics of Mantzu life is the position of women. They are not only on an equality with men, but receive considerable attention from them, and they share their interests and amusements everywhere. Men and women are always seen together. A woman can be anything, from a muleteer to a T'u-ssu. Social intercourse between the sexes is absolutely unfettered. Boys and girls, youths and maidens, mix freely. Love-matches are the rule, and I saw many a handsome young face illuminated by a genuine love-light. The young people choose each other, and either of them may take the initiative. When they have settled the preliminaries, the prospective bridegroom sends a friend to the prospective bride's parents, informing them of his wish to marry their daughter. Consent follows almost as a matter of course, and the bridegroom sends a present of a bottle of wine to the bride's father, and the courtship is fully recognized.

Next the lamas are consulted, to ascertain if the horoscopes of the youth and maiden fit. If not, the difficulty may be overcome by prolonged vicarious chanting of the scriptures and liberal fees. The lamas also choose an auspicious day for the marriage. The marriage ceremony consists in the bride and groom publicly joining hands, drinking wine from a double-spouted bowl, and accepting each other as husband and wife, after which there is a three days' feast in the bride's home. She and her husband then go to their own house, and there is another three days' feast. There are no contracts of marriages for a limited period, as in Western Tibet. Whether the choice has been for good or ill, it is for life, divorce, rarely resorted to, being permissible only in the case of childlessness, and the contract can only be cancelled by the T'u-ssu.

It would not be correct to infer from this that the Mantzu are a moral people. Their standard of morality is low, and the lives of the Lamas have no tendency to raise it. Plurality of wives is an appendage of the position of the T'u-szu, but monogomy is the rule, and polyandry, though the custom of the Sifans to the north, does not exist. No presents, except the bottle of wine previously mentioned, are made by the bridegroom to the bride's father; but her parents, according to their wealth, endow her with cattle, horses, and fields, the last of which, to use our own phraseology, are "settled" upon her. A widow does not wear mourning, and is at liberty to make a second marriage. On the death of her husband, unless she remarries, she assumes complete control over his property, and at her death it is divided among the sons, who frequently, however, agree to live together and keep it intact. If there is trouble concerning property, the T'eoren usually settles the matter, and if he fails to make an amicable arrangement, it is referred to the T'u-szu, whose decision is final.

Good health is the patrimony of these people. There are a few lepers among them, and rheumatism is rather prevalent; but few maladies are known, and measles appears to be the only epidemic which affects children. I did not see one case of skin disease or deformity on the whole journey. They spoke of old age and what they call "exhaustion" as the usual causes of death. Goitre, however, is frightfully prevalent in many of the villages. In some, 75 per cent. of the people are afflicted by it, and it often begins in childhood. It does not seem to affect either the health or spirits. The people think that it comes from drinking snow-water, but it was specially common in some villages, where the sources of the water-supply are far below the snow. The lamas virtually prohibit all medicines not supplied by themselves, and it is only those Mantzu who have been corrupted by contact with Chinese civilization who use any others. They incline to fatalism regarding illness, relying chiefly on amulets, charms, and religious ceremonies. "If a man is very ill he dies," they say, "and when he is not he gets better."

They have a language of their own, but it is written in Tibetan characters, and all notices and inscriptions on tablets and sign-posts are in the same. In the villages nearest to China proper many of the people speak Chinese as well as Mantzu, and the T'eoren in all villages, but further west very few even of the elders understand it, and the T'u-szu himself is unable to read the Chinese characters.

The products of the Somo territory, so far as export goes, are *nil*. The magnificent timber is useless, as the rivers, from their abrupt bends and enormous boulders, in addition to their turbulence, do not admit of its being rafted down. So far as I could learn, there are no golden sands to tempt even the Chinese adventurer. Sulphur and nitrate of soda abound. The Mantzu grow wheat, barley, oats, maize,

buckwheat, lentils, and a little hemp. In good years they raise enough for their requirements, but more frequently have to barter their cattle and coarse woollen cloth for food. Their transactions consist of barter only, silver being known only for its use in personal adornment. There is no prospect for Manchester in that quarter. Pieces of red and green cloth for the decoration of boots are brought from Russia through Tibet, and these and the brass buttons on clothing, suggestive of Birmingham, are their only imports. Both sexes dress in woollen materials, spun, woven, and dyed by themselves, and sewn with their own hempen fibre.

Their views are narrow, their ideas conservative, and their knowledge elementary. England is not a name to conjure with in their valleys. They know of China and Tibet, and have heard of Russia, but never of Britain. Of the war and the *wojen* they were in complete ignorance. I found them hospitable, friendly, and polite, not extravagant in their curiosity, of easy morals, full of frolic and merriment, singularly affectionate to each other, taking this life easily and enjoying it, and trusting the next to the lamas.

In the regrettable absence of photographs, it is difficult to give any idea of their appearance. There are no under-sized men. They were a little taller than my coolies, who were the average height of Chinese. They are deep chested, as becomes mountaineers; their build is robust, and their muscular limbs betoken strength and agility. Their walk is firm and springy, and in wrestling and putting the stone—favourite amusements—the display of muscle is superb. The tribes vary as to good looks, though not as to physique, especially the women, some of whom have the oval face, regular features, and beauty of the brunette type which we associate with the Madonna, while others are plain and resemble Neopolitans. The complexion is as dark as that of the natives of Southern Europe, but a trifle redder, the large dark eyes and eyebrows are level, the nose straight, the mouth usually small and thin-lipped, the foreheads high but not broad, and the ears large and rendered unshapely by the weight of the earrings. The cheek-bones are not in any way remarkable. The characteristic of the Mantzu face is that it is European in feature and expression, and recalls the Latin races.

The men shave their heads and wear cloth or fur caps, but some of the elders said that in former days all the hair was gathered above the forehead and twisted into a horn wrapped up in a cotton cloth, and often "as long as a hand." A similar style is mentioned by Mr. Baber as characteristic of the Lolos of Yunnan. The *coiffure* of the women is most elaborate. The front hair is divided and plaited into from twenty to thirty plaits not wider than a watchguard, and waxed down each side, considerably reducing the forehead. The back hair, with considerable additions, is divided and brought round the head in two massive coils over a folded blue cloth, which hangs a little over the brow. Strings

of large coral beads are twisted round these coils, but at the sides only. The circumstances of a family are indicated by the size and beauty of the coral and silver of the headgear. Jewellery is largely worn by both sexes—earrings, necklets, chains of alternate coral and silver filigree beads, and bracelets set with large turquoise or red coral. The ornaments are often really beautiful and of fine workmanship. When I asked by whom they were made, they invariably replied, "By the Arabs."

The women wear woollen under-garments, short loose jackets with wide sleeves, and skirts reaching a few inches below the knees, as closely pleated as the kilt of a Highlander, sometimes exchanged indoors for a long loose robe. Dark brown and madder-red predominate in apparel. They wear long leather boots, upon which are stitched up the front and sides decorative strips of scarlet and bright green cloth.

The men wear a gabardine and girdle of native cloth, frequently dark red, over a woollen under-garment, leggings, and decorated leather boots or hempen shoes. The cloth or fur cap is often varied by the Sze-chuan turban. They have no soap, and never wash. A corpse is designated as the "twice washed." In the rarefied air of the high altitudes which they inhabit, some of the most unpleasant consequences of dirt are not apparent. I must add that every house in which I received hospitality was tolerably clean, and that I was not aware of the presence of vermin.

There is a singular absence of bird-life in the Somo territory. A species of francolin and ringed pheasants were seen, the blue jay, the crow, and the ubiquitous magpie. The men said that there are boars, small bears, and deer in the forests, but that the trade in hartshorn and horns in the velvet for Chinese medicines had driven the latter back, "they knew not where."

The T'u-szu's rule only extends for 40 *li* to the south of Somo. He is proud of his practically independent position, and when my servant interpreter presented my Chinese passport, and a letter from the Viceroy of Sze-chuan, he said that he did not read Chinese, and that passports and Viceroy's letters were of no use there! The Chinese officer, finding my farther progress hindered, became very courteous. I learned later that he had been deputed to attend on me, whether as spy or help I know not, as far as Ta-chien-lu.

Somo castle, on its eastern side, is a most striking building, built into the rock of the spur on which it stands. It has a number of windows with decorative stone mullions, the lowest over 20 feet from the ground. Its many roofs are planted thick with prayer-flags, and projecting rooms and balconies of brown wood, with latticework fronts, hang from its eastern side over the precipice. The castle yard is spacious and singularly clean; the entrance is handsome, and is faced by a huge dragon, boldly and skilfully painted on a plastered stone screen. Poles with crowns from which yaks' tails depend, and the trident of Siva, as

in Western Tibet, surmount the entrance. The whole is most substantially built of stone, and I looked in-vain for any trace of decay or disrepair. The altitude is about 7518 feet.

On the return journey I was able to vary the route somewhat, which gave me the opportunity of seeing the interiors of some feudal castles, and the manner of living of the upper classes. The aspect of the scenery was even more beautiful than on the upward journey, the snow deeper and purer, the greenery denser, and the flowers more abundant, and included one beautiful begonia confined to a single pass. From Tsa-ku-lao to Kuan the winds were fearful, the country dusty and scorched, and the crops



GATE OF SOMO CASTLE.

in peril; and the peasants, finding Sakyamuni deaf to their entreaties for rain, were calling on the forgotten gods of the rivers and the hills.

Crossing the Cheng-tu plain for the third time, and with the mercury at 93° in the shade, I arrived in Cheng-tu from Kuan among great demonstrations of hostility from the military students, who were "up" for examination, and learned that there and at Chung-king my friends had been made very anxious by two rumours—one, that I and my whole party had been lost in the snow; the other, that I had been taken captive by the Mantzu, and was being held to ransom! Engaging the lightest boat I could get, I descended the Min at the lowest of low water to Sui-fu, halting for a few days at the pleasant town of Kia-ting Fu, near Omei-shan, and visiting some of the remarkable sculptured cave-dwellings in the sandstone cliffs above the river. From Sui-Fu and the River of Golden Sand, I went to Lu-chau, a city of

much importance; from thence to Chung King, and afterwards in a *wu pan* (an open boat with a mat roof) to I-chang on high water, running the Yang-tze rapids at tremendous speed, and reaching that pleasant treaty port in the middle of June, after what came near being a "record passage" for the season, having accomplished a journey of nearly 1200 statute miles by land and about 1000 by water since I left it on January 31.

Before the reading of the paper, the PRESIDENT said: This evening we welcome an old friend, for I think there are few people, either in or out of this Society, who are not acquainted with the books of Mrs. Bishop. I know of scarcely any country in the world which she has not visited and ably described. This evening she is going to give us an account of a most interesting region, a portion of which was previously unknown, i.e. the mountains in the western part of the province of Sze-chuan, in China.

After the reading of the paper, the PRESIDENT said: We have no longer amongst us Mr. Coleborne Baber or Captain Gill, and I am therefore afraid there is no one in this room acquainted with the mountains Mrs. Bishop has recently visited. I do not know whether any one wishes to address the meeting on the subject of these mountains.

In order to appreciate the importance of Mrs. Bishop's journey, we should bear in mind that this range of mountains, which we call the Tsu-kuh-shan range, is a part of the Himalayan system, and from the Indus to the Min the chain is only broken through in six places. The Tsu-kuh-shan mountains are, in fact, buttresses on the western side of the great Tibetan plateau, by far the largest excrescence on the Earth's surface. These mountains have scarcely ever been visited. Marco Polo was apparently among them, but it requires all the acumen of Sir Henry Yule to tell whether the old traveller is talking of what he has seen or of what he has heard. Mr. Coleborne Baber undoubtedly visited them farther south, and explored them to a certain extent, describing the Lolo tribe; and Captain Gill, our Gold Medallist, crossed a very high pass 13,000 feet, and also went up this tributary of the Min river to a point which is called Li-fan-ting; but beyond that point I believe no explorer had ever been. We therefore, as geographers, have to thank Mrs. Bishop for having explored that tributary to its source, and for having crossed the water-parting and descended down to Somo on the other side. She has not only described to us the physical features of the country, but has also introduced to us a most interesting tribe of mountaineers, handsome, cheerful, and affectionate, living amongst the most beautiful scenery, and forming for travellers escorts of beautiful girls. When Mrs. Bishop resolved to penetrate beyond Li-fan-ting, she was running a very great risk to her life from accidents and other causes, and I have no doubt that her Chinese coolies, if any danger had arisen, would have left her alone in the snow to die. We must remember that Mrs. Bishop considered any risk worth running in order to advance geographical discovery. I therefore think that the thanks of geographers are due to her for having undertaken this perilous and very important journey. We have to thank her for the extremely interesting paper she has read to us this evening, and for the numerous careful photographs she took, which have enabled her to illustrate her paper in a very charming way. I feel sure you will carry this vote of thanks by acclamation.

Mrs. BISHOP'S MAP.—The map has been reduced from a drawing supplied by Mrs. Bishop, and supplemented from her itinerary, but has no pretence of being a correct survey.

THE HORN EXPEDITION TO CENTRAL AUSTRALIA.

THE progress of the expedition to that part of Central Australia generally known as the McDonnell ranges, which was fitted out in 1894 by Mr. W. A. Horn, of Adelaide, has been noticed in these pages from time to time, and we have now before us the completed reports on the scientific work done. The report consists of four volumes in small quarto, and, in addition to these, the journal and maps, by Mr. C. Winnecke, the leader of the expedition, appear as an official government publication, not being included in the volumes produced at Mr. Horn's expense.

The objects of the expedition, as laid down by its organizer, were in the main twofold: first, the scientific examination of the country from Oodnadatta to the McDonnell ranges, and the collection of specimens illustrative of the fauna, flora, and geological structure and mineralogical resources of that region, and the illustration by photography of any remarkable natural features of the country traversed; and, second, the securing of photographs of the aborigines in their primitive state, the collection of information as to their manners, customs, and language, and the reproduction of their mural paintings and designs. The work involved in carrying out this extensive programme was distributed as follows: Prof. Ralph Tate undertook the geology and botany; Dr. E. C. Stirling, who also acted as medical officer, the anthropology; Prof. Baldwin Spencer, zoology and the photographic work; Mr. J. A. Watt, geology and mineralogy; and Mr. C. Winnecke acted as surveyor, pilot, and meteorologist.

The expedition left Oodnadatta, the terminus of the Great Northern railway, on May 5, 1894, and, travelling northward across arid undulating plains, reached the Goyder river on May 14. Here a five days' excursion to the westward was made by part of the expedition, with the object of mapping a number of hill ranges, and the whole party reunited at Engoordina, on the Finke river. Thence the journey was continued to Idracowra through a detached range of table-top hills, and a successful excursion was made to obtain photographs of the remarkable natural monument known as Chambers Pillar. At Idracowra Mr. Horn left the party, which proceeded towards Henbury, following the course of the Finke. The country here consisted chiefly of barren sand-ridges, clothed with porcupine grass, but on the river flats grass grew luxuriantly. The general north-north-west direction was continued until the James ranges were reached, when the route changed to westerly, and traversed rich grassy plains with abundant water, described by Mr. Winnecke as the best pastoral country in South Australia. The ranges, formed of sandstone and quartzite, are of a very rugged character, and densely timbered with acacia. Leaving the Finke river, the valleys of the James range were followed till the Palmer river, the most important

tributary of the Finke, was crossed, and Tempe Downs reached on June 2.

Petermann creek, to the south of Tempe Downs, divides the James and Levi ranges, the main difference between the two being that the former is of very limited extent. Gill's range, more to the westward, is similar to the Levi, and the intervening country is rich in pasture, with much "permanent water." Various fossil deposits in all three ranges were examined, and specimens obtained.

From this point a number of the party visited Ayers Rock and Mount Olga. Beyond Gill's range low sandstone ridges are met with, extending westwards to Laurie's creek, where some valuable fossils were obtained, and where the course of the expedition was changed to northerly, towards the McDonnell ranges. Deering creek, reached on June 16, marked a return to well-watered country, and the journey was then pursued in an easterly direction towards Meerenie Bluff. On June 19 a remarkable valley was entered, to which the name Meerenie valley was given. This valley extends eastwards between wall-like ridges for more than 100 miles, and here the Meerenie escarpment is a noteworthy feature, stretching in an unbroken line for 20 miles, and recurring at short intervals much further eastward. The McDonnell ranges in those parts consist of, apparently, isolated mountains, joined by low ridges, and interspersed with well-grassed plains; the waters are limited, and small in extent. Metalliferous rocks were found here for the first time.

The Ayers Rock party rejoined the main body at Glen Helen, when a survey of Mount Sonder was made. The Finke gorge was reached on June 30, and from there a southerly course was taken, away from the McDonnell range, and across Missionaries Plain to Hermannsburg mission station, where an extended stay was made to complete the examination of the Finke river, Glen of Palms, and the Krichauff ranges to the south, and the McDonnell ranges to the north and east. After various excursions by different members of the expedition to Paisley's and Brinkley's bluffs, and to the north side of the McDonnell ranges, Alice Springs was reached on July 15, and the return journey begun on the 18th. The Ooraminna and James ranges were crossed, and the overland telegraph line struck at Alice Well, on the Hugh river, whence all haste was made to Oodnadatta *viá* Crown Point and Charlotte Waters, the destination being reached on August 5.

We have described the itinerary of this expedition with some detail, because the names of the specialists attached to it are themselves a sufficient guarantee that the work done in traversing so interesting a region is of extreme scientific importance. The reports are issued under the general editorship of Prof. Baldwin Spencer, who is responsible for the detailed narrative occupying the greater part of the first volume. Vol. ii. is devoted to reports on the zoological collections by a number

of specialists, and with it are included some excellent coloured plates. Part iii. deals with the numerous interesting problems of physical geography, with geology, and with botany; and Part iv. is given to anthropology, the papers by Dr. Stirling and Mr. F. J. Gillen on the aborigines being, perhaps, the most valuable part of the whole, inasmuch as they place on permanent record many facts which in a few years' time will be beyond the reach of scientific investigation. Some magnetical and meteorological observations of interest are appended to Mr. Winnecke's journal.

THE FIFTY YEARS' HISTORY OF THE RUSSIAN GEOGRAPHICAL SOCIETY.*

THE Russian Geographical Society could not better celebrate its fifty years' jubilee than by bringing out these three stately volumes, containing 1378 large octavo pages of closely printed matter, and adorned by splendid portraits of the founders of the Society, and its presidents and vice-presidents since its foundation, as well as a map showing the progress of geographical exploration of the Russian Empire, and the neighbouring countries within the last fifty years. This important work could also not have been entrusted to better hands than those of the present Vice-President of the Society, who has belonged to it since the year 1849, and who has taken the liveliest part in all its enterprises.

It would be impossible to give here an adequate idea of the rich contents of these volumes. A simple enumeration of the scientific expeditions, the ethnographical researches, and the economical explorations which were initiated by the Society, or in which it took an active part, would cover several pages, to which several pages more would have to be added to simply enumerate the works of importance published by the Society. Sufficient to say that all these explorations, which in fact include most of the geographical work done in Russia during the last half-century, are admirably summed up. For the geographer, such a compendium is simply invaluable, the more so as very many of the reports of the earlier expeditions are quite inaccessible—the books being out of print or having been destroyed (as was the case with the publications of the Siberian branch during the great conflagration at Irkutsk).

The accounts given of the expeditions can hardly be taken even as summaries of the work done—most of these being too short for

* 'History of a Half Century of Activity of the Russian Geographical Society, 1845-1895.' By the Vice-President of the Society, P. P. Semenov, with the collaboration of A. A. Dostolevsky. St. Petersburg: 1896. 3 vols. Large 8vo, with portraits of the Presidents, Vice-Presidents, and Founders of the Society (Russian).

such a purpose; but, after a perusal of these volumes and their name-indexes,* one knows, at least, what sort of information to expect in the reports of such an expedition, and at once sees what it did to extend geographical knowledge. It is to be regretted, however, that the admirable collection of the "Memoirs" of the Society and its branches is analyzed too rapidly—only the titles of the papers being given. The consequence is that all the work that has been done by the explorers *after* their return from an expedition, in order to grasp the general character of the country, as well as most of the work independent of special expeditions, is not analyzed at all in these volumes. Quite remarkable investigations, such as, let us say, Severtsoff's 'Orography of the Tian Shan,' or such separate works as that on the 'Village Community in Russia,' by Semenov himself, are only mentioned by their titles. The same is true concerning all the scientific generalizations arrived at by explorers in the full reports of their expeditions. It must be said, however, that a fourth and a fifth volume would have to be added if that limitation had not been made—the publications of the Society having attained the colossal figure of 246 volumes (89,300 pages) during the first twenty-five years of its existence, and 204 volumes (99,300 pages, many in quarto) during the last twenty-five years.

The Russian Geographical Society was founded in 1845, by a small number of men, among whom we find the great biologist, Karl Baer, and the great astronomer, Karl Struve; the naval explorers, Admiral Krusenstern, Baron Wrangel, and Admiral Ricord; the explorers of Asia Minor, the Aral-Caspian region, and the Kirghiz steppes, P. Tchihatcheff, Vronchenko, and Levshin; the statistician Köppen; the Russian writers, V. Odoevsky and K. Arsenieff; and the great Russian lexicographer and ethnographer, V. Dahl. The statutes of the London Geographical Society were taken as a foundation for the statutes of the Russian Society; and its aim became, from that early date, the *Erdkunde* of Russia—a word which Karl Ritter had accepted about this time as the title of his work, instead of the word "Geography," which stood on it before. Without entering into academic discussions as to the scope of geography, the founders of the Society, owing to the very varied inclinations of its founders, at once divided the Society into four sections—geodesy and cartography; physical geography; ethnography, anthropology, and historical geography; and statistics and political geography. This division proved to be most advantageous, and is maintained until now.

The history of the Society is divided by the author into five periods. The first four years (1845–1850, vice-presidency of Th. P. Lütke) were

* A subject-index would greatly add to their value, and we earnestly hope that such an index will be made.

the organizing period, during which only one expedition (the Ural expedition, under Hoffmann) was sent out.

The next seven years (1850–1857, vice-presidency of M. N. Muravioff) were the period when the national character of the Society was finally developed. The exploration of Russia became the watchword. A number of well-known Russian writers (the Slavophile Aksakoff, and many others) joined the Society and explored Russia itself—its ethnography, the peasant life, the village fairs, etc. The Siberian and the Caucasian branches were opened, and were placed in an associate but quite independent position. The first Siberian expedition (under Colonel Akhte) was sent out, but its most valuable results were never published.

The third period may be taken from 1857 to 1871 (vice-president, Count Th. Lütke). During that period a very great number of expeditions to Siberia, Turkistan, Manchuria, Mongolia, Kashgaria, Kulja, and Khorassan were sent out, by both the Society and its two branches. Caucasia and the Aral-Caspian region were busily explored. At the same time two great expeditions were at work in Russia itself, for the exploration of the trade in corn and the directions it took with the development of the railway net, and of the ethnography of Western Russia. The publications of the Society became very numerous, the Siberian expedition alone yielding a rich mine of information about Siberia, the newly annexed Amur and Usuri regions, and Sakhalin.

To the fourth period (1871–1885) M. Semenoff gives the name of Period of Prjevalsky's expeditions. Central Asia and Western China were busily explored, as well as Mongolia and Turkistan. More detailed scientific explorations began in Novaya Zemlya, Siberia, and Turkistan (polar meteorological stations, geological researches, works on the flora and fauna, on anthropology, etc.).

Turkistan was minutely explored, especially by Severtsoff and Fedchenko, who was sent out by the Moscow Society of Naturalists; the Amu-daria and the Aral-Caspian territory became the theatre of exhaustive explorations; a levelling across Siberia was made, and the deserts of North-East Siberia, as well as the depths of Lake Baikal, were explored; a sea route from Tobolsk, *vid* the Kara sea, to London was opened. Within Russia proper a mass of work was done by the General Staff, the Academy of Sciences, the Meteorological Observatory, various ministries, and so on, and the results of all these researches were communicated in most cases to the Society.

And, finally, to the fifth period belong the years 1885–1895. The work of Prjevalsky was continued by Pyevtsoff, Roborovsky, and Kozloff; while Berezovsky, Bogdanovitch, Obrucheff, Potanin, etc., completed the reconnoitring work of Prjevalsky by thorough investigation. The Siberian branch of the Society divided into three branches (West Siberia, East Siberia, and Amur), each of which displayed a great

activity. Turkistan, Caucasia, the Amur region, the Black sea, were thoroughly explored by scientific expeditions, while within Russia a vast amount of work was done for the study of magnetism and gravitation, for exact levellings, the study of lakes, of glaciers and their movements, of the flora and fauna of wide regions, as well as the anthropology, the archæology, and the ethnography of many parts of Russia.

All these undertakings—their genesis, their accomplishment, and their results—are analyzed in succession in the 'History' of the Society, some parts of these volumes reading with sustained interest, like a good geographical work, full of condensed information about large parts of the great continent of Asia.

P. K.

COSTA RICA.*

By Colonel GEORGE EARL CHURCH.

ALONG the northern border of this little Central American state runs the line of the projected Nicaragua ship canal, and, almost within sight of its southern frontier, the Panama canal. The realization of the former is adopted as a "plank" in the "platform" of both of the great political parties of the United States, and it is not impossible that the Senate bill, now before Congress, may evolve another, looking to the cutting of the canal for government account. This would bring the Clayton-Bulwer treaty again into prominence; and it is perhaps largely due to this reason that the confirmation of the International Arbitration Treaty between the United States and Great Britain hangs doubtfully in the balance, and may not be approved until the canal question is decided. On the other hand, at least two thousand men are quietly delving on the isthmus of Panama, trying to reach such a point with the works as will convince the financial world, and perhaps the French government, of the absolute practicability of that canal route. The company phase of each project gives signs of dying out, and, possibly, we may see the French and United States governments enter the lists, with their millions and their energies, in the race for the opening and control of a water avenue between the Atlantic and Pacific oceans. The country which, on either side, is flanked by one of these projects promises to become a political factor of moment.

During a recent voyage to Costa Rica, I had facilities afforded to me to collect data of geographical value, much of which will be found in the map accompanying this paper. Besides details from many sources, including some from my personal observation, it contains the recent explorations of Prof. Henry Pittier, and geographical facts from the railway surveys made by the engineers of Mr. M. C. Keith. The coast-lines have been laid down from Admiralty charts, but corrected in some cases. At best, the map is but a rough approximation to accuracy. I know of no Spanish-American country, except Ecuador, the mapping of which has been so rudely done; everything seems elusive—even the volcanoes waltz around, in despair of a permanent abode.

With the exception of San Salvador, Costa Rica is the smallest country of the New World. Its area cannot be accurately defined, owing to its unsettled boundary with Colombia, but, exclusive of the part in dispute, is about 21,000 square miles. The most northern point of Costa Rica is in lat. 10° 12' N., and its most western, Cape Morro Hermoso, is 85° 50' long. W. from Greenwich.

* Map, p. 128.

No minister for foreign affairs of any Spanish-American republic is happy unless his country has, at least, one undefined frontier line. Until recently, Costa Rica had two, one on the north, with Nicaragua, and one on the south, with Colombia. The former was settled by the arbitration of the President of the United States, March 25, 1888. He determined that the Treaty of Limits made in 1858 and ratified, but never traced, between the two countries was valid, article second of which runs as follows:—

“The dividing-line of the two republics, starting from the northern sea, shall commence at the extremity of the Punta de Castilla, at the mouth of the San Juan river of Nicaragua, and shall continue its course along the right margin of said river to a point 3 English miles distant from the Castillo Viejo, measured, from the exterior fortifications of said castle, to the point indicated. From there a curve will start, the centre of which shall be said works, and shall preserve a distance of 3 English miles from it throughout its development, terminating at a point which shall be 2 miles distant from the bank of the river, up stream from the castle. From there the line shall continue in the direction of the river Sapó, which empties into the lake of Nicaragua, following a course always 2 miles distant from the right margin of the San Juan river with its circumvolutions to its origin at the lake, and of the right margin of the lake itself to the said river Sapó, where this line, parallel to said margins, will terminate. From the point of intersection with the river Sapó, which, from what has been said, should be 2 miles distant from the lake, a right astronomical line shall be drawn to the central point of the Bahía de Salinas in the southern sea, where the demarcation of the territory of the two republics shall terminate.” *

The arbitrator (President Cleveland) also confirmed and more clearly defined certain consultative rights accorded to Costa Rica by the treaty of 1858, in event of Nicaragua desiring to grant any inter-oceanic canal concession.

It would be difficult to define a boundary-line with less mathematical precision. With reference to her southern boundary, Costa Rica has been in dispute with Colombia since the independence of both states. The latter has never ceased to claim jurisdiction over the entire Caribbean coast of the former, and even over that of Nicaragua as far north as Cape Gracias á Dios; and numerous official recognitions of these claims, on the part of Great Britain, during the Spanish domination, up to 1825, assisted in keeping them alive, even after Spain had abandoned her effort to retain control of her viceroyalty of Santa Fé de Bogotá. So late as 1886, I find Colombia, in an arbitration convention signed with Costa Rica, claiming the Caribbean coast as far north as Cape Gracias á Dios, but the Pacific coast only as far west as the river Golfito, which empties into the Golfo Dulce; while Costa Rica as stoutly held that her sovereignty on the Atlantic side extended south-east to the island of the Escudo de Veragua, and, on the Pacific coast, to Punta Burica. That is to say, she claimed her frontier to be that of the ancient Ducado de Veragua, which follows the course of the Chiriqui Viejo to the crest of the Cordillera, and crosses it to the headwaters of the river Calobebora, and thence down its course to the Escudo de Veragua. Spain, to the government of which the

* A commission was named by the two republics to trace this boundary, and met at San Juan del Norte in 1890; but it is claimed, in Costa Rica, that at every step, the Nicaragua commissioners opposed vexatious obstacles, to the extent of making it impossible to carry out the terms of the treaty, and finally the Costa Rica commissioners proceeded to trace the boundary-line alone. This opposition on the part of Nicaragua probably arose, principally, from her unwillingness to abandon the hope of again possessing herself of her ancient province of Guanacaste, now belonging to Costa Rica, but which the latter will certainly never peaceably abandon.

question was once submitted to arbitration, failed to decide it within the period of time stipulated, and Colombia retired from the arbitration. She subsequently pushed her occupation of the debatable ground north-west, to a line ascending the above river Golfito, thence following the hills of Las Cruces, between the valleys of the Rio Coto de Tériba and the Chiriqui Viejo, to finally gain the crest of the main Cordillera, and descend its northern slope to the rivers Yurquin and Sisola.

Most of the district lying between this line and that claimed by Costa Rica is, especially on the Pacific slope, as little known as it was in the days of Columbus, and when I was in Costa Rica, I found the utmost apathy prevailing in government circles regarding it; in fact, no one appeared to take the remotest notice of the advance of Colombia north-west, almost the entire attention of the country being dedicated to the central belt occupied by the Costa Rica railway and the cart-road to the Pacific, and the territory lying north of these—utterly neglecting the magnificent lands in the southern part of the republic. Volumes have been written in defence of the respective claims of Costa Rica and Colombia, resulting in a rich collection of documents, at least valuable as showing how Spain, in the colonial period, frequently varied the jurisdiction of her viceroys and captains-general, to temporarily suit political requirements, or to favour certain conquistadores, or to readjust ecclesiastical areas of control, or to better defend coast-lines—the latter probably being the reason why, in 1803, the coast of the Caribbean sea, as far north as Cape Gracias á Dios, was (but only by administrative royal order, not by royal cedula or decree) entrusted to the viceroy of Santa Fé de Bogotá, it not then being accessible and defensible from the seat of government of the captain-generalcy of Guatamala, by which, notwithstanding the order, it continued to be governed. On November 4, 1896, Colombia and Costa Rica signed another convention, submitting their boundary dispute to the arbitration of the President of the French Republic, or, failing him, to the President of the Swiss Confederation.

OROGRAPHY.—What fragmentary data exists regarding the orography of Costa Rica is mainly to be credited to the studies of Frantzius, Oersted, Hoffmann, Seebach, Gabb, Scherzer, Wagner, and Pittier, but principally to the latter, who, for many years in the employ of the government of that republic, has earnestly devoted himself to the scientific study of a country which scarcely realizes the importance and value of his work.

The mountains of Costa Rica are not a continuous cordillera, although, in general, they extend from the frontier of Colombia to within a few miles of Brito, at the south-western corner of Nicaragua. Between the northern volcanic section and the more regular, southern, Talamanca range is found a depression about 20 miles broad, from $9^{\circ} 40'$ to 10° north latitude, and a little less than 5000 feet above sea-level at the water-parting. To the eastward, through this gap, and in a broad and deeply eroded valley, runs the tumultuous river Reventazon, and to the westward the Rio Grande de Pirris. Bounding the depression on the south, the Chirripo Grande mountain mass sends off two immense flanking counterforts, one east to the Atlantic shore, and one west to the Pacific coast. A part of the latter, lying between San Marcos and Santa Maria, is, for a length of about 6 miles, known as the Dota ridge. This entire, lofty, transverse, and precipitous barrier almost forbids communication between the northern and southern halves of the republic, and must at all times have had a marked influence on the movement of races in this part of Central America.

Both the northern and Talamanca sections present lines of mountain masses, instead of ranges of serrated crests like many Andean chains of South America. Those of the Talamanca portion are Rovalo, 2150 metres (7050 feet) elevation above the sea; Pico Blanco, 2914 metres (9560 feet); Chirripo Grande, 3500 metres

(11,480 feet); and Buena Vista, 3299 metres (10,820 feet), the last two forming a part of the same mass. Those of the north-west are Turalba, 3358 metres (11,000 feet), Irazú, 3414 metres (11,200 feet) (both volcanoes belonging to the same mass); Barba, 2846 metres (9335 feet), and Poas, 2644 metres (8675 feet) (volcanoes both of the same basaltic mass); and thence the irregular, broad, and volcano-dotted chain, about 60 geographical miles long, which extends north-west, gradually breaking down to the river Sapóá boundary of Nicaragua. In this short distance of 60 miles are found the Cerro de la Vieja, 2075 metres (6808 feet); Monte Muerto, 2255 metres (8000 feet); the beautiful volcano Tenorio, 2042 metres (6800 feet); the volcano Miravalles, 1423 metres (4665 feet); the volcano Rincon, 1371 metres (4498 feet); and the volcano Orosi, 1583 metres (5195 feet). These mountains, so far as they have been examined, are found to be of eruptive origin, basalts and trachites predominating; but extensive sedimentary rock formations are found upon their slopes, as well as vast, loose deposits composed of boulders, clay, earth, and volcanic material.

The number of peaks of volcanic origin south of the Reventazon valley is small, but the Dota ridge shows a double volcanic crater. The Pico Blanco is not volcanic. There are no signs of recent volcanic activity in the Talamanca range, but the volcanic section from the Reventazon north-west, at certain points, gives signs of life. Turalba still smokes, Irazú simply slumbers, and its crater clearly indicates that the volcano is not extinct. This is also proven by the constant seismic disturbances to which the cities of Cartago and San José are subject. The crater of Poas is barely dormant, and Pittier believes that it took part with Irazú in the series of thirty-seven earthquakes at San José from February 25, 1888, to January 1, 1889, with eighteen more to February, 1889—the principal, December 30, 1888, being very destructive to the city. All these shocks were undulatory.

Only Irazú appears to have ejected compact lavas, but at a remote period. Turalba had a famous eruption of sand and ashes in 1864. Its heaviest eruptive fragments have fallen to the west, and Seebach classifies them as andecite. Its eruption of August 17, of the latter year, lasted to March, 1865. The one of February 1, 1866, accompanied by heavy earthquakes, sent its ashes to Puntarenas. In 1723 there was a grand eruption of Irazú; and from that date to 1851 there were seven very violent ones, the last, as well as one of 1841, almost completely destroying Cartago.

The peninsula of Nicoya, forming a part of the province of Guanacaste, is partly elevated plain and partly hills and low mountain ridges, seldom attaining a greater elevation than 1500 feet. It is densely forested, and has not, so far as I know, been explored by any scientific traveller.

The few geologists who have visited Costa Rica agree that its orographic system, including even as far north as the isthmus of Tehuantepec, greatly differs in character, and is of a more recent age than the cordillera of the Andes or the mountain ranges of Mexico and Western North America, and should not be classed as a continuation of them. Pittier holds strongly to this opinion. But this view should be accepted with caution, for there are evidences tending to controvert it, notably the Agucate and Avengares, low mountains and hills which lie along the north-western slope of the volcanic range of Costa Rica, and extend far to the north-west from the valley of San José. These present abundant evidences of being of the oldest geologic formations. Any accurate geologic study is, of course, rendered difficult by the dense tropical vegetation which covers almost the entire country.

In weighing existing data, there seems no doubt that Costa Rica once formed part of a vast archipelago extending from Panama to Tehuantepec. The divide between the two oceans at Panama is 286 feet above sea-level, and the narrow strip of land separating Lake Nicaragua from the Pacific is only about 150 feet

elevation. This is the lowest inter-oceanic depression of the western continent, between the Arctic ocean and the Straits of Magellan. It is clear that the Caribbean sea once connected with the Pacific ocean through the valley of the river Reventazon, up which the Costa Rica railway now climbs to reach Cartago and San José. At its Las Lomas station, about 700 feet altitude above the sea, in the Bonilla-cliffs cutting, are found fossil sharks' teeth (one I have is $2\frac{1}{4}$ inches long), compact masses of sea-shells, fossil fish, and petrified wood full of borings of the *Teredo navalis*. At an elevation of 2500 feet, large deposits of compact shell limestone, out of which lime is made, are also found. Blocks were cut from it to build bridge abutments.

Bishop Thiel brought from the lower course of the Rio Frio fragments of a great vertebrated fossil; and I have just learned that, a few months ago, the workmen, cutting down a small hill at Port Limon, found the skeleton of some huge fossil animal, which was sent to Germany. All these discoveries are, no doubt, proofs of extensive sedimentary deposits. Gabb says that "more than half the area of Talamanca is covered largely by ancient sedimentary rocks, highly metamorphic, while the coast is revetted with small portions of rocks even more recent." Oersted found fossiliferous caps in Ecazú and New Cartago.

A greater ancient strait than the one previously mentioned must have existed across the valley of the San Juan river and Lake Nicaragua, the waves of its southwestern shore washing the base of the volcanic sierras which stretch from Turialba to the extreme north-western frontier of Costa Rica. I was deeply impressed with the truth of this as I stood upon the summit of a northern spur of Irazú and saw, spread out below me, the densely forested valley of the Rio San Juan. Although the mountain range behind me had evidently been uplifted, and numerous volcanoes had piled their *débris* high above the general level, to these were due in part the vast inclined plain before me, which, with a very low ridge that pushes northward between the rivers Frio and San Carlos, form the dam which holds Lake Nicaragua in its present place at a mean elevation of 106 feet above the sea. The amount of detritus which is yearly torn from the mountain slopes and launched into the valley of the San Juan, by almost numberless torrential streams, is enormous. The boulders are left near the base of the foothills, the gravel a few miles lower down, and then the rivers, having tamed their violence, drop their muddy wealth along the rest of their course, to make the plain one of the richest in the world.

On the whole, the mountain ranges and masses of Costa Rica lie nearer the Pacific coast than the Atlantic; but when they were first uplifted, such probably was not the case. The Pacific slope is still bold to the water's edge, margined almost throughout by headlands and lofty hills, and offers fewer evidences of the extensive denudation and erosion so characteristic of the Atlantic side; for here it is that the mountains present their bold front to the north-east trade winds and say, "Thus far shalt thou go and no further." I know of no mountain barrier from Cape Horn to British Columbia, on either side the continent, not even the eastern Andean slopes of Ecuador, Peru, and Bolivia, against which the rain-laden winds wage such ceaseless and relentless warfare. I rode from San José across the pass, 1500 metres (4920 feet) above sea-level, between Irazú and Barba, nearly to Carillo. The ride to the summit was easy; but rarely in the South American Andes have I seen such perpendicular, dark, and profound gorges as I found carved out by the storms on the northern slope of Irazú.

COASTS AND RIVERS.—Under the conditions above stated, it might be supposed that the ocean soundings on the Pacific coast would be much deeper than on the Caribbean, but such is not the case; a 150-fathom contour-line along the former

averages a greater distance from the shore than along the latter. This is probably due to the great counter-current which, from the northward, scours the entire Caribbean coast of Costa Rica. There is a notable difference between the outlines of the two coasts—the eastern is regular and slightly concave to the south-west, while the western is indented with large and small bays and gulfs, several of them of great commercial value. The most northern of these, Salinas bay, belonging part to Nicaragua and part to Costa Rica, is a spacious, deep-water harbour, overlooked by the volcanic peak of Orosi. It is only 20 miles from Lake Nicaragua *viâ* the river Sapoá, which empties into the lake, and was for centuries held to be the best route to the Pacific for the projected ship canal; but the long intervening height of land was found to present greater obstacles than the shorter cutting adopted between the lake and Brito, although the latter, as a terminus, is infinitely inferior to Salinas bay. Secate point separates this from Elena bay, containing the excellent, deep, land-locked Port Elena and the inferior one of Juanilla. On the south, a hilly, broad, irregular peninsula pushes seaward about 15 miles, and terminates at Cape Elena. Continuing south, we come to Port Culebra, probably the finest harbour on the west coast of America between San Francisco and Cape Horn, and destined to become the principal west-coast port of Costa Rica. It opens to the south-west, between Punta Mala on the north and Punta Cacique on the south. It is one mile wide, with a depth of 18 fathoms, the water gradually shoaling to the head of the harbour to 5 or 6 fathoms within a mile of the shore, and anchorage in mud and sand anywhere. It is surrounded by mountain spurs and plateau-topped hills. Several little bays scollop its margin. From one of them, called Bahía Panama, the shore rises gradually inland, and offers access to the province of Guanacaste. The only signs of man, in the whole circumference of this magnificent harbour, are three or four wretched cabins.

South of Cacique point lies Cocos bay, practically a slightly sheltered roadstead with anchorage for perhaps a dozen ships, which in winter may be thrown on the shore by the violent west and south-west gales. The horns of this crescent-shaped, mountain-encircled bay are lofty headlands about $1\frac{1}{2}$ mile apart. A cart-road, much used for the exportation of cedar and other woods from the interior, terminates on its eastern shore, but the difficult traffic over the road promises to soon cease. The crenellated coast-line south of Cocos bay, bordered by mountains and lofty hills, and cut into gorges by small and impetuous watercourses, presents no harbour of importance as far as Cape Blanco, which marks the northern entrance to the extensive Gulf of Nicoya. This, penetrating inland 50 miles north-west, is a magnificent sheet of water surrounded by grand scenery, rivalling, if not surpassing, that of the Bay of Naples, the Bosphorus, or the harbour of Rio de Janeiro. Some twenty islands, large and small, nearly all bold, rocky, and covered with vegetation, contribute to its beauty; while as many small rivers, draining the slopes of the Miravalles and Tilarán sierras, and the mountains of the peninsula of Nicoya, flow into it and diversify the scenery. The principal river, the Tempisque, enters at the head of the gulf, and with its numerous small branches irrigates much of the province of Guanacaste. All of these streams have bars at their mouths, composed generally of mud and broken shells, and only a few of them are navigable a short distance inland for very small craft. Cape Blanco is surrounded by rocks, and the coast, from there and far up the gulf beyond Ballena bay, throws out reefs sometimes a mile from the shore. The latter bay, flanked on both sides by bold promontories, lies about the centre of the south-east front of the peninsula of Nicoya, and is a deep, well-sheltered harbour, but seldom used except by the few coasting craft requisite for the wants of the neighbouring, almost unpopulated district. As far north as the island of San Lucas, which is the penal settlement of

Costa Rica, the west side of the gulf is full of reefs, rocks, and violent currents, and its numerous small bays are only accessible to little craft of a few tons burden, except with great danger. From San Lucas to the head of the gulf, the west side is also lined with reefs and banks, and has dangerous currents, while the little bays are sometimes bordered by swamps and arid wastes stretching far inland. The whole eastern part of the peninsula of Nicoya is broken into hills and low mountains, wild and rarely cultivated, with a hut or two at intervals, although there are to be found many beautiful and fertile valleys. Chiri, at the head of the gulf, is the principal island. It produces salt and cattle, but is half abandoned.

The eastern shore is less beset by obstacles, and small craft coast along it with ease, and at high tide penetrate a few of its many rivers. It rises rapidly a short distance inland, but is at times bordered by mangrove swamps. Near the mouth of the little river Aranjuez, and on a sandspit 3 miles long, stands Puntarenas, the only port of entry of Costa Rica on the Pacific coast. From 1814 until recently, it did nearly the entire foreign trade of the country, which, however, was very little. Ocean vessels anchor from 1 to 2 miles off in the roadstead. There is an iron pier for loading and discharging barges and small craft. The population of this miserable and fever-infested port is about 2800.

From Puntarenas southward to the unnavigable river Barranca, there is a broad beach, which afterwards rises towards the high escarpment of Caldera, upon which it has been proposed to place a powerful battery; but for what purpose, except to fire salutes, is not apparent. The Rio Grande de Tarcoles, which enters the gulf south of the Barranca, has a dangerous bar; but, once inside, it may be navigated a few miles against a very violent current. Its upper waters irrigate the tableland of San José, Alajuela, and Heredia, in the neighbourhood of which towns is grown nearly the entire coffee crop of Costa Rica. About 4 miles south of the mouth of the Rio Grande de Tarcoles is the little reef-encircled roadstead of Tarcoles, surrounded by rocky hills, and boasting a town of four huts. It is one of the two or three points selected as the terminus for a railway from San José to the Pacific, which the government has just undertaken to build for its own account. South of Tarcoles is the useless bay of Herradura, which is the largest on the east side of the Gulf of Nicoya. The coast-line here is rocky and precipitous, which is also its general character until near Punta Mala or Judas, at the southern entrance of the gulf, which is low and surrounded by reefs and rocks. Mount Judas, approximately 300 feet high, is about a mile from the point.

In the Gulf of Nicoya summer is the dry season, and is from November to May. The heat, although very severe, is tempered by the winds of the gulf; but in winter—May to November—the air is saturated with moisture and is difficult to breathe, and the heat is at times almost intolerable. Puntarenas is one of the places where rain is most frequent, but its duration is short. In September it rains occasionally for entire days. The west side of the gulf has the least rainfall. Nearly all the gales are from the east, east-south-east or east-north-east; but, after spending their force on the east side of the gulf, they drive to the west, where they meet a counter-current of air which prevents their reaching the coast of Nicoya. The gulf is full of currents and eddies running from 1 to 3½ miles per hour, and is subject to severe squalls, which, from the north-west, rush down from the sierras.*

From point Judas, low and covered with mangrove swamps, the coast trends south-east to point Llorena in a long, irregular curve, concave to the south-west, for a distance of about 100 marine miles, measured along the shore-line, which, at

* I am indebted to Fradin for much of my information regarding the Gulf of Nicoya. The report of his exploration of it, which he made to the Costa Rica government, is interesting and valuable.

times low and sandy, is dominated by lofty hills, cut at intervals by short, impetuous streams and a few estuaries; but, within this curve, for a distance of 18 miles, between the mouth of the river Naranjo and Dominical point, the sand beach is broken by numerous little rivers, not accessible even to boats. The only safe anchorage in this 100-mile stretch is Urita bay, behind a rocky reef; but there is no useful communication with the interior even here. From the precipitous headland called Punta Llorena to Burica point, the southern limit of Costa Rica, the coast is abrupt, soon rising inland into ridges and peaks from 300 to 700 metres (985 to 2300 feet) elevation above the sea. These give birth to a few short, turbulent streams. About halfway between these two points, the great Golfo Dulce, having a mean width of 6 miles, penetrates inland, north-west, about 28 miles. It has an average depth of 100 fathoms. It was discovered in 1516 by Gaspar Espinosa, who named it the Gulf of Osa. Cape Matapalo, which marks its western entrance, is steep and forest-covered; but Baco point, opposite to it, is low. At the head of the gulf is found the little bay of Rincon. From here to the Esquinas river, at the north-east angle of the gulf, the shore is hilly, and thence to the harbour of Golfito, which is surrounded by high hills, the country rises rapidly inland; but between Golfito and the entrance to the gulf it is lower and less broken, and thence to Platanas point and Burica point (the former rising abruptly to a height of 2300 feet) the coast is bold, the country descending gradually from the north-east. From Point Llorena to Point Burica the coast is wild and almost uninhabited. Even the Golfo Dulce has but a few hundred half-breeds as the sole occupants of its shores. The peninsula would, like that of Nicoya, be an interesting study for an explorer, but the name of its sierras, "Salaipuedes," is not inviting. It might be of importance to Costa Rica if her government were to have the district between the head of the Golfo Dulce and the rich, secluded valley of the Rio Grande de Terraba explored, with the hope of finding a feasible outlet to the sea for the wealth of that beautiful region. The efforts which have been made to open a transitable road to it from the north, ever since the time of the Spanish conquest, have proven futile.

There are but two rivers of moment in the long coast-line from the Gulf of Nicoya to the Golfo Dulce, the Rio Grande de Pirris, and the Rio Grande de Terraba. The headwaters of the former, described by von Frantzius, run in deep cañones, with steep sides almost bare of vegetation, until the region of Guatil is reached, when dense forests are encountered. The surrounding sierras are formed of diorite rocks, but in the mass of Iscazú a nucleus of sienite is found. On the southern side of the ridge, separating the Tarcoles from the Pirris, Miocene, calcareous deposits are met, covered by a sandstone formation, near which there are veins of lignite. The lower valley of the Pirris presents a cap of red clay, which is unable to absorb the rains, and, as the waters do not readily drain off, they become stagnant, and make the district baneful to man.

The valley of the Rio Grande de Terraba, a large part of which was explored and mapped by Prof. Pittier in 1891, was previously a *terra incognita*. Leaving San José, he reached the densely wooded crest of Mount Tablazo, 1826 metres (5990 feet) above the sea. Like the neighbouring Carpentera ridge, he found it of sedimentary formation, Jurassic, or perhaps inferior Cretaceous, showing everywhere a well-characterized stratification of more or less silicious limestone, containing at times great quantities of petrified mollusks (*Pecten*, *Ostrea*, etc.). He also noted many evidences of glacial action. Crossing the Alumbre valley, where traces of coal are found, and the bridge of the Rio Candelaria, 1215 metres altitude (4086 feet), and again ascending to 1548 metres (5080 feet), the torrent of Tarrazú is reached. Thence through beautiful woods, mostly of oak, the track mounts to the Alto del Abejonal, 1900 metres (6234 feet), probably the northern terminus of the *parámos* which are

characteristic of Colombia and all the Andean tablelands. It then descends to the Parrita Grande, 1340 metres (4396 feet), the most southern affluent of the Rio Grande de Pirris. Ascending the Pirrita, and climbing over a very broken country to the divide, 2933 metres (9620 feet), which separates it and the Rio Macho watershed of the Reventazon from the Rio Naranja, Pittier found *en route* three species of oak, as well as conifers, and says, "No doubt these are scattered all along the cordillera from Orosi to the frontier of Colombia." Following the divide, 3299 metres (10,820 feet), through the woods south-east, "by an abominable, infernal track full of numberless mud-holes and tangled roots," a point, 3022 metres (9915 feet), is reached on the Sierra de Buena Vista. "It is not strange that this road is strewn with skeletons. Even men cannot always resist the fatigues of these tremendous journeys. Many of them sleep their last sleep on the plain of Qusero, or at the Ojo de Agua." From Buena Vista, 3299 metres (10,820 feet), three of the principal rivers descend, while the Parrita Grande has its source in one of the main spurs of the same mountain mass.

By a quick descent, the "abominable" road passes La Muerte, 3132 metres (10,274 feet), at the head of the valley of the Rio General, and, continuing along a ridge separating two of the tributaries of this stream, reaches the ford and *rancho* of El General, 660 metres (2165 feet) elevation. At 2273 metres (7455 feet) the oak is still found in the forests. The beautiful and extensive valley which now greets the eye is one of the most fertile of Costa Rica, but is occupied by only a few families. Formerly it was the home of a large indigenous population. In the angle of the rivers Buena Vista and Chirripó exists a vast ancient cemetery, the graves of which have been despoiled in search of the many ornaments of gold they contained—principally golden eagles. Part of an ancient paved road runs near.

The track then continues, over a rough and broken alluvial valley, to the hot, humid, cattle-raising centre called Buenos Ayres, having 25 to 30 *ranchos*, and about 180 population. The grove-dotted lands are of exceeding fertility. Along his route Pittier met a troop of white-faced monkeys; "one of the females had a red passion flower as a decoration in each ear, an early trace of the feminine love for ornamentation." In seventeen hours he crossed twenty-eight torrents. In this valley they have gales of frightful violence. The beautiful volcano of Chirripó, 3500 metres (11,485 feet), the loftiest dome of Costa Rica, overlooks the valley of El General. Between the Pico Blanco and the Chiriqui frontier of Colombia, the cordillera of Talamanca is entirely unexplored, and is said to be occupied by a fierce tribe of Indians called Rayados, on account of the rectilinear painting with which they cover their bodies and faces. From Buenos Ayres to the sleepy and unhealthy town of Terraba, 274 metres (900 feet), with its 50 to 60 *ranchos* and 250 population, the district is hilly, with occasional meadows interspersed with groves. The great bend of the Rio Grande at Terraba is formed almost entirely of a thick bed of red clay, covered with a cap of vegetable earth. From Terraba to Boruca (466 metres (1528 feet) elevation) is a scattered group of 65 *ranchos*—about 350 inhabitants. In 1850, Captain Colombel reported his discovery of the "Laguna de Sierpe," 2½ miles in circumference, near the mouth of the Rio Grande. This reported discovery has been much disputed; but Pittier, although he did not visit the spot, collected evidence confirming its existence. The Indian inhabitants of Boruca are called Bruncas—are dolicocephalic. The men are large, the women short and plump. They are a more intelligent and active people than the Tishbi of Terraba.

This interesting valley of the Rio Grande de Terraba is only accessible, from the north, by the route above described. A road along the coast would become lost in intransitable gorges of the coast range of mountains, which rise from 200 to 1200 metres (2938 feet) above the sea. The greater part of the valley has a privileged

elevation for tropical products. Up to 500 metres (1640 feet) it is suitable for rice; from 200 to 1500 (635 to 4920 feet) it yields the finest beans; while maize grows everywhere luxuriantly. Cacao, tobacco, and sugar-cane give phenomenal crops, while coffee finds a congenial soil and altitude to warrant its extensive cultivation. The months from November to March, which are the summer of the Pacific slope in Talamanca, are those of continuous rains on the Atlantic side, where also the dry months—from April to September—correspond to the wet season on the south-west side of the cordillera.

THE SAN JUAN BASIN.—Turning to the hydrographic basin of the San Juan river and Lake Nicaragua, the north-eastern slope of the Miravalles range is found to send off several small streams to the lake. Señor Moises Rodriguez, member of the Costa Rica boundary-line commission, says, "All the lands on the Costa Rica side of the dividing-line with Nicaragua are suitable for the cultivation of tobacco, bananas, cereals, and above all for pasturage. The climate in general is hot, but agreeable, which, united with the good water found there, gives good health. Between Cuajiniquil, 2½ miles east of the Rio Sapoa and Tortuga, 6 miles further east, are the little streams Lapita, El Cangrejo, Puente de Piedra, La Vivera, Guabo, Cenizaro, and Tortuga—the latter, the greatest in volume, being about 160 feet wide at its mouth, and navigable for boats. In a further distance of 17 miles, going east, are crossed the rivers Závalos, Cañitas, Quesera, Mena, Mico, Zapotillo, Quijada, Quijadita, Santa Bárbara, Sardinia, Barreal, Cañas, Perrito, and, finally, Las Haciendas, which is navigable for small boats. All the land drained by this stream is level, the climate cool. On the right bank of the river is the town of Las Haciendas, near which are fine cacao plantations. From here to San Carlos, at the outlet of Lake Nicaragua, the distance is 64 kilometres, and the principal rivers which cross this tract are El Pizote, Papalusco, Guacalito, Zapote, Caño Negro, and Rio Frio."

The Rio Frio is of considerable magnitude, and, with its many branches, drains a large area of the territory lying on the slopes of the volcanoes of Miravalles and Tenorio. It pours much sedimentary matter into Lake Nicaragua, and has thrown an extensive mud-bank across the lake entrance to the San Juan. It is a factor which demands attention in the engineering of the projected ship canal. The United States commission lately reported that, at a point 5 miles out in the lake, they found 10 feet depth of water and 8 of mud, and, at 1 mile out, 6 feet of water and 11½ of mud. During the colonial period, the Spaniards, in several efforts to explore this river Frio, were driven back by the Guatuso Indians, who occupy the greater part of its valley. It was not until 1856 that a small expedition penetrated across the country to the Rio Frio from the mouth of the river Arenal, a branch of the San Carlos. They reported fertile, hilly slopes in its upper reaches, and beautiful plains for most of the distance as far as its mouth, which, in reading an account of the expedition, I doubt if they ever reached. They were driven back hastily by the Guatusos.

The rubber collectors of Nicaragua have, for many years, ascended the Rio Frio by canoe, to exploit the forests which abound in that gum, although forbidden to do so by law of Costa Rica. They have added to their illicit gains by piratical raids on the Guatusos, plundering their settlements, plantations, and simple property, murdering the adults and capturing the children, whom they sell in San Carlos, Nicaragua, as "servants," at \$40 to \$50 per head. As a result, the Guatusos have been forced to retire further up the river to escape, if possible, their pious persecutors, who excuse themselves by claiming that they capture these inoffensive people "for the purpose of teaching them the Holy Christian religion." The tribe is now greatly reduced in numbers. They live in *palenques* (stockades), and their houses

are similar to the *maloccas* of the Amazon tribes. Each *pulengue* shelters several families, who cook their food at separate fires built on the ground. They live principally on plantains, yucca, maize, sugar-cane, cacao, game, and fish, the latter being abundant in the Rio Frio. They also cultivate and smoke tobacco. Their weapons and tools are extremely primitive, the bow and arrow,* stone axes, and wooden knives. They make a drink, called *chicha*, of roasted green plantains; but also *chicha mascada* in the manner I have seen it made by the Aymar  and Quichua Indians among the Andes. The Guatuso country is probably one of the most delightful portions of Costa Rica. Every tropical product can be grown there in abundance, for the lands are immeasurably rich, and the climate one of the best in the tropical belt. The whole region, even through to the Atlantic coast, is filled with numerous varieties of cabinet and dye woods, mahogany, and cedar. For 3 or 4 miles above the mouth of the Rio Frio, the lands are low and swampy; but afterwards the river-banks are mostly well out of water and forest covered. Several of the branches of the river can be reached and navigated by canoe from Lake Nicaragua, and even a small river steamer can ascend a few miles above the lake.

The San Carlos river joins the San Juan 65 miles from Lake Nicaragua. The depth at its mouth, which is obstructed by an island, varies from 8 to 20 feet, according to the season. The distance up to its first rapid, El Muelle de San Rafael, where there are from 4 to 6 feet of water, is roughly fixed at 62 miles by the curves of the river. Small steamers could reach this point from Greytown, at the mouth of the San Juan, although with difficulty, as the San Carlos has many snags, and, in flood, which sometimes rises to its full height in twenty-four hours, carries a great number of trees and much sand, from which movable islands are formed. The San Carlos has numerous affluents, which at times have a volume of water altogether disproportionate to their length. They descend from the mountain slope north of San Ramon, and from the north-western counterforts of the volcano of Poas. The principal of them are the Pe a Blanca, navigable 8 miles up, and the Arenal, a violent stream rising in the Guatuso range, and which is in flood from October to January. From the east, about 20 miles before reaching the San Juan, the San Carlos receives the river Tres Amigos, which rises in the hills near Poas. Small craft can ascend it 12 miles. Should the clever plans of Menocal for the Nicaragua canal be realized, including his bold idea of the Ochoa dam, the upper San Juan and the lower San Carlos would become impounded and form an arm of Lake Nicaragua, which would flood a large area of Costa Rica, as high up the San Carlos as the mouth of the Tres Amigos. The banks of the latter are, for some miles up, reported to be low, and in the rainy season much of the neighbouring country is flooded, and appears like a lake. The seasons in the San Carlos valley are not well defined. Not a week passes without more or less abundant rain, except from February to the beginning of May. The district between the San Carlos and the Rio Frio is an extensive, forest-covered, undulating plain, with occasional low hills. It is watered by numerous little streams, tributaries of the San Juan, the Rio Frio, or the San Carlos. In common with the Guatuso country, it is fertile

* I have noted, in my travels among the Indian tribes of North and South America, that their arrows are almost invariably rifled, by a row of feathers developing a spiral curve around the lower end. It is the rifling of the projectile instead of the gun, and causes the same compensative rotary motion in the air. Did these tribes, separated by vast distances, each discover the principle, or was it the invention of a single savage brain? If the latter, it must have come into use by tribal inter-communication throughout the New World.

and beautiful, and, once penetrated by a railway, should become one of the most productive sections of Costa Rica.

The river Sarapiquí, which pays tribute to the San Juan, about 20 miles east of the San Carlos, is 600 feet wide at its mouth. It is also one of the important rivers of this watershed. Its numerous affluents descend from the sides of Poas, Barba, and Irazú. The principal ones are the Toro Amarillo and Sardinal entering from the west, while from the east it receives the Rio Sucio, swollen by six mountain tributaries, which are thrown off from Irazú and the Cerro Pelon. The mouth of the Sarapiquí is unobstructed. The river is navigable for large canoes up to the river Puerto Viejo. The margins, as high up as the Sucio, are low, but above that stream are more elevated, and the river becomes narrower, with occasional rapids. The lands are extremely fertile. El Muelle Nuevo, the head of navigation, is 45 miles from the river San Juan, and 68 miles by the road across the mountains to San José. The curves of the river are easier than those of the San Carlos, but it is obstructed by snags, while trees on the banks run their roots far into the river. Sometimes there are violent floods, which continue for days, and which rise as much as 20 feet in twelve hours. Fradin speaks of a freshet which he saw on December 27, 1894, which came down stream with a roar, and a wave "4 metres" high, carrying everything before it. In seventeen hours he counted 247 large trees being precipitated into the San Juan. The lowest stages of water are from February to March, similar to the San Carlos. The Toro Amarillo branch courses through beautiful lands, but is navigable only a few miles up for canoes. It is said to have a large cataract in its middle course, just before it describes a grand curve concave to the east. The Sucio enters the Sarapiquí at a point on its right bank about midway between the Sardinal and Toro Amarillo. The main river and several of its branches have, as yet, no settled bed, and there are numerous evidences of the desolation they have caused in their wanderings. The Amarillo branch of the Sucio (not to be confounded with the Toro Amarillo), which I forded between Guapiles and Carillo, has made wild work over a breadth of from 5 to 6 miles of country, leaving a black, boulder-covered track to mark every change of its erratic moods. Where I crossed it, the boulders were strewed, for half a mile in width, by hundreds of thousands of tons. No wonder, when the river brings its artillery into action, the cannonade may be heard for miles, or that it can bombard and grind to fragments any structure the hand of man can create. Von Frantzius says, "A little before the junction of the Sucio with the San José, it throws off several branches, which afterwards reunite, and direct their course to the Atlantic under the name of the Tortuguero, receiving *en route* several other affluents, which rise on the northern slope of the volcano of Turrialba." The Sucio is thus much reduced in volume before entering the Sarapiquí. Information relating to this stream and its branches is confused and uncertain, and, like much else in Costa Rica, indefinite and delusive.

The Sarapiquí was explored in 1591 by Captain Francisco Pavon, by order of the Licenciado Velazquez Ramirez, and in 1640 Fernando de Siboja descended it from the side of Barba. It was then called the San José. Between 1819 and 1827, four efforts were made to open a route to the river San Juan from Heredia and Alajuela *viá* the Desengañio pass (lying between Barba and Poas) and the river Sarapiquí. The government, wordily anxious to find an outlet to the Atlantic for the products of Costa Rica, then almost entirely forced to reach the European markets by a voyage around Cape Horn, mildly fostered the explorations. In 1828, eighteen mule-loads of tobacco were transported from Alajuela to the Atlantic by the rivers Sarapiquí and San Juan. The route afterwards, up to 1835, seemed to be forgotten, but was then improved a little, and used from 1836 to 1851, and

perhaps to 1855, as a mail route for correspondence with Europe and for travellers, but was always unserviceable except for a very limited traffic. When the Panama railway was opened in 1855, the Sarapiquí route returned to its virgin solitude.

From the Sarapiquí to the river Colorado outlet of the San Juan, the banks of the latter, in Costa Rica, are but slightly elevated, and from 50 to 1200 feet inland the lands are low and swampy, but occasionally a hill is found from 15 to 18 feet high.

The San Juan river, for a part of its length, forms the boundary between Costa Rica and Nicaragua. From Lake Nicaragua to Castillo (37 miles), the only obstacle to navigation at all seasons for large steamboats is the Torre rapids, 75 feet long, and 27 miles from the lake. They have but 3 feet of water on them when the river is high. At Castillo, where the river is 80 feet wide, there are two rapids, 500 feet long each, in a distance of 1600 feet, with a total fall of 9 to 12 feet, the intermediate connecting channel being deep. There is but little current between the lake and Castillo, except at the Torre rapids. Five miles below Castillo there is a rocky bank projecting into the river, covered with 4 feet of water in rainy seasons; but in exceptionally dry ones, which are noted to take place every seven years, nearly the whole bank is exposed. About halfway down stream, between Castillo Viejo and the mouth of the river San Carlos, are the Machuca rapids (48 miles from the lake)—the upper one is called the Diamante, and the lower one the Machuca; each is about 300 feet in length. They obstruct navigation for about $1\frac{1}{2}$ mile. At high river they are covered by from 4 to 7 feet of water, which has a current of about 4 miles per hour, and only the ripples indicate that there are rocks underneath. Below the Machuca rapids, the river is broad and deep as far as the junction with its Colorado outlet, about 17 miles from the sea. Here it turns about nine-tenths of its volume of water into the Colorado. This is navigable for river steamers at all seasons, but has a dangerous bar at its mouth, where the sea breaks heavily, and on which there are 8 to 9 feet of water.

From the Colorado junction to Greytown, about 20 miles distance, the San Juan averages about 300 feet width for the first 16 miles, and 100 feet for the remaining 4, with a depth at high water of 6 to 8 feet. When the season is very dry, and but 2 to 3 feet of water on the Greytown bar, lighters take cargo from the ships anchored off Greytown, go down the coast to the Colorado, cross its dangerous bar, and transfer their freight to the small river steamers which ascend to Lake Nicaragua. The United States commission of engineers estimate the minimum discharge of the lake at 11,390 cubic feet per second, and the maximum at 18,059 feet, and the flood discharge of the San Juan, below the mouth of the San Carlos, at 125,000 cubic feet per second. Levy gives the San Juan at the mouth of the Sarapiquí a flow of 17,500 cubic metres per minute in the dry season, and 53,000 in the wet.

Montero Barrantes says, "The Colorado forms several islands in its course. It has as an affluent the river Chirripó, and forms the *caños* (natural canals) of Cerros de Colorado, Bravo, Pereira, and Chirripo Chiquito. It has an excellent anchorage near its mouth. The river itself forms several lagoons, which communicate with each other by *caños* perfectly navigable. The principal of these is the Agua Dulce, a short distance from the sea. It is 11 miles long, about 800 feet wide, and from 30 to 40 feet deep. Passing from the difficult Caño de la Palma, in the midst of swamps, the Caño de Tortuguero is reached, the entrance to which from the sea is called Cuatro Esquinas. It is approximately 38 miles long, about 1000 feet in width, with a depth of from 50 to 60 feet. The rivers Palacio and Penetencia, navigable for boats, empty into this *caño*. The river Tortuguero, which gives its name to the plains watered by its affluents, is formed from several of

these, known as *caños*—such as the Caño Desenredo, Caño Agua Fria, and Caño de las Lomas. The Caño de Tortuguero communicates with the Parismina through those called California and Francisco Maria Soto, also navigable. The margins of the Parismina are swampy. It has as affluents, the Guasimo, Camarón, Dos Novillos, and the Destierro.”

The district drained by the Tortuguero, in its lower course, is but little raised above the ocean, and probably in flood-time the river connects by several *caños* with the Chirripo and with the delta of the Colorado, as well as with the lagoon of Zaiman lying south of the Colorado. Its numerous upper waters are a part of the northern drainage of Irazú and Turialba.

The whole river system lying between the Sarapiquí and the Caribbean sea is a tangled web of uncertainty, and, like the entire northern watershed of Costa Rica, is likely to remain so, although sadly requiring proper exploration. I marvel that no examination of even the western part of this watershed has been made by any one of the several corps of engineers who have from time to time been detailed by the United States government or the canal companies to make the plans and estimate the cost of the projected Nicaragua canal. It might be supposed that the untamable rivers which descend from Barba, Poas, and the Miravalles range of mountains are factors of engineering importance, the thorough study of which it is dangerous to neglect, not only in relation to the design of the canal works, but their subsequent maintenance. It may be that existing difficulties have not invited their exploration; and in truth this is no easy task, except so far as they may, for a few miles, offer facilities for canoe navigation. What it is to dive into the jungle lying in the plain at the northern base of Irazú, is best shown by a leaf from my personal experience in the month of June: My party consisted of six, besides myself. We were well mounted on excellent mules and horses. At 5.45 a.m. we rode north from Guapiles, for a mile and a half through the *potreros*, and then plunged suddenly into the dense forests lying between the “Twin” rivers, the Guapiles. It was a tangled mass of trees, vines, undergrowth, creepers, thorn-bushes, and fallen trees—a mixture of every imaginable obstacle in the shape of vegetation, and frequently so impenetrable that we were obliged to halt, to cut our way with *machetes*, that we might find a so-called pathway, which we sought to follow, but frequently lost. For miles we forced our way onward, sometimes crossing rivulets and mudholes, and one swamp through which our beasts floundered to the saddles, and where, to prevent them from disappearing, we had to dismount and also flounder through the black mud. Here we lost our way, and for half an hour had to cut a track westward to one of the Guapiles rivers, which is from 3 to 4 feet deep. Into this we plunged, and followed the middle of it down stream for about half a mile, when we again took to the forest on the bank, found the path, and, continuing for about 6 miles through the same unvarying obstacles, struck the narrow, rude track which had been cut, north 61° west, by the surveyors of the projected Costa Rica northern railway. It was now past nine o'clock. Here it commenced to rain, and we put on our waterproofs. Mine was thick rubber, the best I could buy in London—“Especially made for the tropics,” the dealer said. The rain went through it as if it were a rag, and for the next seven hours I might as well have been under a hydrant. We were now on the west bank of the Western Guapiles, a stream 80 feet wide. Further along we found stretches of wild plantains. We had to jump many fallen trees. Some of the mudholes were almost intransitable. Soon our beasts, from the top of their backs and ears to their feet, looked as if they had been painted with black slime, and their riders were almost in the same condition. We often crossed small streams with steep banks, so steep sometimes that we had to dismount to let the mules and horses slide down or

scramble up, which they did bravely. At length we reached a river about 100 feet wide, the east bank of which, nearly perpendicular, was 30 feet high, and the west bank 12. We could find no break anywhere, and had no tools to cut an incline. Finally, we pushed the horses and mules one by one over the edge, and they went sliding, tumbling down into the river. We followed, caught and mounted them, crossed the rather deep stream, and with great difficulty scaled the opposite bank. One horse and rider, however, in trying to gain the bank, fell over backwards into the river, and the rider, being underneath, saved himself with difficulty. Pushing onward through the never-ending forest, deluged with rain, and fording many little streams with treacherous bottoms, we reached the river Caño Blanco, 150 feet wide. Here we found two villainous-looking rubber-collectors from Nicaragua, who had reached this point by canoe from the San Juan river. They had a rude shelter roofed with plaintain leaves, under which was a fire for the purpose of drying rubber sap, about a gallon of which was in a small hole in the ground near by. We then struck north for about a mile, tracing the river to its junction with the "Florida" (or Amarillo?), which in turn, a little further north, is said to flow into the Sucio.

We breakfasted standing in the mire and rain. The forests afforded no food for our animals; but we gave each of them a couple of pounds of maize we had taken with us. They appeared to understand what was required of them, and failed not. They worked with a courage and intelligence at times exceeding our own. We mounted to return. The rain had turned to a dismal drizzle; the soft loamy earth was saturated; our animals sunk constantly to their fetlocks, sometimes to their knees. We wallowed through the slime-holes; S. frequently tumbled into them; once he went on his back, horse and all, and scrambled out entirely plastered. We often had to dismount to help our bogged horses and mules reach hard ground. I need not elaborate the experiences of the return journey. We arrived at Guapiles again about six o'clock in the evening, all resembling equestrian mud statues.

During the day our course through the forest was along a general elevation of 300 to 400 feet above sea-level. The land had a gentle drainage incline to the north-east. The soil was of matchless fertility. The loam, which is of great depth, rests on a sandy clay. The entire deposit is probably mixed with volcanic ash, and it perhaps contains a little lime.

The Sierpe and Parismina rivers flow into the sea south of Tortuguero. The former is short, but the Parismina, with its several branches, is a child of Irazú. Its lower course is sometimes considered to be a part of the river Reventazon, which, however, has its confluence with the former a few miles from the sea.

The Reventazon river has carved its way to a profound depth around the south and south-eastern bases of Irazú and Turialba, and thence, flanking the latter volcano, it turns northward to join the Parismina. It receives many tributaries from the northern slopes of the Talamanca range, and almost mingles its headwaters with those of the Rio Grande de Tarcoles and the Rio Grande de Pirris, which flow into the Pacific ocean. Spread to the right and left, through this narrow gap between the two seas, and on the line from Port Limon to Puntarenas, lies the one streak of civilization that Costa Rica possesses. It contains the mass of its population, its trade ports, its capital and principal towns, its coffee lands and banana plantations, and its railways. Nearly all the remaining area of the country has been drowsily dreaming away the centuries since Columbus first touched its shores.

The Pacuare river, the ancient Suerre, enters the sea about halfway between the Reventazon and the Matina. Its waters, in 1630, instead of flowing to the sea,

joined the Reventazon, causing the port of Suerre, which had previously been utilized, to become valueless; but in 1651 Governor Salinas closed the two channels which deviated its waters, restored the port, built a custom-house, and reopened trade with Portobello and Cartagena.

The Matina river is a short stream entering sea just north of Port Limon, near the roadstead of Moin, where up to 1880 ocean craft anchored, and, *viá* the town of Matina, situated on this river, carried on a laborious traffic with the interior as far as Cartago. The connecting road was a horrible mule-track, 75 miles long, which crossed many rapid rivers, great swamps, and much broken mountain country. This route was also used in the colonial period, especially at a time when piracy flourished in the West Indies. The freebooters frequently attacked and sacked Matina, although what they could find in such a wretched place it is difficult to understand. The river Matina is navigable for small steam-craft up to the point where it receives its principal affluents, the Chirripo, Barbilla, and Zent, which are also all navigable for short distances by canoe. It yearly overflows its lower valley, generally in December or January, but sometimes in November, February, or March, and deposits an inch or two of exceedingly fertile mud. The finest banana estates in the world exist in its valley, especially along the Zent branch.

The entire coast-line from the river Colorado to the Matina is separated from the Caribbean sea by a continuous narrow sandbank, between which and the mainland is an estuary, said to be navigable the whole distance by boats. The intermediate rivers which I have mentioned pour into this narrow estuary, drive their currents across it, cut through the sandbank, and enter the sea. Sometimes a violent gale closes one of the openings, which are all shallow; but the river again forces its way through the obstruction to its ocean exit. This whole coast, 65 miles, is forbidding and dangerous, and has but little depth of water within a mile of the shore, upon which a monotonous, heavy surf breaks during the entire year. It is only frequented by the "turtle" fishermen from April until August, who, at times forced to land, find their way to the Rio San Juan through the intricate system of rivers and caños I have described.

Port Limon, in lat. 10° N., and long. $83^{\circ} 3' = 13^{\circ}$ W. from Greenwich, is the only port of entry of Costa Rica on the coast of the Caribbean sea. The first house was built there in 1871, but many cabins were erected there the following year to shelter the negro labourers who commenced the construction of the Costa Rica railway. Two thousand white workmen were then introduced from New Orleans, all but about twenty-five of whom died before the railway was completed to Matina. Its first 20 miles cost the lives of 3500 men—a record worse than that of Panama. The port fronts to the south, and the little peninsula on which Limon is situated is surrounded by a narrow coral reef, upon which, at low water, the abundant animalculæ putrify and produce typhoid fevers, while the swamps back of the town are fertile sources of malarial fevers. The site, which now has perhaps 3500 to 4000 population, is being raised with earth about 4 feet, and drained; and a sea-wall is being built along the low-water line of the reef and filled in behind to the general level. The health of the place is already much improved, and it promises to become one of the healthiest ports on the Caribbean sea. A wooden pier 930 feet long, badly located, and penetrating the bay in the wrong direction, accommodates two sea-going ships, one of 21 feet and one of $2\frac{1}{2}$ feet draft; but an iron pier is about to be built to replace it, which will berth four large ships of deep draft. A small island, called Uvita, lies immediately east at a distance of 3660 feet from the town. Were a breakwater run out to this island, it would make the port first class. Such a work would, I roughly estimate, cost £1,000,000.

The Talamanca coast, lying south of Port Limon, has been ably reported upon by Prof. Gabb, who, in 1873-4, spent seventeen months in its examination. His report describes it as low, flat, and swampy, excepting where it is broken by hills. The little river Banana is the first one met with. Its valley supplies large quantities of timber, especially cedar logs, which are floated down to a saw-mill at its mouth, and sawn into boards. Next comes the Estrella, also a short stream, formerly known as the Rio del Norte, which rises among the Dota mountains. Then follows the Tiliri river, the mouth of which is in lat. $9^{\circ} 34' 14''$ N. In its lower course it is sometimes called the Sixola, and is the largest stream of Costa Rica south of Port Limon. It runs along the southern base of the great eastern counterfort of the Talamanca range through a spacious, undulating, wooded valley of 100 to 150 square miles area, having also low grounds which are sometimes dry and at others swampy. Its Urén branch rises on the north-east slope of the Pico Blanco, the view from the summit of which is said to be "incomparably more extensive" than that from the crest of Irazú. The Teliri is navigable for light draft steamers for 15 miles up; but from the Urén to Gule there are twenty-six rapids and numerous snags. Boats carrying half a ton of goods ascend to Sapurio, $1\frac{1}{2}$ miles up the Urén. The river Tilorio or Changuinola, south of the Sixola, makes its riotous way to the sea from the Talamanca range of mountains. Along its lower margins the mud flats extend for a great width, and from its mouth, towards the north-west, cover the region which surrounds the lagoon of Sansán up the rivers Zhorquin and Tiliri. Behind the muddy zone, the lands rise rapidly into hills, which in a few miles reach an altitude of several thousand feet, and at times mingle with the principal cordillera. Along the entire sea margin of Talamanca runs a narrow sand-belt of firm land, at times not 100 feet wide, and then again a quarter of a mile. At Limon, Cohuita (lat. $9^{\circ} 46' N.$, and long. $82^{\circ} 51' 10'' W.$), and Puerto Viejo, hills, connected by spurs with the more elevated country of the interior, extend to the coast; and among them, and in the plains, varying from 1 to 5 miles inland, are found forest-covered swamps transitable in the dry season, but in the wet one entirely covered with not less than 10 feet of water. Parallel to the coast margin are long, narrow, deep lagoons, filled with half-stagnant water from the mud-banks, and separated from the sea by the narrow sand-belt above mentioned. These lagoons usually flow into the rivers that descend from the mountains. Between the Tiliri and Tilorio is the crooked, narrow, and deep estuary called the Laguna de Sansán, an ancient affluent of the Tilorio, full of sharks, alligators, and fish. It receives a little stream called the Dalni, which drains an impassable swamp. The Talamanca mountains have narrow crests, and are very precipitous on the Atlantic side.

South-east of and near the Tilorio is the Boca del Drago, one of the entrances to Almirante bay. I doubt if Colombia will acknowledge the frontier of Costa Rica to extend further than this, however righteous the claim of the latter may be to the entire magnificent bay of Alburima or Chiriqui; for Colombia, from neglect of her neighbour, has occupied the ground, and now exports from the Boca del Toro 2,000,000 bunches of bananas yearly to the United States. I feel sure that this bay, which includes that of Almirante, and is 50 miles long and 20 wide, and is said to contain 394 islands, large and small, is lost to Costa Rica.

During the Spanish rule, after 1540, several efforts were made to "pacify" the tribes of Talamanca and colonize their country. In 1640 the Indians destroyed the capital, Santiago de Talamanca. Since then, the province has relapsed into its primitive, barbarous condition. Its population now numbers about 2500 miserable Indians, with a sprinkling of Spanish blood. It is notable that the Ducado de Veragua, on the southern border of Talamanca, which was selected and conferred on

the family of Columbus, as the most beautiful of all of his discoveries, remains to-day almost as wild, unpopulated, and unknown as when he landed on its shores.

Cocos island, lying in the Pacific ocean about 266 miles to the south-west of the Golfo Dulce, in lat. $5^{\circ} 32' 57''$ N., and long. $86^{\circ} 58' 25''$ W. of Greenwich, is a possession of Costa Rica. Captain R. McCartney Passmore, a highly intelligent and zealous English ex-naval officer in the employ of Costa Rica, but who has recently fallen a victim to the fevers of Puntarenas, made a report upon his survey of Cocos in 1895. He found that its outlines had never been accurately delineated. The highest point of the island is 2250 feet above the sea. From this altitude the land gradually descends to a bold, steep coast, along which there are many irregularities and rocks. The interior is broken into numerous fertile valleys, but there is probably not a square kilometre of level ground on the island. Chatham bay, which is the best, has anchorage for half a dozen large ships, and there is abundant wood and excellent potable water. The anchorage is bad, and the surf-beaten shore makes landing difficult, especially at high tide. Wafer bay, which is separated from it by a ridge 700 feet high, has anchorage in 25 fathoms of water. A heavy surf also beats around the rocky margin of this bay. A danger, not noted in the Admiralty charts, exists to the west of Cape Dampier. It is a small rock, only visible at low tide, and around it the water is very deep. The rock, being in the track of vessels passing to the west of the islands, constitutes a real danger, especially during the night. Captain Passmore found numerous bogs and wood and water everywhere around the island, but believes that the interior has never been explored. There are signs of mineral wealth, and it is reported that gold has been found. The island had ten colonists in 1894, part of the emigrants sent there under a contract with the Costa Rica government to establish an agricultural colony. It is, however, suspected that the real object of the *empresario* is to hunt for immense treasures in gold bars, said to have been buried in three separate parcels in as many localities by the pirate Benito, or, according to another story, by the captain of an English brig, to whom the treasure was entrusted in Peru during the war of Independence, and who fled with it to the island.

MINERAL WEALTH OF COSTA RICA.—In the province of Alajuela, a little to the north of the cart-road which runs from San José to Puntarenas, is Monte Aguacate, part of a low mountain range which extends far to the north-west, and not very distant from the Gulf of Nicoya. In general it is of metamorphic formation, principally of diorite and porphyry. Here, in a good climate, at about 2000 feet elevation, are found many auriferous veins of great richness. They are of quartz mixed with decomposed, feldspathic rocks, and have given *bonanzas* of from \$60 to \$37,500 gold per ton. The presence of gold in Monte Aguacate was first noted by a Spanish bishop, Garcia, whose episcopal residence was in Nicaragua, but who, on a visit to Costa Rica, the least important province of his diocese, called the attention of his escort to the auriferous appearance of the rocks of the above-named mountain. It resulted in the opening of a mine called Guapinol, which, in one *bonanza*, gave \$1,000,000. Later, several other mines were worked, from one of which, Los Castros, \$2,000,000 were taken in a few years. It is estimated, from the best data obtainable, that about £1,000,000 sterling have been taken from Monte Aguacate. Several of its veins are from 6 to 7 feet wide, but that called the Quebrada Honda is 16 feet wide. Most of the ore is of high grade and of a refractory character. It is probable that it is rich in sulphurets, and carries considerable copper. The mines were worked in the rudest, primitive manner, and only a small percentage of the gold was saved. At present they are not worked.

It is probable that the whole south-western slope of the Guatusos and Miravalles range of mountains is auriferous, the few reports of scientific examinations

made of it tell us of numerous, strong veins, miles in length, of great width, assaying 8 dwts. and upwards on the surface outcroppings, and offering exceptional facilities for easy working. The rocks in the north-west extension of this district consist principally of feldspar, porphyry, basalt, and dolorite. The gold veins, which nearly all run north-east and south-west, are encased mostly in feldspar, sometimes in porphyry, and occasionally in basalt. They consist in great part of crystalline quartz, and are from 2 to 40 feet wide. In the Abengares district some good prospecting work has been done on the "Tres Amigos" property (1600 feet above sea-level), and numerous powerful veins have been discovered. The "Tres Hermanos" mine, near by, has a rich vein 17 feet thick, which has been followed for 3 miles. The surrounding country is believed to be of ancient rocks undisturbed by volcanic action, but it is covered by dense forests and vegetation, making exploration difficult. It is not improbable that, were it carefully examined, it would be found to be one of the richest auriferous regions in the world.

INTERNAL COMMUNICATIONS.—Costa Rica is very deficient in these. About sixty years ago a fairly good cart-road was opened from Cartago to Puntarenas, *viâ* San José. Over this, nearly the entire export and import trade of the country passed up to 1891, when railway communication was opened to the Atlantic coast. A branch of the above cart-road, fairly transitable for a part of the year, runs north-west through Guanacaste towards the frontier of Nicaragua. A few other short cart-roads have been rudely built for local purposes, and are serviceable during the dry season. For the rest, the people are obliged to use mule-tracks, over which no man should be condemned to ride during the rainy months.

The Costa Rica railway main line extends from Port Limon to the capital, San José, 108 miles, and thence to Alajuela, 14 miles further west. Thirty-nine miles from Port Limon, from La Junta, a branch runs north-west to Guapiles, but formerly extended a further 8 miles to Carillo. This extension had to be abandoned owing to the violence of the floods of the Amarillo and Sucio rivers, which swept away the works as fast as they could be built. It was the original intention to carry the railway to San José by the way of Carillo and the La Palma pass, between Irazú and Barba, but the engineering difficulties were insurmountable. A well-paved cart-road, 25 miles long, now in part abandoned, was, however, carried over the pass at great cost. Almost the entire coffee crop of Costa Rica is now sent by railway to Port Limon for shipment to Europe and the United States.

The government owns a moribund piece of railway, about 14 miles long, running east from Puntarenas to Esparta, a town about 700 feet above the sea. Another railway, for government account, is projected to connect San José with the Pacific coast, and the rumour that the work of construction is about to be commenced is probably correct, as the President of the Republic recently assured me "that the revenues of the State warranted him in setting aside £100,000 per year for the purpose." The length of the line will be about 45 miles across a rough section of country.

An important line of railway is in project from Jimenez, on the Guapiles branch of the Costa Rica railway, 56 miles from Port Limon, to the mouth of the Rio Frio, near its entrance into Lake Nicaragua. It is to cross the river San Carlos near El Muelle, from which point it is proposed to extend the line to Culebra bay on the Pacific, through a low pass of the Miravalles mountains, about 2000 feet above sea-level. If built, such a railway would contribute enormously to the development of northern Costa Rica. The region traversed by the line is immensely fertile and healthy. The connection of the Costa Rica railway with Lake Nicaragua will give the republic of this name much-needed, easy access to the Atlantic ocean for nearly its entire trade.

The CLIMATE OF COSTA RICA, fortunately for man, is well tempered by the winds, owing to the narrowness of the country and its exceptional situation between two oceans. Northerly winds prevail during the greater part of the year. In 1889, observations at San José gave 13 hours of N. winds, 186 N.N.E., 571 N.E., 227 E.N.E., 93 E., 58 E.S.E., 25 S.E., 6 S.S.E., S. none, S.S.W. none, 1 S.W., 3 W.S.W., 4 W., 83 W.N.W., 66 N.W., 13 N.N.W. The west-north-west and north-west are only prevalent from May to October inclusive. The climate of the uplands is an enervating, monotonous, eternal spring. At San José, the hottest day of the year is about 18° C. (65° Fahr.), and the coldest, 16° C. (61° Fahr.). From January to April there is not a drop of rain. From May to November it averages about two hours of abundant rain daily, generally between one and four o'clock of the afternoon, averaging, with great regularity, from 10 to 12 inches per month, and 70 to 80 inches during the year. Towards the end of June, or early in July, there is a short dry period called the Veranillo de San Juan. Through the Desengaño and Palma passes, the northern rains penetrate a short distance every day, and the northern descent of the latter, towards Carillo, is probably the most rainy district of all the republic.

From 1866 to 1880, the rain-gauge kept by Mason at San José showed a yearly average of 66 inches. At Tres Ríos, 4140 feet elevation, 6 miles east of San José, and at the western foot of the Ochomoga pass, the rain record, for 126 days out of ten months, showed 100 inches; while at San José, during the same period of ten months, there were 147 rainy days, with a fall of 84 inches. In the month of May, Pittier measured 9 inches of rainfall in one and a half hour.

The rainy season on the Caribbean sea slope of the country does not correspond to that of the Pacific; in fact, there are no continuously dry months, and on the northern declivities of the volcanoes of Turrialba, Irazú, Barba, and Poas, it rains more or less during the entire year. At times there are "cloud-bursts." During my stay in Costa Rica, one took place, in the month of June, over the valley of the river Matina and the lower Reventazon. The former, swollen by the violent down-pour, leaped its banks, and went tearing through the forests for a width of several miles, sweeping before it that part of the Costa Rica railway which crosses its valley. Among the lower hills of the Reventazon the water drove through the embankments. The saturated mountain slopes, composed of loose material, tufa, gravel, sand, clay, common earth, and boulders, slid in masses across the track.

Port Limon is said to have a rainfall of 89 inches, but there are no reliable records for the east and north of the country. The fall, however, must exceed that of Colon, which averages 120 inches. The mean rainfall at Greytown for 1890, 1891, and 1892, was 267 inches yearly; while at Rivas, on the Pacific coast of Nicaragua, it was 59 inches for the same years. The late United States canal commission estimated the average rainfall of the lake Nicaragua basin at 80 inches, and the basin of the San Juan river at 150 inches. The daily evaporation of the lake they fixed at 0.2 of an inch.

Some writers have ventured to classify the climate of Costa Rica according to fixed contour-lines of elevation, but this is crude. At times a height of 1500 feet will be found cooler than 3000. In the Santa Clara district, north of Irazú and Barba, it is cooler at 500 feet than it is in the valley of the Reventazon river at 1500. In general, the torrid lands of the country range from the sea to 1500 feet above it, and up to 400 or 500 feet, until cleared and well drained, abound in malarial fevers; but as high ground is reached, from 1500 to 3000 feet, the fevers are of light type, and not dangerous; while from 3000 to 5500 feet, above which last altitude there is but scant population, the diseases are those of the temperate zone, and are due less to local conditions of soil and climate than to personal

neglect. At San José, Pittier has observed that, at the change of seasons, when the atmosphere is calmest, there is the most illness. Altogether, Costa Rica is the healthiest tropical country in the New World. Notwithstanding this, the inhabitants of the uplands dread a visit to the coast area, and can with great difficulty be induced to take service there. While at San José, I studied this question carefully. There are 745 employés on the Costa Rica railway, of whom 62·68 per cent. are Jamaica negroes, and 22 per cent. Costa Ricans, the remainder being of various nationalities. Practically, all the Costa Ricans are employed at an elevation above 1500 feet, and all the negroes are below that. These are faithful, willing servants. If the lowlands are ever populated and developed, it will probably be by the negro race. For this purpose, they are far superior to the white man, and are not so lazy in a hot climate.

It is also notable that only about five to seven per cent. of the 12,600,000 population of Mexico live in its low, torrid lands, or perhaps a little more than the number required to attend to the wants of its foreign trade.

I have noticed that the Quichuas, the Aymarás, and mixed races on the tablelands of South America have an aversion to the lowlands, however inviting nature may be, and cling to the arid rocks and sands from 7000 to 15,000 feet above the sea. The most fertile soil and luxuriant vegetation, only a mile or two below their habitations, are no temptation to them to descend the mountain slopes. Even when poverty drives them to accept the high wages paid in the healthy nitrate fields of Tarapacá, they hurry back to their mountain homes so soon as they have accumulated a little money. It is evident that races of men do not readily consent to any marked change in the altitude of their habitat—the lowlander no more than the highlander; for the former cannot easily expand his chest to the requirements of 10,000 feet elevation.

Nature has not succeeded in alluring European emigrants to settle in Costa Rica. All the inducements which have been held out by the Government of that Republic have proved abortive, and must continue inadequate. The country is full of discouragements to the settler, who generally possesses little else than "God's gifts to the poor—time, faith, and energy." He cannot, as in the temperate zone, grow a crop in one year which will tide him over the next, with a small surplus. He is a bold man who will match his one pair of arms against the forces of nature in a malarial, tropical forest. Nor is his moneyless patience equal to clearing the land, and waiting several years for a marketable crop, such as coffee or cacao. Costa Rica must look for its immigrants to the wonderful fecundity of its inhabitants, whose number, now approximating 250,000, would quickly double were it not for the terrible percentage of infant mortality; due not to the lack of food, which is everywhere abundant, but to the general neglect of even the little knowledge of sanitary laws which the people appear to possess. The best, most agreeable, and profitable immigration which the country can have is thus nipped in the bud.

The FLORA OF COSTA RICA, owing to its richness and variety, has attracted much attention. In 1888, Dr. Polakowski had succeeded in making an enormous collection of different species, which he found to be identical with the flora of Colombia, and since then many species have been added. Pittier says that the vegetation is very similar to that of Nicaragua. The forests abound in rich and valuable timber trees, among them mahogany and cedar, and offer a great number of types. Probably no equal area of the New World possesses such infinite diversity of floral forms. Nature here exhibits herself in her most riotous and prodigal mood, not alone in the flora, but the fauna of the country. As regards the latter, there are 725 species of birds now known there—more than twice the number found in all

Europe. Many varieties of the parrot family enliven the forests. Sixty-eight species of mammals have been enumerated, among them rare species of the monkey tribe, the jaguar, puma, ocelot, the coyote, the Virginia fox, weasel, otter, wild boar, tapir or danta, mountain buck, the great anteater, two species of the armadillo, and, besides others, a migratory vampire bat of enormous size. Calvo tells us that the latter at times invade the south-east of Costa Rica in millions, at intervening periods of from five to fifteen years, and cause such ravages among domestic animals that the inhabitants are obliged to emigrate and take their live stock with them. In a single night, the bats bleed the strongest ox to death, as well as cats, dogs and fowls.*

One hundred and thirty species of reptiles and batrachia are mentioned. The rivers, coasts, and lagoons abound in fish and alligators, and the sea-tortoise is found in great plenty along the Caribbean shore. Large beds of pearl oysters are worked in the gulfs of Nicoya and Dulce.

The market of San José presents a variety of fruits, cereals, roots, and vegetables, cultivated and wild, which, it may safely be said, rival in number and quality that of any other tropical market in the world. Never have I eaten a potato equal in fruity flavour to that grown in the ash-impregnated soil on the south-western slope of the volcano of Irazú. The pineapples, on the northern slope of Barba, I found superior even to the much-vaunted ones of Guayaquil or Bahía de San Salvador, while the *aguacates* were matchless in size and flavour. It is notable that when seeds from temperate lands are planted in Costa Rican soil, the first fruit grown from them is large and delicious, but its progeny rapidly degenerates, and becomes small and insipid. The finest water-melon I have ever tasted was grown on the northern lowlands of the Santa Clara district from seed imported from Canada.

The HISTORY OF COSTA RICA may be divided into periods—the discovery, exploration, and conquest; the settlement and Spanish dominion; the modern period since its independence from the crown of Spain. This, however, is not the place to elaborate its history, which I merely outline *á grandes rasgos*. Up to 1540, Spain had reserved for the crown that part of the territory of Veragua lying west of the portion which had been granted to the heirs of Columbus, but in that year it was erected into a province, and called Costa Rica.† Covering a period of sixty years from the date of its discovery, some ten feeble exploring and colonizing expeditions, mostly from Panama, were fitted out to “pacify” the country. They all proved disastrous, the only result being the exasperation of the natives, whom the Spaniards plundered, butchered, and treated with signal barbarity. Between 1560 and 1573, the limits of Costa Rica were defined and confirmed by Philip II., those on the Atlantic coast being the same as to-day, so far as Nicaragua is concerned.

In 1562, Juan Vásquez de Coronado was named Alcalde Mayor of the province

* In Ecuador, in 1880, I learned that such are the ravages and voracity of the vampire bats in the Amazon districts of the country, that no domestic animals can be raised there. In Bolivia, at the headwaters of the Mamoré river, I once had a mule nearly bled to death in a single night by vampire bats.

† The historians of Costa Rica have never been able to determine when or how the country received its name. I suggest that it is a corruption of Costa de Oreja, a name which was applied to a part of the coast of Central America by the Spaniards, during the fourth voyage of Columbus, because some of the many Indians whom they met “wore gold earrings, having holes in their ears large enough to admit a hen’s egg” (*vide* Herrera, ‘Decades de Indias,’ Decada I., chap. vi.). Padre Gumilla, chap. vii., says that “the name is found on many ancient maps.” It was an easy transition from Costa de Oreja to Costa Rica.

of Costa Rica and Veragua. He was a man of ability, a graduate of the University of Salamanca, and superior in the best qualities of head and heart. He subjugated nearly the entire province, and founded the city of Cartago, which remained the capital of Costa Rica until recent times. Returning to Spain in 1564, the king gave to him and his successors the title of "Adelantado and Governor of the Province of Costa Rica;" but, embarking in the following year for the scene of his conquests, he was lost with his entire expedition.

Up to 1622, fifteen governors succeeded Vásquez; but, disappointed in their efforts to find gold, enslave the Indian population, or make the country prosperous, they allowed it to relapse into a barbarism far worse than it was at the time of its discovery. Barrantes says that, in 1622, it had but fifty Spanish families, and these were in a state of absolute poverty. A report which the king ordered to be made about that time for purposes of taxation, states: "In Costa Rica, no mines of any metal are worked, no gold-washings, no indigo cultivation, no sugar-mill. The citizens cultivate only maize and wheat; there is no money; the poverty is such that the flour and biscuits which are not consumed are exchanged for necessary clothing."

Under these depressing conditions, the king, in 1634, named, as captain-general, Gregorio de Sandoval, of the Council of War of the States of Flanders. As he reached his post from the Atlantic coast, he noted the importance of having a better port than the then existing one at the mouth of the river Pacuare, and, therefore, in 1639, founded that of Matina, connecting it, by a mule-track 102 miles long, with Cartago. His short rule was marked by a generous consideration of the natives, and by many measures that contributed to lift the province out of its misery. From 1666 to the end of the century, both the Caribbean and Pacific coasts were ravaged by piratical expeditions.

In 1718, Diego de la Haya y Fernandez was named captain-general. The following year he reported to the king on the condition of Costa Rica, which he pronounced "the poorest and most miserable of all America. The current money is the cacao seed, there not being a sixpence of silver in the entire country. There is not an eatable sold in street or shop. Every family has to sow and reap what it consumes or expends during the year. Even the governor has to do this or perish. Meanwhile, the inhabitants of the province are contentious, chimerical, and turbulent, and among the whole of them there are not forty men of medium capacity."

In 1797, the governorship and military command were conferred on Tomás de Acosta; but, after ruling for twelve years, he wrote, "There is not in the entire monarchy a province so indigent as this; for some of the inhabitants are clothed with the bark of trees, and others, that they may go to church, hire or borrow from their friends." This may be said to have been the condition of the country when the rule of Spain ended. The fifty-eight governors who, since 1563, had followed the ill-fated Vásquez de Coronado had been little more than managers of a neglected farm, which scarcely yielded sufficient to enable its labourers to eke out a miserable, half-starved existence. They had killed off or enslaved the indigenous population. Their poverty had precluded the opening of roads or the clearing and cultivation of the lands, while the exactions of Spain, and its barbarous political and fiscal policy, had smothered all commercial expansion. In fact, Costa Rica had, during over three centuries of Spanish domination, constantly retrograded, and when the Spaniard retired from it, he left it less civilized than when he entered it in 1502.

On September 15, 1821, Costa Rica joined Nicaragua in a decree of independence. On January 10, 1822, she proclaimed her union with the Iturbide Empire of Mexico under the "Plan of Iguala;" but in 1824 resumed her independence, declared for a republic, elected Juan Mora as president, and became one of the

"United Provinces of Central America." This weak, unmanageable union was dissolved in 1838. Perhaps 2000 miles of railway and 5000 miles of telegraph line might give the cohesive strength required for such a confederacy. It fell in pieces for want of internal communications, like the old Colombian federation of New Granada, Venezuela, and Ecuador.

Among the twenty-four presidents and dictators who have governed Costa Rica since 1824, several have been men of marked intelligence and devoted patriotism; and, under their administration, the country has slowly emerged from its former depression, until to-day it may be said to be in a healthy political and commercial condition. Since its independence there have been but few stirring events to agitate the body politic. The most important of which the nation boasts is the efficacious aid it gave to Nicaragua, in 1857, to crush the filibuster Walker, whose object was to add Nicaragua, as a slave state, to the United States, and thus help ensure a further lease of life to the pro-slavery party.

The government of Costa Rica is a Centralized Paternal Republic. The country has five political divisions—the provinces of San José, Alajuela, Heredia, Cartago, and Guanacaste. There are also two *comarcas*, or territories, one of which, Puntarenas, is the coast-line of the Pacific from the Gulf of Nicoya to Colombia; and the other, Limon, is the whole Caribbean coast from Nicaragua to Colombia. In 1823 the capital was transferred from Cartago to San José, which is situated in a spacious and beautiful valley on the Pacific slope. It has about twenty-five thousand inhabitants. The houses are generally low, of one story, with tile roofs. The streets are well macadamized, and the public buildings are spacious and ornamental. Several well-kept parks add to its thrifty appearance. Altogether, it is one of the prettiest towns I have seen in Spanish America.

Costa Rica, at the date of its independence, had a population not exceeding 60,000. A census taken in 1892 gave it 243,205, and of these over 200,000 are accredited to the mountain districts, between 3000 and 5000 feet above sea-level. The whole coast-line of Puntarenas had but 12,167; and the entire Caribbean coast, the Comarca of Limon, but 7484. There is a larger percentage of white blood than in any other Central American state; but the people appear to be of a gloomy, unsocial disposition, and, as a general rule, the women look as if joy and they had long ago parted company. I missed that buoyancy of character and genial manner which welcome the traveller in Mexico and all the states of South America. Why all this is so, I know not, for the people are thriving, industrious, and pacific in disposition, while many of them are well educated and highly intelligent. There is also a peasant proprietor class, consisting of hard-working sturdy farmers, who are owners of little areas of coffee plantations, or of carts and oxen engaged in internal trade. This class gives to the country most of its political stability. Wealth is more generally distributed than in any other Spanish-American state, and the taxes are very light. These might readily be doubled without any hardship to the people. The mental, moral, and material advancement which Costa Rica has made since it emerged from the baneful shadow of Spain is remarkable. At that date the yearly income of the government was infinitesimally small. A period of thirty years passed before it reached, in 1851, \$267,000. Twenty years later it was \$1,078,000. A further twenty years swelled it to \$5,625,000 currency. It is still growing fast, and is now about \$6,500,000 yearly, or say £540,000, of which £185,000 arise from custom dues. The imports are those customary to the Spanish-American states. Nothing worth mention is exported except coffee, bananas, and timber. The former was first planted in 1835. The annual average crop is now 250,000 bags of 17 to the ton. It is grown at an elevation of 3500 to 4000 feet. The original estates still produce, but the trees are nearly worn out. The total area of all the plantations is about 52,000 acres.

In 1880, an experimental shipment of bananas was made to the New York market. This year the shipments to New York and New Orleans, all from Port Limon, will probably exceed 1,800,000 bunches, of 30 to the ton, having a market value of from £350,000 to £400,000. The fruit is the largest and richest in flavour of any imported into the United States. Plants of the banana family grow in Costa Rica up to an elevation of 4500 feet; but the upland product is inferior, and none are grown for exportation at an altitude above 1000 feet. Even here the fruit is not so large and full as that grown at a height above the sea of 15 to 700 feet, within which limits are produced almost, if not all, the bunches now exported. The best lands for their cultivation are the river "bottoms," which are generally overflowed several times during the rainy season. Here the plant is irrigated by the floods, and its useful life may be counted at from twenty to thirty years, while on the high grounds it is barely ten years.

On the deep, black soil of the overflowed lands, the growers count on a yearly yield of two hundred bunches to the acre, about seven tons of fruit. Excellent cacao was grown during the Spanish occupation, but none is exported now. The production of it appears to have been neglected, during recent years, in favour of coffee.

A large quantity of timber, principally cedar, is exported from the shores of the Gulf of Nicoya and the coast of Guanacaste. The Golfo Dulce is also rich in cabinet woods, such as ebony, mahogany, and cedar, and many of the trees there are of enormous size, but this district is not worked.

The foreign debt of Costa Rica represents a composition which the republic made with its creditors, and amounts to £2,000,000 of 5 per cent. bonds. The internal "floating debt" is now \$742,871, or say £62,000, it having been reduced to this small amount since January 1, 1895, when the government again repudiated the interest on its foreign debt. In addition, the payment of certain local annuities has been assumed by the government, which, capitalized, represent \$638,719, or say £53,200.

The commercial statistics of the Secretaria de Hacienda are not kept in a manner to delight the student of finance. It is difficult to even approximately ascertain the total value of the exports and imports during any period of five consecutive years, and the figures, so far as published, are misleading and inaccurate. The finance minister gives the average yearly value of imports at about £800,000, and of exports at about £1,000,000, for the years 1894 and 1895.

THE ABORIGINAL INHABITANTS.—There are indications that Costa Rica was once the debatable ground between the powerful Mexican immigrant and the warlike Caribs of northern South America. The daring valour of the latter was alone rivalled on the western continent by that of the Iroquois, the Sioux, and the Comanches. The Caribs were lowland, river, and coast people; a tall, muscular, copper-coloured race which, when the New World was discovered, occupied the entire coast from the mouth of the river Orinoco to that of the river Amazon, and stretched inland over all the half-drowned districts and far up the valley of the Orinoco. Their nomadic spirit led them to the conquest of many of the Windward islands, and, I am disposed to believe, urged them to invade all the countries bordering the Caribbean sea and gulf of Mexico having estuaries and rivers which could be penetrated by their war canoes. These carried from twenty-five to one hundred men each, and were of sufficient size to make long voyages. Such was the *elan* of these savages that they did not hesitate to attack, in the Boca del Drago, the ships of Nino and Garcia in 1499; and they were only repulsed by superiority of weapons.

The Caribs probably reached Costa Rica indirectly by the aid of the north-east trade winds and the equatorial current. The latter sets to the west along the coast of Guiana, about 30 miles from the shore, with a velocity of 2 miles per hour, and finally strikes the Mosquito coast of Nicaragua and that of Honduras and Yucatan. Such navigation, during certain months of the year, would be easy and natural for large canoes manned by these vikings of the west. Their return home would be no less easy: a swift counter-current, having a width of 30 miles, runs south and east along the Mosquito, Costa Rica, and Panama coasts as far as Portobello in Colombia, but grows a little narrower as it nears this point—from which, however, a current also sets eastward along the shores of Colombia and Venezuela as far as Guiana. Thus it is apparent that facile navigation was offered to the Caribs—for war or for commercial purposes—between the entire north of South America and Central America, and even all the countries bordering on the Gulf of Mexico. To those who seek to determine what communication existed between the South and North American races in pre-historic times, I suggest the route I have indicated. It accounts for the presence of the Caribs on the southern shores of Cuba, the ports of which they probably used for rest and recuperation during their voyages.

The Carib, being of the lowlands, would naturally never settle among the mountains. Were I engaged in ethnological research, I should never look for traces of him at any point 1000 feet above the sea. Along all the Caribbean coast districts of Yucatan, Honduras, Nicaragua, Costa Rica, and Chiriqui, and throughout the province of Panama, the Carib has left traces of his presence—perhaps of his conquest and settlement of extensive areas of those countries; and Codazzi tells us that the Chocomas Indians, who populated the littoral on the Pacific side of the isthmus of Panama, spoke Cueva—a mixture of Carib and Chocoma. Columbus found that the tribes between Chiriqui and Portobello differed so much in language that they could not understand each other. No doubt the topography of the country caused extensive segmentation of tribes, and I have observed—especially in the Amazon valley—that when this takes place they begin to rapidly differentiate their language, which ultimately almost drops its original type. The ethnology of the New World has been greatly confounded and entangled by the habit, in which ancient and modern explorers have indulged, of designating as tribes what are merely *gentes* that have a constant tendency to disintegrate. Prior to its discovery, Costa Rica was completely forested—a dense jungle, offering no plains or prairies except, perhaps, small areas in Guanacaste in the north-west, and it may be a little open land on the upper slopes of some of its volcanoes.* Consequently its inhabitants must have occupied a status but little above that of savagery. Possibly after the Mexican conquest they may have been taught to improve their condition by the cultivation of maize, beans, the squash, cacao, and cotton, but to a very small extent; for their rude implements were ill-suited to clearing and keeping down the growth of a tropical forest. Even the Mexicans must have had a rough struggle for existence in the greater part of Costa Rica, and have finally degenerated into a purely hunting and fishing life. By food thus obtained, added to wild fruits and nuts, Costa Rica could scarcely support, as a maximum, four inhabitants to the square mile; and even this small number I believe to be greater than ever existed in the vast forest-covered valley

* It is remarkable that the inhabitants of volcanic countries are fond of crowding around the slopes of its volcanoes. It is probably due to the fertilizing qualities of volcanic ash. The belt of population around the slope of Mount Etna is said to be denser than in any other agricultural district of Sicily.

of the river Amazon. Their control over food could not have been greatly superior to that of the other animals that shared the country with them, and, in some cases, inferior. If, at rare intervals, they were able to till some open spot, it could only have been of perhaps sufficient area to sustain a *gens*, perhaps a *phratry*, but never a tribe. Therefore, it was natural that Costa Rica should be occupied by *genies*; and if, on the north, the Mexicans, or on the south, the Indians from Columbia, overran parts of the country, they must, in the difficulty of communications, and the endless warfare with Nature for existence, have ultimately split into fragments, losing in great part their common language, and mingling it with that of the *gens* whom they conquered, and whose language was better suited to the requirements of the locality.

It is evident that an off-shoot of the highland Mexican race pressed south and east from Chiapas, Mexico, into and through the long strip of the Pacific coast occupied by the Chorotegas or Mangles; followed the Pacific slope of the Cordilleras and the narrow space between Lake Nicaragua and the ocean; penetrated into north-western Costa Rica; settled, and helped the Mangles develop a considerable civilization, in the district of Guanacaste and Nicoya; and, in part, subdued all the mountain-lands lying north and west of the valley of the river Reventazon. Pushing their outposts through the extremely thinly populated districts to the south and south-east of this valley, even as far as the present eastern limit of Costa Rica, they doubtless met the Indians from Columbia who sought control of the mountain districts in the neighbourhood of Panama; but whenever Mexican or Colombian Indian entered the Atlantic lowland belt, he probably met the Carib, and it is easy to believe that the latter left them little peace.

The Mexicans have left abundant traces of their language in Costa Rica, especially throughout its northern half. Many Mexican words are now in common use there, incorporated with the Spanish tongue, notably the names of numerous plants, animals, and geographical localities. A cacique, Iztolin, conversed in the Mexican language with Vazquez de Coronado in 1564 on the southern shore of Almirante bay.

For the purpose of tracing the migrations of man, is it wiser to trust to languages or to racial characteristics, mental and physical? How many centuries would it require to alter the almond-shaped eye of the Chinaman, the eagle face of the North American savage, the tiger look of the Apache, to replace the Quichua mouth by that of the Caucasian, to change the brutal face of the Huelche and Puelche, or the peculiar proportions of the leg of the Aymara? *

With much erudition, Juan F. Ferraz, recently chief of the Bureau of Statistics of Costa Rica, has gone into the question of the population of that country at the date of the Spanish conquest. He notes that the conquistadores, to magnify their deeds, swelled the number of aborigines to 60,000; but it appears that the Adelantado, Paráfan de Rivera, made an elaborate, detailed estimate of them in 1569, which resulted in a total of 25,500. No doubt that, prior to that date, many of them had been killed during the period of their pious "pacification." M. de Peralta, who has made a profound study of the history of Costa Rica, having at his disposal the colonial archives of Spain, says, "The Náhuas (Aztecs) and Mangles (Chorotegas), Gúetares, Vicsitas, Térrabas, Changuenes, Guaymies, Quepos, Cotos, and Borucas were the principal people who occupied the territory of Costa Rica at

* The thigh-bone of the Aymará Indian, measured from the trochanter major to the knee-joint, is much shorter than the tibia, being quite the reverse of the European or the African, or of any other race yet described. *Vide* David Forbes on the 'Aymará Indian.'

the time of the conquest. The Náhuas and Mangués proceeded from the north, at least the Náhuas; and if the Mangués did not go from Chiapas, it is necessary to admit that, from the Gulf of Nicoya to the margins of Lake Nicaragua and Managua, they extended to the south of Mexico, where, up to a few years ago, their language was spoken at Acalá." The Mangués, or Chorotegas, at the time of the Mexican invasion, occupied the peninsula of Nicoya and all the lands surrounding the gulf of that name. They were then, no doubt, the most powerful and advanced people in Costa Rica, and carried some of the arts, such as pottery, sculpture, weaving, and tilling the ground, to greater perfection than any other of its people occupying the territory between theirs and that of the Chibcas on the tableland of Colombia. In their graves are found gold ornaments and specimens of the ceramic art, showing taste in design superior to any that the present civilized Costa Rican Indian can now manufacture. These graves also contain beautiful specimens of obsidian, greenstone, and even finely wrought jade tools and jade ornaments—knives, axes, arrowheads, armlets, rings, and a multitude of stone seats, idols, etc. They appear to have worked gold extensively, applying it to the manufacture of jewellery. Where they obtained the jade has not been ascertained; but no doubt among the numerous implements and ornaments I have seen, and which were taken from the graves in Nicoya, many are true and beautiful specimens of green jade. The Güetares made their homes on the slopes of Turialba, Irazú, and Barba, to the south-east of the Mexicans and Chorotegas, and, in a less degree, they shared in the skill and advancement of the latter; but their pottery was inferior in artistic merit and quality of material and workmanship, judging from collections of it which I have seen. Peralta says, "The Nahuas and Mangués of the region of Nicoya have completely disappeared, although the first still survive in Mexico, and the last yet retain now and then a descendant in Masaya (Nicaragua) and in Acalá (Chiapas).

"Of the Nahuas (Aztecs) it is not necessary to say that they have left notable monuments of their material civilization, of their scientific attainments, and a language that served as the instrument of a cultivated and thoughtful race."

About 15 miles east of Guapiles, I visited "La Mercedes" estate belonging to Mr. Keith. Here I rode a short distance into the forest to look at some Indian graves and mounds. They are numerous and large; some of the latter were 100 feet long, 75 feet wide, and 15 feet high. They appeared to be filled with broken statues of men, women, animals, and other objects sculptured from volcanic rock. We cut the weeds and exposed an immense statue which must have been 10 feet high, probably a god or a chief. He had a rope around his left shoulder. It hung down under his right arm, and suspended to it and resting on his thigh was the head of a man. His legs were broken, but the arms hung at the sides with hands on the thighs. I brought to London, from these mounds, a fine, life-size specimen of the head of an alligator and one of a puma. I am told that similar mounds are to be found elsewhere in the Santa Clara district, north of Turialba and Irazú. If so, it indicates that there must have been a considerable population there at some remote period of time. It is said that the Roman Catholic missionaries obliged the Indians to break their images; but this cannot account for the fragmentary condition of almost every object which is found there. It is probable that, prior to the latter part of this century, no missionary ever penetrated to even the vicinity of the spot I visited. It may have been the custom of the tribes, in time of war, to smash the gods, idols, and images of their enemies. Possibly, many of the figures we consider as violently mutilated were cut from fragments of volcanic rock or boulders of sufficient size to permit the carving of only a part of the object it was desired to represent.

It is almost, if not quite, impossible to find the bones or skull of an aboriginal in the ancient burial-places of any part of Costa Rica. In fact, a race may have existed there in very recent times, and yet all traces of it have disappeared. Nor can one marvel at this as he watches nature disposing of the *débris* of her tropical workshop; for once death seizes man, brute, tree, or plant, she sets her forces into action with frightful vigour to decompose the object into its natural gases. The encased bones of a man, buried in the ground, may last at the most three to four years; a fallen tree is reduced to powder by millions of insects, aided by sun, rain, and chemical action. Were nature less active in the annihilation of whatever falls in the race, death would smother her efforts, and life would cease to take the lead. Woe to the wretched brute that falls ill by the wayside! At the first stagger, a shadow appears in the sky, and then vulture follows vulture—

“First a shadow, then a sorrow,
Till the air is dark with anguish.”

These scavengers form a ring around him, and wait with interminable patience for his eyes to grow dim; then, pouncing on his head, they pick them out. The poor, blinded brute falls, and within twenty-four hours his bones alone mark the scene of the tragedy.

It may be that, in Central America, during the last hundred thousand years many races of men have gone down in the struggle against these tireless tropical forces, which, in turn, we challenge, but, now, equipped with all the appliances of recent civilization.

THE GEOGRAPHY OF MAMMALS.*

By W. L. SCLATER, M.A., F.Z.S., Director of the South African Museum.

No. VII.—THE PALÆARCTIC REGION.

SECT. I.—BOUNDARIES OF THE PALÆARCTIC REGION.

THIS, the last of the six great Regions, consists, as its name implies, of the whole northern part of the Old World. Its boundaries have already been defined in previous articles dealing with the Ethiopian and Oriental Regions, these being the only regions with which it marches. Speaking generally, it may be said to consist of the whole of Europe, the northern border of Africa, and Asia north of the Himalayas. Its southern boundary in Africa was taken, in the article on Ethiopia, as the Tropic of Cancer; this, of course, is a purely arbitrary line, and runs through the centre of the Sahara Desert. It would, perhaps, be more accurate to put in its place the northern edge of the Sahara as the limit, and to include all the desert country both of Africa and Arabia in the Ethiopian Region.

The question of Egypt is a difficult one, as its fauna undoubtedly contains a mixture of forms characteristic of both the Palæarctic and Ethiopian Regions; on the whole, however, Egypt, up to the First Cataract, is best included in the Palæarctic Region.

In regard to the boundary-line between the Palæarctic and Oriental Regions, there can be no doubt that at the higher elevations of the Himalayas a true Palæarctic fauna is met with. Eastward of Sikkim, however, as has already been shown, it is very difficult to draw a definite line, chiefly in consequence of our

* Continued from vol. ix. p. 76. Map, p. 128.

defective knowledge; but the boundary already adopted in the case of the Oriental Region seems, on the whole, to be a suitable one—namely, that of the northern waterparting of the Yang-tee-Kiang—thus leaving Muping and the district of Eastern Tibet explored by the French missionary, Père David, within the confines of the Palaearctic Region.

There are only two important groups of islands connected with this Region; these are the British Isles in the West, and the Japanese islands in the East. The faunas of both these insular groups are of the true "continental-island" type, and differ very slightly from that of the neighbouring mainland. This is more especially the case with the British Isles, where we find among the mammals no peculiarities worthy of mention, with the exception, perhaps, of a recently discriminated stoat (*Mustela hibernica*), said to occur only in Ireland.

SECT. 2.—GENERAL VIEW OF THE MAMMAL-FAUNA OF THE PALÆARCTIC REGION.

The Palaearctic Region, although covering a larger area than any of the other Regions, comes only fourth as regards the number, both of species and genera, of mammals represented in it, being surpassed in this respect by the Neotropical, Ethiopian, and Oriental Regions. The total number of such genera is 103, out of which 25 are absolutely confined within its limits, while 4 others are highly characteristic of it, though they just cross its frontiers. The remainder, 74 in number, are mostly widely spread. When these figures have been reduced to percentages, it will be found that only 24 per cent. of the genera are endemic, which is considerably less than in any other of the Regions hitherto treated of.

Reviewing the fauna in detail, we find that of the nine terrestrial orders, six only are represented in the Palaearctic Region, the edentates, marsupials, and monotremes being completely absent. Among the ungulates, of which a considerable number of forms are found within the Palaearctic sphere, there is a fair percentage of peculiarities. The Bactrian or two-humped camel is known to exist still in a wild state only in certain districts of Central Asia, while the Arabian or one-humped camel has never yet been met with in a truly wild condition, so that the genus *Camelus* may be considered as truly Palaearctic. Two other endemic genera belonging to the deer family (*Cervidae*) are *Moschus*, the musk-deer, a small hornless deer found only in the higher mountain ranges of Central Asia; and *Capreolus*, the roe-deer, fairly well spread over the whole extent of the Region.

Among the *Bovidae*, *Saiga*, an antelope found on the steppes of Russia and Western Asia, *Pantholops*, another antelope of the Central-Asiatic mountains, and *Rupicapra*, the chamois of the European mountain ranges, are confined to this Region; while the wild goats and sheep have by far their fullest development here, although they have spread in one or two cases into the neighbouring Regions. Of the rodents, the two most characteristic Palaearctic families are the dormice (*Myoxidae*) and the jerboas (*Dipodidae*). Of the former family two genera, and of the latter four, are all confined to this Region. There are also two very peculiar genera of Carnivora met with in this Region. One of these (*Æluropus*) is a curious bear-like creature of a white colour, with the ears, shoulders, limbs, and rings round the eyes black, which has only hitherto been obtained in the high mountains of Eastern Tibet. The other genus, *Ælurus*, sometimes called the panda, is also found in the same district, but extends southwards into Yunnan. Remains of a closely allied species of this genus have lately been found in the Pliocene deposits of England. This animal is usually placed in the otherwise strictly New World family *Procyonidae*, which embraces the racoons and their allies. The only other carnivorous genus not represented beyond the limits of the Palaearctic Region is *Meles*, containing the familiar badger and other species.

The Insectivora are found in considerable numbers in this Region, three genera of shrews and three of moles being restricted to it. Among these are the little water-shrews (*Crossopus*) found in England, and thence throughout the Palearctic Region as far as the Altai mountains. *Crossopus* is distinguished by having fringes of stiff hairs along the sides of its feet and tail, which are doubtless of great assistance to it in swimming. Another shrew, *Nectogale*, found only in Tibet, is still better provided for an aquatic existence, as it has webs between the toes of both fore and hind limbs. The most remarkable endemic representative of the family of moles in the Palearctic Region is the desman, *Myogale*, of which there are two species, one found in the Pyrenees, and the other in the streams and lakes of South-Eastern Russia. The external appearance of these animals, however, resembles much more that of a shrew than that of a mole.

Considering that the whole of this Region lies within the temperate zone, the number of its bats is considerable, although they mostly belong to widespread genera. The monkeys are represented in the Palearctic Region by outlying species of two genera, *Macacus* and *Semnopithecus*, which are both abundant in the Oriental Region. To the former of these belongs the well-known Barbary ape (*Macacus inuus*), which inhabits the rock of Gibraltar and the Barbary states of Northern Africa, as well as several species of Eastern Asia. One of them (*M. tcheliensis*) is enabled by its thickened fur to endure the extremely severe climate of the mountains north of Peking, and is probably the most northern monkey now living.

SECT. 3.—SUBDIVISION OF THE PALEARCTIC REGION INTO SUBREGIONS.

The subdivisions of the Palearctic Region recognized by Wallace were four in number; these are—First, the *European Subregion*, which includes Europe north of the Alps and the continuing mountain ranges that form the backbone of the continent; secondly, the *Mediterranean Subregion*, which consists of the remainder of Europe, Northern Africa, and Western Asia as far as the borders of the Oriental Region; thirdly, the *Siberian Subregion*, which includes not only the country from which it takes its name, but also the whole of the desert region of Central Asia, and reaches as far south as the Himalayas; fourth and last, the *Manchurian Subregion*, containing the greater part of China proper and Manchuria together with Japan.

These subregions, however, do not appear to represent the true faunal divisions of the Palearctic Subregion quite adequately. In the first place, there seems to be a fairly continuous and unchanging fauna extending from the west of Europe all across Siberia and embracing the northern island (at any rate) of Japan. This wide area is still, to a great extent, covered with forest, and was, no doubt, entirely so beset until within comparatively recent times.

Again, Wallace's arrangement divides between two subregions the vast extent of desert country that reaches from the Sahara through Egypt, Arabia, Persia, and Turkestan to Mongolia, which also appears to contain a fairly homogeneous fauna. Wallace's Manchurian Subregion, on the other hand, seems to be well established, and to be the most distinctive of all his subregions. In addition to this, the extreme northern parts of the Old World beyond the limit of arboreal vegetation may be taken, together with the corresponding portion of the New World, to form another subregion in which, however, the mammalian fauna is extremely limited.

We may, therefore, distinguish four subregions in the Palearctic Region as follows:—

1. The *Panarctic Subregion*, comprising the extreme northern part of Scandinavia, Russia, and Siberia as far as Berings Strait, the southern boundary

of which is the northern limit of trees, corresponding, though by no means accurately, with the Arctic Circle. This part of the Old World, together with the most northern part of the New World, will form one subregion.

2. The *Europasian Subregion*, containing the whole of Europe, with the exception perhaps of the steppes of Russia, Siberia north of the great mountain ranges and south of the Arctic Subregion as far as Kamtchatka in the north and Northern Manchuria in the south, together with the island of Saghalien, and perhaps, too, the Japanese island of Yezo. In this subregion must also be included Asia-Minor, the Caucasus, and the Elburz mountains.

3. The *Eremian Subregion*, including the north of Africa, Northern Arabia, the greater part of Persia and Afghanistan, and the great desert of Central Asia, extending from the steppes of Southern Russia as far as Manchuria.

4. The *Manchurian Subregion*, embracing the greater part of China proper, Southern Manchuria, and Japan, and extending westward to Western Tibet and the top of the southern slopes of the Himalayas.

The boundaries of these subregions will be best understood by referring to the accompanying map, in which they are approximately delineated; but it must be always understood that it is quite impossible in most cases to draw a hard and fast line as the boundary between two adjacent Regions on land.

SECT. 4.—THE PANARCTIC SUBREGION.

The Panarctic Subregion, as already defined, includes the most northerly parts of the Old World beyond the limits of arboreal vegetation, and along with it may here be considered the corresponding part of the New World.

This subregion is a land of transition, and contains a fauna virtually intermediate between that of the Old and New Worlds. This fauna, as would indeed be naturally expected, owing to the extreme severity of the climate, is, so far as the mammals are concerned, an exceedingly scanty one. We find, however, that it is of very uniform character, nearly all the mammals which belong to it ranging throughout its entire extent with but slight specific divergences, if any.

The more important of the Panarctic mammals are, first of all, two genera of deer (*Rangifer* and *Alces*), containing the reindeer and elk, which are usually regarded as identical with the cariboo and moose of the New World; and *Ovibos*, containing the musk-ox, which has recently become extinct in the Old World, though still to be found over a great part of the New World portion of the subregion. The lemmings (*Myodes*) and the Arctic hare (*Lepus variabilis*) both range throughout this subregion; and this is also the case with the Arctic fox (*Canis lagopus*), the white bear (*Ursus maritimus*), the ermine (*Putorius ermineus*), and the glutton (*Gulo luscus*), all of which are common to the northern regions of both hemispheres. All the above-mentioned animals have their southerly limit not far south of the boundary of the subregion, except in such cases as where high mountain ranges have afforded them means of expansion southwards.

The mammalian fauna of this subregion is so scanty that it seems hardly worth while to draw up a special table of the genera that form it. The principal genera have been already noticed as belonging to the ungulates, rodents, and carnivores, which are, in fact, almost the only orders of terrestrial mammals represented in this subregion.

SECT. 5.—THE EUROPASIAN SUBREGION.

The *Europasian Subregion* contains the great temperate forest-area of the Northern Hemisphere. In its western part, at any rate, this has been considerably modified by the hand of man, but in primæval times the forests probably extended almost without break from the Bay of Biscay to Kamtchatka.

The European fauna is not very rich; it comprises fifty-seven genera, of which four only are restricted to its boundaries. The endemic forms among the Ungulata are, *Capreolus*, containing the roe-deer, a single species of which is found throughout the whole extent of the Region; and *Rupicapra*, the chamois, found only in the Pyrenees, Alps, Carpathians, and Caucasus. The single endemic rodent is the familiar dormouse (*Muscardinus*), which is apparently confined to Europe. On the other hand, the little water-shrew (*Crossopus*) extends from England to the Altai mountains.

There are a considerable number of genera common to the European Sub-region and the Nearctic Region. With the exception, however, of two, the elk and the reindeer, these have mostly spread also into the other Palearctic Subregions. On the whole the fauna of this subregion has little individuality, and calls for very few remarks as to its distinctness.

Appended is a list of the genera drawn up in the same manner as in the previous tables.

EUROPEAN SUBREGION.

	Ungulata.	Rodentia.	Carnivora.	Insectivora.	Chiroptera.	Primates.	Total.
Endemic	2	1	0	1	0	0	4
Palearctic	2	3	1	1	0	0	7
Old World	3	4	3	3	3	1	17
Holarctic	2	6	2	1	1	0	12
Widespread	3	5	6	0	3	0	17
Total	12	19	12	6	7	1	57

SECT. 6.—THE EREMIAN SUBREGION.

The Eremian or Desert Subregion of the Palearctic Region contains representatives of a larger number of genera than the European, and a higher percentage of endemic forms, although even here we do not find so much individual character as in some of the subregions previously treated of. A considerable number of the genera are common to this and the Ethiopian Region, which is, perhaps, not to be wondered at, considering the long land-boundary which runs between them.

Among the ungulates only one genus is confined to this Region—the camel (*Camelus*), which is now found wild only in certain desert tracts of Central Asia, being elsewhere known only in a domesticated condition. But remains of animals of this genus have been found in comparatively recent beds both in India and Algeria. Except for this, other indications seem to point to the fact that the camels must have had their origin in the New World, where they are now represented only by the llamas. But remains of several allied genera of *Camelidæ* have been met with in the Tertiary beds of North America, where, however, they have been long extinct. *Bubalis*, which contains the antelopes usually known as "hartebeestes," and *Hyrax* (the conies or dassies) are common to this subregion and to the Ethiopian Region. Among the rodents no less than five genera are confined to the subregion, the most remarkable of these being, perhaps, the jerboas, or kangaroo-rats, as they are called, from having their hind legs elongated for jumping purposes. The four known genera of jerboas, which contain a large number of species, are not found outside the limits of this subregion. A fifth endemic genus of rodents is *Ellobius*, which is thoroughly adapted to a subterranean life, having very short limbs and tail, and rudimentary external ears. The only two known species of this genus are restricted to the Eremian Subregion.

The Eremian Carnivora, as is usually the case with this group, are mostly widespread, and this is also the case with the bats. The Insectivora are not very numerous, but one genus is peculiar to the subregion; this is *Diplomesodon*, a little shrew-like animal of terrestrial habits found in the Kirghiz steppe. Another genus, *Macroscelides* (the elephant-shrew), though typically Ethiopian, has one species that extends into this subregion in Algeria and Tunis.

The monkeys are represented in the Eremian Subregion by one species only, the well-known Barbary ape (*Mucacus inuus*), which is found in Algeria, Morocco, and Gibraltar.

The genera that occur in the Eremian Subregion are shown in the following table, which may be compared with the corresponding table appended to the European Subregion:—

EREMIAN SUBREGION.

	Ungu- lata.	Ro- dentia.	Carni- vora.	Insecti- vora.	Chiro- ptera.	Pri- mates.	Total.
Endemic	1	5	0	1	0	0	7
Palaearctic	2	3	1	1	0	0	7
Palaearctic and Ethiopian ...	2	3	4	1	2	0	12
Old World	4	5	2	3	7	0	21
Holarctic	0	3	0	0	1	0	4
Widespread	2	4	4	0	3	1	14
Total	11	23	11	6	13	1	65

SECT. 7.—THE MANCHURIAN SUBREGION.

The Manchurian Subregion bears a similar relation to the Oriental Region as the Desert Subregion does to the Ethiopian Region, and the number of genera of mammals that are common to it and the Oriental Region is considerable.

On the whole, too, this is the most specialized of all the Palaearctic subregions; six genera out of a total number of sixty being endemic, and several others only just crossing its borders. This subregion contains within its limits the highest tableland on the face of the globe, that of Tibet, the zoology of which is not so well known as it should be, owing to the persistent exclusion of European travellers from its limits. What knowledge we have of the Tibetan fauna relates chiefly to the larger animals, and among these are several very interesting and peculiar forms. It is, therefore, probable that when more about this Region is known, many novelties will be discovered among the smaller animals as well.

The ungulates of the Manchurian Subregion show no genera which are absolutely confined to it, but a curious little deer with short straight antlers (*Elaphodus*) is highly characteristic of it, although it extends into the outskirts of the Oriental Region. Another peculiar genus is the Tibetan antelope (*Pantholops*), well known to Indian sportsmen, which is found only at great heights on the Tibetan plateau. A third Manchurian genus, also of great interest, is the takin (*Budorcas*), a large bovine animal with horns somewhat resembling those of the South African gnu; this is also found only among the higher mountain ranges, and is probably confined to the subregion.

Among the Manchurian rodents there are two genera peculiar. One of these is *Eupetaurus*, a flying squirrel, which, unlike all others of the same group, lives in a part of the world practically devoid of forests. It is as yet known only from the neighbourhood of Gilgit, in the extreme north-western part of the Indian Empire,

but doubtless has a wider range. The second endemic genus, *Typhlumys*, has been formed for the reception of a curious, almost blind mouse of Northern China.

Among the Carnivora of the Manchurian Subregion the only genus of very special interest is *Blutopus*, which has already been mentioned in the general account of the Region. The Insectivora of the Manchurian Subregion are numerous, comprising as they do ten genera, of which three are endemic. These are all of them shrews, two of which, *Ohimarrogale* and *Nectogale*, are aquatic forms with webbed toes, while the third, *Aaurisorex*, is almost certainly fossorial. All the Manchurian bats belong to fairly widespread forms.

Finally, there are two genera of monkeys represented in the subregion, *Macacus* and *Semnopithecus*, but these genera more strictly belong to the Oriental Region.

Below is a table of the genera of the subregion, arranged as in the foregoing subregions, which shows what a considerable number of forms are common to this and the Oriental Region.

MANCHURIAN SUBREGION.

	Ungu- lata.	Ro- dentia.	Carni- vora.	Insecti- vora.	Chiro- ptera.	Pri- mates.	Total.
Endemic	0	2	1	3	0	0	6
Palaearctic	2	1	1	0	0	0	4
Palaearctic and Oriental	4	1	3	3	1	2	14
Old World	3	4	0	2	5	0	14
Holarctic	0	4	0	2	1	0	7
Widespread	4	5	6	0	3	0	18
Total	13	17	11	10	10	2	63

SECT. 8.—THE PAST HISTORY OF THE PALAEARCTIC REGION.

Although the palaeontological history of Europe, so far as it has been worked out, has been very thoroughly investigated, our knowledge of its extinct mammals, at any rate, is not to be compared with that which has been acquired in the Nearctic Region. This is probably due, to a great extent, to the comparative rarity on this side of the Atlantic of fresh-water lake deposits, the investigation of which, in North America, has produced most astonishing results.

Passing over the Mesozoic mammals, which throw very little light on any of the problems involved in the present case, we find in the earliest Eocene beds scanty remains of a fauna containing hardly any members of the existing orders of Mammals. In their place is a series of forms closely resembling one another in possessing five-toed and plantigrade extremities, furnished with neither hoofs nor claws, but with structures somewhat intermediate between the two. Nevertheless, even among these primitive mammals, it is possible to recognize the germs of the marked characters which at the present day separate the various orders. In North America, in beds of the corresponding age, a much more ample stock of remains of a similar fauna is met with. Later on, in the Upper Eocene beds a much larger number of mammals appears, this fauna containing at least a hundred genera, most of them of large size, whereas to-day the European mammal-fauna consists only of fifty-four genera, and of these more than half are of small size. At this epoch slight distinctions between the European and American forms begin to appear, showing that even at these early times there was a commencing separation between the two great continents. In the earlier part of the Miocene age, so far as we know, no very great changes take place, but at the end of Miocene time we find in several

localities wonderful assemblages of fossil mammals in great abundance and in an excellent state of preservation, which enable us to make a better comparison. Such localities have been discovered at Pikermi in Greece, in the island of Samos in the Ægean sea, at Maragha in Persia, and, perhaps the most important of all of them, in the Sivalik hills at the southern base of the Himalayas.

This fauna bears a close resemblance to that of the Ethiopian Region in its present state, especially as regards the presence of giraffes, gazelles, and other ungulates. North of the Alps this fauna, although represented, is not nearly so rich, many of the antelopes and giraffes being absent and being replaced by various forms of deer (*Cervidae*), which now commence to be very much more prominent. In the true Sivalik fauna of India there are a good many types, which have never yet been found in Europe; such, for instance, as the camels, which are specially characteristic of the American Tertiary strata. Furthermore, there are found, in the American formations of this age, a large number of forms, such as *Bos*, *Equus*, *Hippopotamus*, and *Ursus*, which do not appear at all in Europe until the later Pliocene times.

When the Pliocene times arrive, we begin to find a preponderating number of still existing genera present in the fossil beds, although the greater number of them have, at the present epoch, retreated southwards into the Oriental and Ethiopian Regions. This southward migration seems to have gone on throughout the Pliocene period, and was probably occasioned by the increasing cold caused by the gradual advent of the great Ice-age, which now began to make itself felt over the whole of the northern part of the globe.

Finally, during the Glacial period the fauna assumed nearly its present form, containing large numbers of species that still survive. At this epoch, too, a connection appears to have been formed between the Old and New Worlds in the neighbourhood of Berings Strait, by means of which an interchange of animals took place, and resulted in occasioning the similarity which forms so marked a feature on a comparison of the Nearctic and Palæarctic faunas.

It is this similarity that has caused certain writers on geographical distribution to unite the Palæarctic and Nearctic Regions into one, whereas, as a matter of fact, palæontological evidence seems to show that, out of all the four Regions embraced under the term "Arctogæa," the North American or Nearctic Region was the first to be separated from the main mass, and that the similarity is a comparatively modern element in the character of the two faunas.

ADDRESS TO HER MAJESTY THE QUEEN.

THE following address from the Society was forwarded last week to the Home Secretary for presentation to the Queen on the auspicious occasion of the completion of sixty years of Her Majesty's reign:—

TO HER MOST EXCELLENT MAJESTY THE QUEEN-EMPRESS.

*The Humble Address of the President and Council of the
Royal Geographical Society.*

MOST GRACIOUS SOVEREIGN,

We, Your Majesty's dutiful and loyal subjects, the President and Council of the Royal Geographical Society, beg leave, most respectfully,

to offer, in the name of the Society, our sincere congratulations on the completion of the Sixtieth Year of Your Majesty's happy and glorious reign.

Sixty years ago, on the occasion of Your Majesty's accession, our predecessors offered Your Majesty a humble address, thanking you for your gracious condescension and munificence in granting the Society the honour of Your Royal Patronage, and in bestowing upon the Society a Royal Premium for the encouragement of geographical science and discovery.

Your Majesty has been graciously pleased to continue these marks of your Royal favour throughout your long reign, much to the advantage of the Society and to the advancement of the important subject with which it is its function to deal. The most distinguished explorers and geographers at home and abroad during that long period have been the recipients of the Medal which Your Majesty's liberality enables the Society to award each year.

In the humble address offered by the Society sixty years ago it was predicted that the reign of Your Majesty, like that of your great predecessor Queen Elizabeth, would be famed for its glory and prosperity, and for the promotion of geographical knowledge. This prediction has been amply fulfilled, for during Your Majesty's reign, all the unknown lands of the earth have been opened up, the depths of the ocean have been explored, both poles have been closely approached, and that to a large extent by British enterprise.

Through this means, not only has knowledge been greatly advanced, but humanity has been materially benefited, civilization spread over the globe, and the glory of the great Empire over which Your Majesty reigns, enhanced in a degree never before equalled.

That Your Majesty may still be long spared to reign over this great Empire is the earnest wish and ardent prayer of Your Majesty's loyal and devoted servants and subjects, the President, Council, and Fellows of the Royal Geographical Society.

(Signed) CLEMENTS R. MARKHAM,
President.

June 21, 1897.

THE MONTHLY RECORD.

ASIA.

Return of Dr. Sven Hedin to Europe.—After an absence of nearly four years, during which his routes have covered Asia from end to end, Dr. Sven Hedin has returned to Sweden, bringing with him voluminous records of observations on the geography, geology, meteorology, orographical features and languages of the extensive regions traversed by him. Even before this last series of journeys, Dr. Sven Hedin was well known to geographers for his journeys in Persia and ascent of the

peak of Demavend, and he has since extended his operations throughout the whole of Central Asia, including Russian Turkistan, the Pamirs, Chinese Turkistan, and, last of all, Tibet and Mongolia. He has already communicated to us the results of some of his journeys, accounts of which have appeared in our pages, and we hope to welcome him among us in person at a meeting of the autumn session, when he has promised to read a paper on the general results of his journeys. Dr. Hedin is at present engaged in writing a popular account of his travels, after the issue of which he will devote himself to working up the vast mass of scientific material, which will be published separately. He is to receive the gold medal of the Russian Geographical Society early in the autumn.

Lake Urmia.—The titular Archbishop of Philippopolis, the head of the French missionaries at Urmia, sends to the *Missions Catholiques* of June 11 (vol. 29, p. 278) a short note on the state of the great salt lake of Urmia. He states that the inhabitants of the country bordering on the lake are becoming very anxious on account of the steady rise in its level which has been going on for the last five years. The plains of Urmia on the west, Salmas on the north-west, Maraga on the east, and Suldus are being encroached upon. The villages have in some instances been submerged, and meadows, fertile fields, vineyards, and gardens, formerly from six to eight hours' walk from the lake, have been converted into marshes by the gradual infiltration of water, which rises from the ground in many places where springs were formerly unknown. The village of Aftuan, near Khosrova, in the plain of Salmas, has disappeared, and Baleau, in the plain of Urmia, where formerly wells 30 feet deep were required to reach water, is now saturated to the surface of the soil, and all cellars and excavations have become pools.

Hydrographical Expedition to the Ob and Yenisei.—After having explored, during the two previous years, 1894 and 1895, the lower Yenisei and its bay, as well as the bay of the Ob and one of the branches of the river, the Great Ob, the steamer, *Lieutenant Ovtzyn*, and its sailing barge, *Lieutenant Skuratoff*, wintered at Tobolsk. They left it on June 16, 1896, and went down the Ob, the members of the expedition making astronomical determinations, and correcting the map of the river. It appeared that there is a number of shoals along the left bank, while along the right bank the river is free of them. The branch which is known as the Little Ob was explored next, the other branches being too shallow and thus offering no interest for navigation. The bar was carefully mapped, and it appeared that only close to the right bank is there a passage 12 feet deep, while along the left bank the maximum depth was only 9 feet. Consequently, the expedition directed its attention towards the discovery of some bay which would be sufficiently protected for big steamers being unloaded there before crossing the bar. Such a bay was found at last, and was named Nakhuka. It is situated 20 miles to the north of Cape Yamsale; it is sufficiently protected from the east winds, and can receive ships having a draught of 17 feet. The mapping of the Ob bay was completed next, and it became apparent that the left bank, which was mapped in this century, had undergone but slight modifications, while the eastern coast, which was mapped in the last century, requires many changes. From the Ob the expedition proceeded, *viâ* the Kara sea, to Arkhangelsk. The island Byelyi, so far as could be ascertained in foggy weather, is marked pretty correctly on the maps. In the Kara sea the two vessels experienced a bad storm, and on issuing from the Yugor strait, on September 3, they met with ice. In the Yugor strait, two English steamers, which were waiting for Mr. Wiggins, were spoken to, the expedition supplying them with its maps. On September 28 the expedition reached Arkhangelsk, bringing in most valuable hydrological, meteorological, astronomical, and pendulum observations, as well as natural history collections.

Transbaikalian Geographical Society.—The Amur branch of the Russian Geographical Society has formed, as is known, a sub-branch in its Chita, or Transbaikalian section. This branch, as we now learn, has prospered well. Many persons have responded to its appeal for books, etc., and a new building, with a botanical garden annexed to it, is now going to be erected to receive the library and the museum. In 1896, the library consisted already of 4095 volumes, and the museum was in possession of 13,259 objects—6819 in natural science, 1745 in anthropology, 3374 in archæology, and so on. The most notable gifts were: a herbarium of Transbaikalia (652 determined species); a collection of maps, etc., from the Nerchinsk museum; collections of rocks; a great number of objects relative to Buddhism (a gift of the Gusino-ozersk *hambo-lama*); and a highly valued collection of samples of gold, both in sands and in rocks, with a geological collection—a gift of A. F. Heller.

M. Bonin's Journey in the Chinese Empire.—Although M. Bonin returned to France early in the year, a full account of his journey does not appear to have been yet placed before the Paris Geographical Society. Nevertheless, the details given in the *Comptes Rendus* of that Society (pp. 71–75, 111–113) show that the northern section of the route, between Ta-t sien-lu and Urga, has, like the southern section between Tong-king and Ta-t sien-lu (*Journal*, vol. viii. p. 515), been of much interest from a geographical point of view. Between Ta-t sien-lu and Lan-chau, M. Bonin traversed the little-known countries on the Tibetan frontier of China, inhabited by the aboriginal tribes known to the Chinese as Man-tze, and lately described to the Society by Mrs. Bishop. A point of interest brought out by his journey is the comparatively low altitude (10,000 feet) of the divide between the Yang-tse and Hoang-ho basins. From Lan-chau M. Bonin descended the Hoang-ho (partly by water) as far as the most northerly point of its great bend, in the Ordos country, which he crossed in order to visit the tomb of Jengis Khan. He is said to have crossed the Gobi to Urga away from the main routes, and, returning *viâ* Peking, Shanghai, and Hongkong, to have gained the distinction of being the first traveller to make the complete circuit of China.

The Lyonese Commercial Mission to China.—Apart from the commercial objects of this mission (*Journal*, vol. viii. p. 296), a good deal of light seems to have been thrown by it on some of the less-known parts of Central and Western China. A short account of its proceedings appears in *Aus allen Welttheilen*, 1896–97, p. 350, and a more detailed description in the *Tour du Monde*. After a preliminary journey in Tong-king,* the expedition proceeded up the Red river, and, dividing its forces, traversed the provinces of Yunnan, Kweichau, and Se-chuan, in various directions. The province of Yunnan is estimated to have at present a population of twelve to thirteen millions, a number much smaller than formerly. Representatives of Chinese firms of Hongkong and Canton were found at most of the places visited, and these two cities are said to take 83 per cent. of the trade of Yunnan, while Tong-king gets at present only 10 per cent. With improved navigation on the Red river, the French consider that competition from the side of Burma would be but little to be feared, and Lao-kai on the upper Red river is thought to have a great future before it, as a place of exchange between Tong-king and Yunnan.

* Hanoi, in Tong-king, is said to have attained an enormous development within the last decade, and to be in a fair way to rival Singapore, Colombo, or Shanghai.

AFRICA.

Anthropogeography of the Upper Nile Region.—An instructive study by M. E. de Martonne, which originally appeared as a series of articles in the *Annales de Géographie* (October, 1896, to January, 1897), has lately been issued separately in pamphlet form. It claims to be the first systematic attempt to show in detail, for the upper Nile countries, the intimate connection which exists between the physical geography of a region and the life of man upon it. Previous writers have been too apt, M. de Martonne thinks, to lay stress on purely ethnological facts, which, after all, are of less importance in determining the life of a people than the physical surroundings in which they are placed.* The writer first gives a sketch of the physical geography of the region dealt with, showing next the effect which the facts noticed have had on the life of its inhabitants, and, lastly, elucidating difficult points by a consideration of ethnological facts. Each section serves as an explanatory comment on one of the three maps with which the brochure is provided. Rainfall, M. de Martonne shows, is the most potent factor in determining the main types of plant life in the region in question. He draws the usual distinction between forest, park-like country, savannah, and steppe, the marshy region of the lower Bahr el Ghazal, etc., forming an additional type of country in the upper Nile region. A comparison of the maps shows in a striking way the dependence on these distinctions, both of the density of population (generally greatest in the park-like country), and of the forms of life displayed by the people, as hunters, cultivators, herdsmen, and fishers respectively. Some obscure points, such as the reason why certain herdsmen have settled down into a stationary life on the agricultural lands of the lake-plateau, are cleared up by a study of the ethnography especially that part which deals with the migrations of tribes, shown on Map III. A point which is not quite clearly explained by the author is the reason for the different mode of life of the Dinka and Bongo groups, both of which are Nilotic, and both inhabit a country mainly composed of savannahs. That the latter are iron-workers is, of course, explained by the nature of the soil, but it is not equally evident why they are purely agriculturists, while the Dinka are cattle-rearers. A somewhat kindred study, relating to the same region with parts of the upper Welle basin, appears in the *Mitteilungen* of the Leipzig Geographical Association (1896), from the pen of Dr. Curt Müller. It deals with the history of the development of states in the transition zone which borders the Bantu domain to the north, the dominant factor being, of course, the intrusion of light-coloured races (among which the writer includes the Zandé and Mangbattu), and the subjection by them of the former Bantu populations. Dr. Müller deals less than M. de Martonne with the influence of geographical factors, and gives a considerable space to the question of the political organization of the states. Whereas the normal condition of the original populations was one in which the political unit was the village ruled by an independent chief, the political régime of the intruders is marked by the presence of rulers whose influence extends over a large area, and who belong to a recognized dynasty. Corresponding to the importance of the ruler in the political system, is that of his place of residence as the geographical centre of the state, the political ties becoming weaker in proportion to the distance from the same, while uninhabited border tracts form the outmost periphery of the separate units, and bring about a marked political insularity. This is especially to be seen in the Zande and Mangbattu territory, of which a map is given.

* M. de Prévile's work, noticed in our pages towards the end of 1895, regards the subject from the same point of view as M. de Martonne, but, as it treats of the whole continent, is necessarily less detailed with regard to the region in question.

The Victoria Nyanza.—Father Brard, already known to geographers for his survey of the Sesse island, in the Victoria Nyanza, contributes to the April number of *Petermanns Mitteilungen* a short sketch of the various tribes inhabiting the southern shores and islands of that lake, with which his numerous voyages on its waters have made him familiar. Interesting details are given of the customs and mode of life of the several tribes. The Baziba are met with all over the lake, carrying on a brisk trade of barter between various countries on its shores. Like Dr. Baumann, Father Brard divides the peoples inhabiting the countries to the south of the lake into three principal branches—the Wazinja in the south-west (closely allied to all the tribes on the west side of the lake as far as Unyoro), the Wanyamwezi (including the Wasukuma) in the south, and Bakerewe and their allied tribes in the south-east. Uzinja has of late years become depopulated, now containing only 150,000 inhabitants, confined to the lake-shore. One of the reasons assigned for this is the prevalence of polygamy, whilst the absence of the same custom is given as a reason for the large population of Usukuma. Father Brard does not despair of the civilization of the negro, though he acknowledges the many difficulties in the way. A map accompanies the paper, one of its most noteworthy features being the large size of the islands of Lubondo and Maisome, which are made to occupy a large part of the area of Emin Pasha gulf. Father Brard notices an unusually high rise of the lake in 1895, which seems to correspond with the recently recorded high levels of Tanganyika and Nyasa (*Journal*, vol. ix. p. 326).

The Sahara.—Dr. Fred. S. Zaytoun, sometime medical officer of the North-West African Company, contributes a paper to the March number of the *Scottish Geographical Magazine* on Cape Juby, which again draws attention to the fact that the few scraps added in recent years to our knowledge of the Sahara have gone to show that the area known by that name is not the mere moving sand-waste most people were formerly content to suppose. The Sahara is not everywhere flat, and it is not entirely desert; mountain ranges cross it which in places attain a height of 5000 feet above sea-level, and enclose verdant valleys dotted with groves of trees and supporting a large population. There accordingly remains a wide field for exploration, but the difficulties to be overcome are enormous, and we cannot expect rapid progress in a country where the native population is so hopelessly hostile to any interference from outside. Dr. Zaytoun's paper deals specially with the Western Sahara, stretching from the Abaggar mountains and Adrar on the east to the Atlantic, and from the Atlas down to the Senegal. The region is divided into a number of independent districts, with a total estimated population of about two millions. Cape Juby lies almost directly opposite the Canary islands, and from it the coast trends north-westward to the Wad Draa, the largest river of North-West Africa, and southward to Cape Bojador. A remarkable feature of the Cape Juby region is the extreme healthiness of its climate. The north-north-east trade winds, which blow during eight months of the year, produce great uniformity of temperature, and the air is at the same time so dry that diseases, such as dysentery, intermittent and black-water fevers, common in hot and malarious districts, are entirely unknown.

AMERICA.

Mr. E. A. Fitz Gerald's Explorations in the Andes.—Writing from Puente del Inca, south-east of Aconcagua, May 3, Mr. Fitz Gerald reports satisfactory progress in his mountain explorations in the Andes. From the triangulation and levelling accomplished, he thinks that the altitudes hitherto given will have to be considerably reduced. He has come across some interesting glaciers and, he thinks, a new and active volcano to the south of Tupengato. The latter peak is certainly volcanic, as much pumice and volcanic stones were found on the summit and elsewhere, but

Aconcagua is *not* so. In fact, there seems no volcano near it. The survey of Aconcagua and surrounding valleys with theodolite, telemeter-gradient-level, etc., was completed, but some side valleys remained to be examined. Mr. Fitz Gerald's party was suffering much from cold and from the effects of bad water and the high altitudes combined with high winds. He hopes to be in London early in September.

Area of Drainage Basin of Lake Superior.—The *National Geographical Magazine* for April, 1897, gives some recent measurements of coast-line and area. These are as follows:—

Coast-line on American side	...	...	...	...	880 miles.
" Canadian side	...	...	...	...	992 "
					—
Total coast-line	...	...	...	1872	"
Area of open-lake water-surface	...	...	...	30,465	square miles.
" bays	...	...	...	1,041	"
" islands	...	...	...	660	"
					—
Total area	...	...	...	32,166	"

of which 23,359 square miles are on the American side, and 8807 on the Canadian. The boundary-line across the lake between Canada and the United States is 289 miles. The largest and most remarkable of the islands is Isle Royal, belonging to Michigan, which forms an isolated and nearly submerged mountain ridge 12 miles from Minnesota. It differs from the other islands in the very deep soundings that can be made on all sides. There are abundant indications of copper, but mining has never been a commercial success. There is abundant water and excellent soil, but the population is small and never permanent. At the north of the lake lie a series of islands, of which St. Ignace, with its precipitous sides, may be taken as the type. There is only one archipelago proper, the Apostle islands, which are almost uninhabited. The drainage of Lake Superior is about 82,800 square miles. Of this the lake forms 39 per cent., and of the land 39 per cent. is Canadian and 22 American. A proposal has been made to dam the St. Louis and divert its water to the towns of Superior and Duluth, with a head of 650 feet, as an enormous source of cheap power; but the watershed between the St. Louis and the Mississippi is so low that it might be difficult to prevent the St. Louis from emptying into the Mississippi.

AUSTRALASIA AND OCEANIC ISLANDS.

Further Exploration in New Guinea by Sir Wm. Macgregor.—In two reports to the Governor of Queensland, dated January 18, 1897, Sir Wm. Macgregor gives details respecting a visit of inspection to certain places in the eastern part of British New Guinea, and a summary of the latest information on the gold-bearing districts of the possession. Accompanied by several prospectors, the Lieut.-Governor started in November last up the Musa river, a large stream which empties itself into the sea a little west of 140° E. long. The natives met with proved friendly, but the effects of the raid of 1895, by natives of the Mount Trafalgar district to the east, were seen in the form of deserted and ruined villages. After proceeding for some days' journey up the river, its navigation proving exceedingly difficult on the last day, Sir Wm. Macgregor was unfortunately compelled to return, owing to a serious accident to Mr. Kowald, one of the prospectors. An odd claim for payment was made by the natives, on the score of their grief and resulting sleepless nights entailed by the accident. Mr. Simpson, however, proceeded onwards, and examined

the country watered by the Moni, Oiwa, and Adana, upper branches of the Muss. Although some gold was seen, the general result of the inspection was disappointing from the prospector's point of view. Throughout the journey from the sea, the three-peaked Mount Garopu, to the south-south-east, seems to have been a conspicuous object. The Lieut.-Governor subsequently paid a visit to the Mambare river district, where good relations with the natives on the whole prevailed. Several miners were in the interior, but the news from them was not encouraging. Those on Murua or Woodlark island are reported as doing better than those in New Guinea, where four parties in all are at work. The rubber industry has assumed considerable proportions in the eastern parts of the possession, and the rubber seems to be of good quality.

Exploring Tour in North Queensland.—In the course of their journeys in search of a suitable locality for a new mission station, the Moravian missionaries in North Queensland have lately come upon two rivers, not previously shown on our maps, which empty themselves into the Gulf of Carpentaria, a little south of Duyfhen point (*Periodical Accounts*, March, 1897). They appear to have water throughout the year, and to be navigable for some 25 miles from the sea. The country to which they lead is said to be high, comparatively fertile, and eminently suited for a station. It is inhabited by small tribes of natives, who are totally devoid of clothing. The streams have been named the "Mission" and the "Hey," the former being the continuation of "Myall's creek," on which the Yorkdown cattle station is situated.

The Island of Lombok.—Captain W. Cool, of the Dutch engineers, has written an account of the military operations carried out in 1894 by his countrymen in the island of Lombok, in the Eastern archipelago, and his work has lately been translated into English.* The island has been remarkable for the unusual political relations which have prevailed, a native Mohammedan population (known as the Sassaks) having been subjected by the Brahminical rulers of the neighbouring island of Bali. This had but lately occurred at the time of Wallace's visit to the archipelago, and during his stay at Lombok he gained the impression that the Sassaks were contented with the new state of things. However, of late years the tyranny of the Balinese had become unendurable, and the Sassak chiefs addressed urgent requests to the Dutch authorities for help against their oppressors. After, perhaps, an undue amount of hesitation—caused, apparently, by a want of confidence, to which recent events in Achin and Flores had given rise—an expedition was at last decided on, and led finally to the complete overthrow of the Balinese, to the great benefit of the Lombok people. The story of the expedition is told in detail by Captain Cool, who also gives two chapters on the people of the island, their manners and customs, and the history of their connection with the Dutch. His information is largely drawn from previous writers, a useful list of authorities being given at the end. But as most of these are naturally Dutch, Captain Cool's summary of our knowledge of the island will be of much use to English readers, and forms, perhaps, the most valuable part of the book from a geographical point of view. An excellent index does much to facilitate reference.

POLAR REGIONS.

Proposed New Voyage of the "Fram."—With Dr. Nansen's support and approval, Captain Sverdrup proposes next year to proceed in the *Fram* up Smith sound for the exploration of the northern coasts of Greenland. One object of the

* 'With the Dutch in the East.' By Captain W. Cool. Translated by E. J. Taylor. London: Luzac. 1897.

expedition will be to examine the so-called "palaocrystic" ice, and, if possible, to determine whether it be due to accumulation from the resistance offered by the arctic lands north of America to the polar currents, and how far it extends northward before giving place to ice more like that encountered by the *Fram* in the eastern hemisphere. The possibility of reaching a high latitude by Smith sound will, of course, much depend on the season, but, should the northern coast of Greenland be reached, it is hoped its exploration from the point reached by Peary on the east may be completed.

The Departure of the "Windward."—Following up her two successful voyages to Franz Josef Land, the *Windward* sailed on June 10 for the third time for that icy region, taking with her a fresh instalment of supplies for Mr. Jackson and his party. The equipment includes some *kayaks*, which have been specially made by Dr. Nansen for the English explorer, and also a light collapsible boat, and other stores, which are to be left for Herr Andr e's use, should he be compelled to retreat from his balloon expedition by way of Franz Josef Land. The *Windward* again sails under the experienced command of Captain James Brown, and it may therefore be hoped that her third voyage will be as fortunate as her second.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Mr. Lydeker on the Distribution of Mammals.*—The second volume of the 'Cambridge Geographical Series' is formed by a clear and comprehensive sketch, by Mr. R. Lydeker, of the main facts in the past history and present geographical distribution of the mammalian subdivision of the animal kingdom. It might at first sight seem matter for regret that the study should be confined thus to a single branch of animal life, by which characteristic the book is broadly distinguished in its plan from that published by Dr. Heilprin in the 'International Scientific Series' in 1887; † but in his introductory chapter Mr. Lydeker gives good reasons for the limitation, showing the importance of the study of mammalian distribution from two special points of view, viz. the comparatively late epoch at which mammals attained their maximum development, and the restriction of their movements by the distribution of land and water obtaining at the time of their migrations. From the second of these the study of the distribution of mammals is particularly interesting to geographers, as throwing light on the more recent changes in the great surface features of the globe.‡ The series of papers by Mr. W. L. Sclater, which have appeared in the *Journal*, is likewise written from this point of view, but is concerned rather with the distribution of existing forms than with the past history of life on the globe, whereas the investigation of the facts brought out by a study of fossil forms constitutes an important element in Mr. Lydeker's volume. In laying down the great zoological subdivisions of the Earth's surface, he agrees in the main with Mr. Sclater, adopting, like him, the three broad divisions proposed by Dr. Blanford in 1890, and using likewise for them the terms Notogæic, Neogæic, and Arctogæic. These he considers as "realms," the minor subdivisions being designated "regions." In the definition of these latter, he rather follows Dr. Heilprin than Mr. Sclater, uniting the Palaearctic and Nearctic regions under the name "Holarctic," and raising the Sonoran transition tract of the former to an

* 'A Geographical History of Mammals.' By R. Lydeker, B.A., F.R.S., V.P.G.S., etc. Cambridge University Press. 1896.

† Misprinted 1878 on page 26.

‡ On the vexed question of the permanence of ocean basins, Mr. Lydeker takes a middle view, inclining to the opinion of Prof. Suess that the Atlantic at least is of comparatively recent date.

equal rank with the other subdivisions of *Arctogrea*. Madagascar and neighbouring islands form another separate region, while *Notogrea* constitutes four separate regions, instead of the two of Dr. Heilprin. Dr. Wallace's writings are of course largely drawn upon in the course of the study, although Mr. Lyddeker points out the drawback arising from his scheme of zoological realms, in that it gives no greater rank to Australia and South America than to the other divisions of the Earth's surface, and overlooks the remarkable difference between Africa and Madagascar.

Atlantic Currents.*—The six charts contained in this atlas have been constructed from information collated and prepared in the Meteorological Office. The amount of labour entailed in carrying out this work will be best understood from the fact that the operation has occupied about eight years, during which four of the staff of the Meteorological Office have been employed in plotting the data. The task of generalization has been done at the Hydrographic Department by Commander H. E. Purye-Cust, R.N., and Lieut. H. W. H. Helby, R.N. In the notice accompanying the charts, a list is given of the material available, which includes thousands of log-books, remark-books, and observations, many of which have been supplied by foreign governments. The system on which the charts are drawn is remarkably simple, and, when taken together with the instructions contained in the accompanying notice, should be easily understood by any navigator. The figures against the arrow afford a means of estimating the permanence of the currents in the general directions shown. The navigator is, however, warned in the notice that the currents depicted on the charts are generalized, and that the chance of finding the current shown will vary in proportion as the arrows surrounding the spot for which information is sought are consonant or not, but absolute correctness must never be expected. No currents under 6 miles a day have been recorded. Although the charts are only six in number, they are available for every month in the year. The other month or months for which they may be used is mentioned in the Title. It cannot be doubted that the information contained in this atlas will be of great service to those navigators and students of physical geography who will take the pains to study the charts, and that the atlas forms a valuable addition to the aids to navigation.

Balfour Shoal.—Dr. John Murray adds another to the long list of papers embodying his researches on coral formations and deep-sea deposits in an article on the Balfour shoal in the *Scottish Geographical Magazine* (vol. xiii. p. 120). The shoal in question is a remarkable submarine elevation discovered in lat. 19° S., long. 157° E., by Commander Balfour, when searching in H.M.S. *Penguin* for the supposed Ocean Ranger reef. Commander Balfour's name is honourably known to oceanographers in connection with soundings in the greatest depths yet recorded in the ocean, and he has made a further contribution to science in the series of samples of deposits collected on the Balfour shoal, which have been examined by Dr. Murray. The shallowest depth obtained over the shoal was 836 fathoms; from the summit there are steep slopes, about 1 in 4·4 towards north-east, and more gentle slopes towards south-west. The surveying officers report the occurrence of disturbances of the water at the surface, due to the presence of the shoal, notwithstanding its great depth—an interesting fact which seems to call for closer examination. Analyses of the samples of deposits on the Balfour shoal show that they contain a very large quantity of carbonate of lime, ranging from about 89 per cent. on the summit to 72 per cent. at the base of the cone, the decrease taking place with fair regularity.

* 'Monthly Current Charts for the Atlantic Ocean.' London: published at the Admiralty, March 20, 1897, under the superintendence of Rear-Admiral W. J. L. Wharton, C.B., F.R.S., Hydrographer. J. D. Porter, agent. Price 7s.

In all cases the carbonate of lime is almost wholly made up of dead shells which have fallen from the surface waters, and it is remarkable that in depths of less than 1000 fathoms the deposit takes the form of pteropod ooze, while beyond 1000 fathoms there is typical globigerina ooze. Samples obtained by Commander Balfour on the great depths away from the shoal are all red clays, the carbonate of lime organisms disappearing entirely in depths beyond 3000 fathoms. On the steep north-east slope of the shoal there were indications of the deposition of manganese peroxide in greater quantity than elsewhere.

GENERAL.

Memorial to Joseph Thomson.—The memorial to the late Joseph Thomson, designed by Mr. Charles MacBride, of Edinburgh, was unveiled on June 8 by Sir Clements Markham at Thornhill, Dumfriesshire, in the presence of a large number of friends and admirers of the deceased explorer, including his aged father and mother. After the performance of the ceremony, Sir Clements Markham delivered a short address, recounting the services of Mr. Thomson, and showing how, by his own merits, he had won his way to distinction and public usefulness. Dr. Scott Keltie then, in the name of the committee and subscribers, made over the memorial to the care of the Dumfries County Council. The site chosen is immediately in front of the school at which Thomson received his education, and midway between the homes of his infancy and boyhood. The panelled sides of the memorial display a bas-relief and inscription commemorating his work in Africa, and the whole is surmounted with a bust in bronze, giving a striking likeness of the explorer. A marble replica of the bust will be presented to the Society.

Geography at Victoria University.—We are glad to learn that the Victoria University Court has approved of the inclusion of Geography as an optional subject in the preliminary examination of the university. This must be regarded as an important step in the progress of geographical education in England, and we hope that the number of students who take the subject will be such as to justify the action of the University Court. The following are the subjects for the next examination: (a) *Physical Geography*—The agents at work on and beneath the surface of the Earth; phenomena resulting from earth-heat; distribution of land and water. (b) *Political and Commercial Geography*—Political and economical effects of natural features of countries; outlines of geography of the British Empire (including historical geography); political and commercial geography of the United Kingdom.

OBITUARY.

Ney Elias, C.I.E.

By STEPHEN WHEELER.

THE announcement of the death of this distinguished traveller and geographer will be received with profound regret by all who knew of the high value of his work.

Mr. Ney Elias, Gold Medallist and member of the Council of the Royal Geographical Society, corresponding member of the Geographical Society, Berlin, late Her Majesty's Consul-General for Khorasan and Seistan, died in London, after a short illness, on May 31. Born in Kent on February 10, 1844, and educated partly in England, partly at Paris and Dresden, Mr. Elias first went to the East in 1866, in the employ of a commercial firm engaged in the China and Japan trade. His geographical bent had shown itself before he left Europe. In 1865 he had been elected a Fellow, and he was one of the first to profit by the special instruction

given at the Society's rooms, taking lessons in astronomy and surveying under Commander George, R.N. Three years after his arrival in China, he wrote a paper for the Society,* which, as Sir Roderick Murchison said, "gave us for the first time accurate information regarding that remarkable phenomenon, the diversion of the waters of the great Hoang-ho, or Yellow river;" the diversion, that is, which had taken place between the years 1851 and 1853, and had been predicted some time before by the Abbé Huc. The paper and the accompanying charts embodied the results of three separate journeys.† Little is said about the hardships undergone, and the perils encountered, when riding along the old bed of the river, or voyaging up and down its new course in fragile native craft, ill fitted to battle against strong currents. The author was more intent on elucidating the practical and scientific results of his expedition than on writing a sensational account of his adventures. The scientific results were summed up by the President (Sir R. Murchison): "He traced the course of the river to its new embouchure in the gulf of Pechili, fixed positions by astronomical observations, and made a survey which enabled him to complete an exceedingly good map of the country traversed." "The manner in which he carried out his examination," Sir Roderick added, "did him the highest credit."

In July, 1872, accompanied by one Chinese attendant, Mr. Elias started from Peking on his expedition to and across Western Mongolia, a journey described by the President of the Society, Sir Henry Rawlinson, as "one which will live in the memory of geographers, after travels which are the mere record of personal adventure have been long forgotten." Mr. Elias had made his way from the great wall of China through the then almost unknown steppes and mountains of Mongolia, a distance of nearly 2500 miles, to the Russian frontier; and thence another 2300 miles to Nijni Novogorod, the easternmost point at that time reached by the railway. And he had done more than this. Sir Henry Rawlinson, when presenting him with the Founders' Gold Medal, referred with marked approbation to "the indefatigable industry which you have displayed in carrying through your entire route a continuous series of observations." "That they should have been accomplished," the President added, "at his own expense by a young amateur surveyor who, in the words of Sir R. I. Murchison, 'pursued his travels in China through a pure love of geographical exploration, during holidays taken from active commercial pursuits,' does indeed strike one with astonishment."‡ To give in this brief notice anything like an adequate notion of the achievement which won for Mr. Elias one of the two highest distinctions at the Society's disposal would be impossible; and it must suffice to have quoted the opinion formed by Sir Henry Rawlinson. Mr. Elias's paper was published in the Society's *Journal*,§ and the Founder's Gold Medal was awarded to him on May 26, 1873.

Recognizing the merit and abilities of the now distinguished young traveller, Sir Henry Rawlinson and Sir Bartle Frere exerted their influence with the Indian Government on his behalf, the result being that in March, 1874, he was gazetted an extra Attaché in the Foreign Office at Calcutta. Thenceforward, up to within a few months of his death, he was actively employed in the service of his country, to which he devoted himself with the unflinching if silent determination that marked all his actions. What he sacrificed to his high and heroic ideal of duty will never be fully known.

In September, 1874, Mr. Elias was appointed Assistant to the Resident at

* *Journal, R.G.S.*, vol. xl. (1870), p. 1.

† See also a paper by Mr. Elias on "The New Bed of the Yellow River" in the *Journal of the North China branch of the Royal Asiatic Society, Shanghai, 1869.*

‡ *Proceedings R.G.S.*, vol. xvii. (1872-73), p. 230.

§ *Journal, R.G.S.*, vol. xliii. (1873), p. 108.

Mandalay, in Upper Burma, and shortly afterwards was instructed to accompany Colonel Horace Browne as second in command of the British Overland Mission to China. The disastrous issue of that ill-fated enterprise needs not to be retold. The murder of Augustus Margary and the repulse of the mission a few marches within the Chinese border are fully described in Dr. Anderson's book,* as well as in official reports. But it is necessary to mention here that, as related by Dr. Anderson, Mr. Elias admirably performed the task imposed on him of providing transport for the expedition, engaging followers, and negotiating with the hill chiefs; that the plans of the mission were changed at the last moment contrary to his advice; and that, accompanied by Captain Cook, he made his way in safety



NEY ELIAS, C.I.E.

(From a photograph by Maul and Fox.)

to the headquarters of the famous Li-sieh-tai, and, by the exercise of tact and resolution, got back to Bhamo without misadventure.

In 1876 Mr. Elias submitted to the Government of India a carefully devised project for an expedition from Peking through the north-western provinces of China to Northern Tibet and the Kuen Lun mountains; and he subsequently expressed his willingness to accept the very onerous conditions which Lord Lytton's advisers thought it prudent to impose, namely, that he should travel as a private person,

* 'Mandalay to Momein.' By John Anderson, M.D. London. 1876.

and that the Government should not be called upon to assist him in the event of his plans miscarrying. But the idea of a Tibetan expedition, to his intense disappointment, had in the end to be abandoned. The scheme fell through, mainly, as Mr. Elias believed, owing to the opposition of one or two members of the viceregal council and to obstacles created by diplomatists at Peking, to whom the Indian Foreign Office referred the matter without giving Mr. Elias a chance of fully explaining his project or of meeting the arguments against it. No personal ambition had inspired him. He was convinced that the political interests of the British Government would be promoted by the undertaking, as well as the cause of geographical research. "It is certainly wrong," he wrote at the time, "that Russian expeditions should be able to explore our frontiers and make themselves favourably known, while we are unable to show ourselves there." No one better understood the perils of such an enterprise, but he was fully prepared to stake life and reputation on the execution of it. Perhaps it may be as well to explain here that he always deprecated the notion that any advantage was to be gained by sensational efforts to reach Lhasa. Only a few months ago he wrote in a private letter, "What do people imagine they will see there beyond what Manning and Huc saw? and the geography has been pretty well worked out by the pundits. I am afraid," he added, "that our explorers are wanting in originality. Why doesn't somebody try Arabia or the Malay peninsula instead of Tibet over and over again? And how is it that we allow a Frenchman to do such a really important piece of work on our frontiers as Prince Henry of Orleans did last winter (1895-96) in proving the sources of the Irawaddy?"

Had Mr. Elias remained in Burma, he might have found the means of anticipating Prince Henry; but by the end of 1877 he was at the other extremity of the Indian empire, having been appointed in October of that year British Joint Commissioner of Ladak, in succession to another of the Society's Gold Medallists, the late Robert Shaw. At first, as he said, there was little to be done there besides ibex-shooting, though he was also able to prosecute his researches in the history of Central Asia. But in 1879 a new field of activity was opened to him. In the year of his appointment to Ladak, Yakub Beg of Kashgar died or was poisoned, leaving his kingdom to be reoccupied by the Chinese; and the Indian Government became anxious to establish friendly relations with the new rulers of Eastern Turkistan. Mr. Elias, accordingly, made several journeys across the Karakorum. From the official record of his services, it appears that he was "on special duty" at Yarkund from June 14 to August 17, 1879; "on deputation to Kashgar" from March 8 to August 26, 1880; and "on special duty" again at Kashgar from May 26 to September, 1885. His reports to Government at this period have never been published; but a long letter in the *Times*, dated from Kashgar, July 10, 1880, and entitled "The Chinese Reoccupation of Turkistan," contains some of the results of his observations. It completely disposed of the fictions current in Europe as to the exploits of the Chinese army, and gave a spirited and trustworthy account of the sudden collapse of the dominion founded by the Turki soldier of fortune, Yakub Beg.

In September, 1885, under instructions from the Indian Foreign Office, Mr. Elias left Yarkund for the Pamirs and the upper Oxus. A brief summary of the expedition is given by Mr. C. E. D. Black; * while the geographical results have been alluded to by the Right Hon. George Curzon in his recent paper on "The Pamirs and the Source of the Oxus," and, previously, in a letter to the *Times* (December 14, 1893). But a full account of this remarkable journey has yet to be published. Mr. Elias

* 'A Memoir of the Indian Surveys, 1875-1890.' London. 1891.

carried out a route survey from the Chinese frontier to Ishkashim, a distance of 600 miles; he fixed points and altitudes on the Pamirs; he visited the confluence of the Murghab and Panja rivers, which no Englishman has done before or since; he traversed Badakhan and Balkh, reached the camp of the British Boundary Commission near Herat, and thence returned to India by way of Balkh and Chitral. "Mr. Elias informs me," Mr. Curzon wrote in his letter to the *Times*, "that, from a careful inspection and personal fording of both rivers (i.e. the Aksu-Murghab and Panja streams where they unite at Kila Wamar), and from minute local inquiries as to their respective fluctuations, he was able to satisfy himself that the Panja is at every season but one (June and July) a very much more voluminous stream than the Murghab." Of course, as Mr. Elias explained in his report, there were other factors in the problem, as to which was the head-stream of the Oxus; but he had solved what in 1885 was the vital one. Nothing remained for his successors to investigate save a few questions which, however interesting, were comparatively of minor importance. It may be said, therefore, that to Mr. Elias belongs the honour of being the first to solve a problem which had long been a mystery to geographers and a vexation to statesmen. He indicated the true sources of the Oxus.

In a private letter in January, 1888, Mr. Elias wrote to a friend, "The Government have just gazetted me to the order of the C.I.E., in spite of my having often begged them not to do so. As soon as I saw it in the *Pioneer*, I wrote and asked to be gazetted out. I do not regard it as a reward, and I mean to stick to my refusal in spite of all consequences. I have often told them that I would have no order (once when it was a question of a C.S.I.)."

In October, 1889, Mr. Elias was ordered to take command of a commission deputed to inquire into the political geography of the Shan States, on the borders of Burma and Siam.* The commission carried out a survey of the country, effectively asserted British authority in places where no doubt existed as to the justice of British claims, and made recommendations to Government as to a future delimitation.

From November 7, 1888, to February 12, 1889, Mr. Elias was on special duty in connection with the Sikkim Expedition; and here again his official work is hidden away in confidential reports to Government. On December 14, 1891, he was appointed agent to the Governor-General at Meshed, and Consul-General for Khorasan and Selistan, which appointment he held till November, 1896, when he was obliged to retire by continued ill health, the effects of exposure and hardships he had undergone during his many solitary and arduous journeys in Central Asia.

During his furlough in 1895, Mr. Elias spent most of his leisure in the preparation of an English edition of the *Tarikhi-Rashidi*, a history of the Moghuls of Central Asia, together with autobiographical memoirs written in the seventeenth century by Mirza Haidar of Kashgar, a cousin of the Emperor Baber. Possessing merely an elementary acquaintance with Persian and Turki, Mr. Elias enlisted the services of an accomplished Oriental scholar, Mr. Ross, for the work of translation. But the introduction, the notes, historical and geographical, together with the material for an admirable map, were contributed by himself; and the volume, both in its inception and execution, bore the unmistakable stamp of his unrivalled experience and knowledge of the countries and peoples described by the author. It is especially valuable for the light it throws on disputed points in regard to the historical geography of Central Asia and the ethnology of Turk, Tartar, and Moghul.

Mr. Elias died very suddenly from blood-poisoning. Only a few days before, he

* See a paper, by Colonel E. G. Barrow, in the *Proceedings* of the Simla United Service Institution for 1890.

had discussed other literary projects with a friend, and more especially the idea of bringing out a new edition of the autobiography of Baber. He had also been correcting the proofs of a memorandum on unexplored tracts in Asia, which he had written for the Society.

Of his private life and interests, of the attractiveness of a character in which a certain reserve of demeanour would at once disappear when something was to be done for others, of the steady pursuit of worthy aims with what seemed absolute unconsciousness of lower incentives to ambition, it may be out of place to speak here. But his merits were not to be obscured by persistent modesty, and met with a wider recognition than he imagined. No one, indeed, even on the most casual acquaintance, could fail to note some indication of his fine qualities; while the splendid proofs of his courage and endurance, his keen judgments and wide attainments, are marked for geographers on the map of Asia.

Baron Oscar Dickson.

Baron Oscar Dickson, the well-known patron of Swedish arctic exploration, died at his estate at Almnäs, in Sweden, on June 5, in his seventy-fourth year. Although born and bred in Sweden, our deceased associate was of Scotch extraction, being the second son of James Dickson, who, with his brother Robert, emigrated to Gothenburg early in the century, and founded there the since well-known mercantile firm of Dickson and Company. The two brothers were known far and wide for their munificence and liberality, and the sons of James fully sustained their father's reputation in this respect. From 1868 onwards few arctic expeditions left the shores of Sweden but were supported in greater or less degree by Oscar Dickson, who, in Baron Nordenskjöld, found just the man needed to carry his ideas into execution. The three earliest expeditions to which, in whole or in part, Oscar Dickson contributed the funds were directed towards Greenland and Spitsbergen, that of 1872-73 wintering further north than any which had preceded it in this part of the world. In 1875 and following years the northern coast of Asia was the point aimed at, and the tentative expeditions of 1875 and 1876, to the mouth of the Yenesei, paved the way for the great voyage of Nordenskjöld in 1878-79, by which the north-east passage was effected for the first and (so far) for the only time. The expense of this expedition was borne in equal shares by King Oscar, Oscar Dickson, and M. Sibiriakof. Oscar Dickson's interest in arctic voyages did not end here. The funds for Baron Nordenskjöld's Greenland expedition of 1883 were entirely provided by him, and he contributed a liberal sum to the Danish expedition in the *Djmphna*, and warmly supported many minor scientific undertakings. He had joined our Society in 1875.

OBITUARY OF THE YEAR.

The following is a list of the Fellows of the Society who have died during the year 1896-97 (April 30):—

SIR PERCY ANDERSON; EDWARD ARMITAGE; WM. JAMES ARMITAGE; HON. DAVID ARNOT; W. F. AINSWORTH; ROBERT BRADFORD; Colonel R. C. BIRKETT; H. R. BAILLIE; JOHN WILLIAM BIRCH; HENRY W. A. COOPER; Right Hon. HUGH C. E. CHILDEES; THOMAS BARCLAY CARTWRIGHT; GEO. W. CAMPBELL; WILLIAM CAMPBELL; SEDGWICK S. COWPER; Major P. W. G. COPLAND-CRAWFORD; JAMES CLEMINSON; LOUIS P. CASELLA; WILLIAM DEBENHAM; Major EDWARD WILLIAM DUN; WILLIAM FANE DE SALIS; SIR WALTER EUGÈNE DE SOUZA; HON. CHARLES

H. S. ESKINE; WILLIAM ALFRED ECKERSLEY; Hon. JAMES J. FELLOWS; JOHN DALZIEL FAIRLEY; General the Hon. Sir ST. GEORGE FOLEY; ANTHONY FORSTER; General CHARLES FOSTER; Colonel ALEXANDER GORDON; GEORGE GREGSON; ISAAC JAMES GREEN; Sir FREDERIC HUGHES; JOHN HUDSON; EDWARD DOWLING HODGSON; ROWLAND HAMILTON; HENRY HOLBOYD; WINSLOW JONES; JOHN BROOKES JOHNSTON; BRYANS THOMAS KNIGHTS; Captain FREDK. EYRE LAWRENCE; F. G. LUCK; Lord LILFORD; GEORGE LAWFORD; Sir T. GALBRAITH LOGAN; DONALD LARNACH; Major JOHN L'AKER; Baron Sir FERDINAND VON MUELLER; JOSEPH A. MOLONEY; KENNETH R. MURCHISON; C. KEIR MACKINTOSH; WILLIAM G. MARGETTS; Admiral of the Fleet, Sir ALEXANDER MILNE; Dr. F. J. MOUAT; BENJAMIN NEWBATT; JOHN LOWE NICOLL; Major E. RODERIC OWEN; EDWARD LAVINGTON OXENHAM; EDWARD D. OGILVIE; Sir JOHN PENDER; CAPTAIN JAMES PORTER; GEORGE PHILLIPS; FREDERICK PORTER; Admiral Sir GEO. H. RICHARDS; F. RICHARDSON; ROBT. RICHARDSON; General J. MEREDITH READ; EDWARD STAPLETON; HAROLD STEPHENS; EDWIN SPEIGHT; Captain JAMES MASTERS SHARE; General Sir CHARLES W. D. STAVELEY; GILBERT STEVENSON; Admiral WALTER STEWART; M. VIVIEN DE ST. MARTIN; Dr. F. A. A. SMITH; EDWARD OWEN TUDOR; JOHN WHITE; HERBERT WORTHINGTON; CHARLES H. WESTENDARP; WILLIAM NOEL WEST; Count WILLY DE WAGNER; E. D. YOUNG.

CORRESPONDENCE.

Formation of a Lake in Nagar.

By a letter just received, I learn that the Hobar glacier in Nagar, which was traversed and described by me in 1892, has advanced and dammed up the Hispar river, forming a lake in the deep and narrow gorge below the foot of the Hispar glacier. The foot of the Hobar glacier is depicted in an illustration to my letter on the crossing of the Hispar pass (*R.G.S. Proc.*, November, 1892). The length of the lake is stated to be 4 miles. If the ice-dam breaks, the waters will pour down the Hunza gorge, and may do considerable damage below Gilgit.

W. MARTIN CONWAY.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1896-97.

Anniversary Meeting, May 17, 1897.—Sir CLEMENTS MARKHAM, K.C.B., F.R.S.,
President, in the Chair.

The Secretary read the Minutes of the last Anniversary Meeting.

ELECTIONS.—*Edward Herbert Anning; Frederick E. Blaisdell, C.E.; Sasi Bhusan Chattergn; Robert Codrington; John Cohen; Tathwell Henry Bate Collinson; Thomas Penson Griffithes; R. T. Günther, M.A.; S. McCracken, B.A.; William Monkman Maitland; John T. Meesom, B.A.; James Hope Lloyd Verney; Dr. George de Wagner.*

The President then presented the medals and other awards for the year.

The PRESIDENT: M. Lessar, we are very much obliged to you for coming here this afternoon in the unavoidable absence of your distinguished countryman, M. P. Semenov. The Council has awarded the Founders' Gold Medal to M. Semenov, the Vice-President of the Imperial Russian Geographical Society, in recognition of his great services to geography, in having promoted the exploration of Central Asia with great zeal and success during a long course of years, and also for his own

journeys in the Tian Shan mountains, parts of which were visited by him for the first time. M. Semenov has also made valuable addenda to the translation of Ritter's Asia, and is the author of the Students' Russian Dictionary of Geography. This Society has always very highly appreciated the labours of Russian explorers and Russian geographers, and on five previous occasions they have won our royal award. On the present occasion, although the medal is granted solely for M. Semenov's own merits, still we believe that my venerable friend, to some extent, may be considered to represent other distinguished explorers who have laboured under his initiation. I have just heard with great pleasure that M. Semenov has for the fifteenth time been elected Vice-President of the Imperial Geographical Society, a post which, I believe, he has held with much distinction for nearly a quarter of a century. I have the pleasure of placing this medal in your hands for transmission to M. Semenov.

M. LESSAR (Councillor of the Russian Embassy): C'est avec des regrets bien sincères que M. Semenov, retenu à St. Pétersbourg par les devoirs du service, a dû renoncer au plaisir de venir à Londres afin de remercier personnellement la Société Royale de la haute distinction qui lui a été décernée, et c'est à moi qu'est échu l'honneur de le faire en son nom. Nous venons d'entendre en quels termes Sir C. Markham a jugé l'œuvre du Vice-Président de la Société Impériale Russe de Géographie, et certes je n'ai rien à ajouter à cette appréciation flatteuse. Je saisis seulement cette occasion pour payer à M. Semenov une dette de reconnaissance pour ainsi dire personnelle, en mon nom et au nom de plusieurs générations de ceux qui ont travaillé aux progrès de la géographie en Russie. Le voyage au Tian Shan, brillant début qui mit M. Semenov d'emblée au premier rang des explorateurs, n'a été que le commencement de sa carrière scientifique. Depuis lors pendant plus de 40 ans il a pris une part dirigeante au mouvement géographique de notre pays: la liste des ouvrages de la plus haute valeur que nous lui devons est trop longue pour être citée ici; il n'y a pas eu une seule expédition scientifique ou exploration russe à laquelle M. Semenov n'ait pris part, tantôt comme initiateur, tantôt comme guide sûr et savant, élaborant les programmes et donnant des conseils auxquels bien souvent a été dû en grande partie le succès des voyages entrepris.

Aussi en cette occasion, je suis heureux non seulement de vous assurer de la part de M. Semenov qu'aucune distinction ne lui a jamais procuré plus de satisfaction que la médaille que M. le Président vient de me transmettre, mais encore vous prier de vouloir bien recevoir la vive gratitude de toute mon pays pour l'hommage rendu encore une fois—pour la sixième fois, comme vient de le dire M. le Président—a un de nos plus éminents savants, hommage bien précieux quand il vient de la part de l'illustre Société Royale à laquelle la science géographique doit une si grande partie de ses plus beaux progrès.

The PRESIDENT: The Patron's Gold Medal has been awarded to Dr. George Dawson, the Director of the Survey of Canada, for his numerous journeys and explorations in the North-West territory and in British Columbia, and especially for the valuable work he did while in command of the Yukon Expedition. Dr. Dawson, by his writings, has done very valuable work for physical geography, and has thrown light on the physical geography of that part of the North American continent to the westward of the great lakes. He has always done his best to forward exploration in the Dominion of Canada, in those parts especially which are still unexplored and unknown. Sir Donald Smith has kindly undertaken to forward the gold medal to Dr. Dawson, now in Canada.

Sir DONALD SMITH (High Commissioner for Canada): I wish to say that I look upon this as a privilege and a very great pleasure indeed, both as representing Canada and personally to receive from you this medal for Dr. George Dawson, the

worthy son of a most worthy father, Sir William Dawson, both of whom we regard with great pride in Canada.

The PRESIDENT: Lieut. Vandeleur, the Murchison Grant has been awarded to you for your very valuable reports and surveys, and for other geographical work which you have performed during the last five years. On your return from your expedition into Somaliland, Mr. Coles, who examined your work, was very much struck by its remarkable accuracy and the pains you had taken, and I then foresaw that you would do much more valuable work for geography, although I scarcely anticipated you would do it so soon. Very shortly after your return you were sent out to Uganda, Unyoro, and the upper Nile, making numerous astronomical observations and surveyings while on active service and in a hostile country. Your work in the field enabled you to construct valuable maps. In the present year, under the auspices of our Vice-President, Sir George Goldie, you have during active service made other valuable surveys—I may almost say that you were advancing with your sword in one hand and your sextant in the other. It is a very great pleasure to me personally to be the channel through which you receive this award, for in all my experience I have never known a geographer so young as you are, or indeed of any age, perform so much extremely valuable geographical work in so short a time. The award will be presented so soon as it is ready in the form that pleases you best.

Mr. Bille, we are extremely obliged to you for coming here this afternoon, and very glad your Excellency has returned to England in time to receive these awards for your countrymen, whose absence is unavoidable. Dr. Thoroddsen, during the last seventeen years, has done most valuable work for geography and geology in the most inaccessible parts of Iceland; while Lieut. Ryder has, in his work along the east coast of Greenland, made several most interesting geographical discoveries. We place these awards in your hands with the request that your Excellency will forward them to your countrymen, and convey also to them our great appreciation of their valuable labours. The awards will be presented in the form they like best; Dr. Thoroddsen will receive a watch, and Lieut. Ryder a piece of plate.

M. BILLE: I need not tell you I accept with great pleasure the request to transmit to my compatriots the awards you have done them the honour to bestow upon them, and I think I can vouch for the feeling of gratitude with which Mr. Ryder and Dr. Thoroddsen will accept them; indeed, no greater encouragement could come to them from a more exalted place. Scientists and explorers from small countries like my own will often feel quite keenly the restrictions which handicap their efforts—their limited resources, as a rule, and the language generally unknown. There is no doubt that much that is achieved, and much that might be achieved, is doomed beforehand to be as unknown as that foreign language, but if they can look to a great and celebrated Society like this to support their efforts, and to eventually proclaim their success, their courage will rise, their energy will double, and their horizon will widen. It is, in fact, to them like a ticket of admittance to the platform from which they can address the civilized world. I need not say any more to explain the importance the acknowledgment in the solemn meeting of this Society will have for my compatriots, and I beg to express the gratitude and thanks I feel myself.

The PRESIDENT: The Gill Memorial has been awarded to Mr. C. E. Douglas for his persistent and most useful exploration of the western slopes of the New Zealand Alps, during which he has ascended most of the valleys as far as the glaciers in the face of difficulties caused by the rough ground, dense forest, and innumerable chasms. He has in this way furnished valuable reports and maps, and we feel we are giving this honour to Mr. Douglas, not only for the zeal

he has shown in these explorations, but also because we remember he has done it, until quite lately, entirely at his own expense. I have pleasure in handing the Gill Memorial and the diploma to Mr. Kennaway, secretary of the Agent-General for New Zealand, who has kindly attended in place of the Agent-General for New Zealand, who is unable to come.

Mr. KENNAWAY: I beg to thank you on behalf of Mr. Douglas and also of the Agent-General for New Zealand, for the kind manner in which you have spoken of Mr. Douglas, and the handsome way in which you have shown your appreciation of his explorations in the Southern Alps. I myself many years ago explored, not the Western, but the eastern slopes of the Southern Alps, and to a certain extent, therefore, I know the hardships he must have undergone on the western slopes, where the forests are very dense and the inaccessibility is very great. I think also I might state that it is a little appropriate that I should receive for him your Society's award, as I was once the representative of Mount Cook in the local parliament of the Province of Canterbury. I beg, therefore, to again thank you very much for the kind manner in which you have presented this award to Mr. Douglas.

The President then delivered his Anniversary Address (see vol. ix. p. 589). Lord BELHAVEN proposed and Mr. G. S. MACKENZIE seconded a vote of thanks to the President for his address.

After visitors had withdrawn, the President appointed Captain Bedford and Captain Stiffe scrutineers of the ballot for the new Council.

The Secretary read the report of the Council as follows:—

REPORT OF THE COUNCIL.

The Council have the pleasure of submitting to the Fellows the following Report on the general and financial condition of the Society:—

Membership.—The number of Fellows elected during the year ending April 12, 1897, was 267, and nine Honorary Corresponding Members. In the previous year, 1895-96, the total elections amounted to 239, and in 1894-95 the number was 210. Our losses have been, by death 82 (besides one Honorary Corresponding Member), by resignation 40, and by removal on account of arrears of subscription 56; making a total increase of membership for the year of 97. In the year 1895-96 there was an increase of 47, in 1894-95 an increase of 12. The total number of Fellows on the list (which does not include those (25) who have been elected but have not yet paid the fees, and exclusive of Honorary and Honorary Corresponding Members) on May 10 was 3854.*

Finance.—As will be seen by the annexed Statement of Receipts and Payments for the year, the total net income for the financial year ending December 31, 1896 (i.e. exclusive of balance in hand), was 11,023*l.* 1*s.* 8*d.*, of which 7379*l.* 8*s.* consisted of entrance fees and subscriptions of Fellows. In the previous year, 1895, the total net income was 10,209*l.* 11*s.* 8*d.*, and the amount of subscriptions, etc., 7458*l.*; in 1894, the two totals were 9853*l.* 4*s.* 6*d.* and 6852*l.* 10*s.* respectively.

The net expenditure for the past year (i.e. exclusive of balance in hand) was 10,820*l.* 15*s.* 1*d.* The net expenditure in 1895 was 10,057*l.* 10*s.* 6*d.*; in 1894, 9583*l.* 0*s.* 5*d.*

* It will be observed that the elections are given for the year ending April 12, the accounts for the year ending December 31. The total number of Fellows elected during the financial year January to December, 1896, was 250, including three Honorary Corresponding Members.

The Finance Committee of the Council have held, as usual, meetings during the year, supervising the accounts of the Society. The Annual Audit was held on March 31 last, the accounts being audited by a chartered accountant and duly certified as correct. The following is the Auditor's Report:—

Auditor's Report.—"I beg to report that I have examined the account of Receipts and Payments of your Society for the year ended December 31 last, with the books and vouchers relating thereto, and find it to be correct. I have also verified the balance at the bankers and the securities held for investments of the Society, as follows:—

Securities held by Bankers:—

- 1000*l.* Norwegian 3½ per cent. Bonds.
- 1000*l.* India 3½ per cent. Debentures.
- 1800*l.* Great Western Railway 4½ per cent. Debenture Stock.
- 4850*l.* Great Indian Peninsula Railway 5 per cent. Guaranteed Stock.
- 1334*l.* London and North-Western Railway, 3 per cent. Debenture Stock.
- 1333*l.* North-Eastern Railway 3 per cent. Debenture Stock.
- 2000*l.* Caledonian Railway 4 per cent. Preference Stock No. 1.

Inscribed at Bank of England:—

- 3135*l.* 14*s.* 11*d.* 2½ per cent. Consols "A."
- 440*l.* 2½ per cent. Consols "B."
- 1023*l.* 5*s.* 6*d.* New South Wales 3½ per cent. Stock, 1924.
- 100*l.* New Zealand 4 per cent. Stock.
- 1003*l.* Metropolitan 3½ per cent. Consolidated Stock.
- 400*l.* Metropolitan 2½ per cent. Consolidated Stock.
- 1000*l.* India 3½ per cent. Stock.

"The receipts for the year have amounted to 11,023*l.* 1*s.* 8*d.*, including 877*l.* 4*s.* 7*d.* received in respect of legacies. The expenditure has amounted to 10,820*l.* 15*s.* 1*d.*, including 898*l.* 1*s.* invested. The ordinary receipts therefore show a surplus over ordinary expenditure of 223*l.* 3*s.* The arrears of subscriptions amount to 1289*l.*, being 19*l.* less than at December, 1895.

"The market value of the securities held by the Society for
 moneys invested at April 16, 1896, was £ *s.* *d.*
 28,309 10 4

"And there has been further invested during the year 898 1 0

29,207 11 4

"The market value of the investments at December 31, 1896, was 28,363*l.* 0*s.* 8*d.*

"W. B. KEEN."

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR 1896.

Receipts.

Payments.

1896.		£ s. d.	£ s. d.	1896.		£ s. d.	£ s. d.
<i>Balance in Bankers' hands, Dec. 31, 1895</i>	.. ..	441 11 11		<i>House:—</i>			
<i>Ditto Accountant's</i>	.. ..	5 11 3½	447 3 2½	Taxes and Insurance ..	118 1 8		
<i>Subscriptions:—</i>				Parochial Rates on Shop	26 11 3		
Arrears .. ..	.. ..	322 0 0		Coals, Light and Water	107 6 6		
For the current year ..	.. ..	4236 18 0		Repairs	117 18 4		
Paid in advance .. ..	.. ..	870 0 0		Office Keeper and Messenger	124 3 4		
				Miscellaneous	97 1 2		
<i>Entrances Fees .. ..</i>	.. ..	.. ..	5438 18 0	<i>Office:—</i>		591 2 3	
<i>Life Compositions .. ..</i>	.. ..	.. ..	1140 0 0	Salaries	1034 13 4		
<i>Parliamentary Grant .. ..</i>	.. ..	.. ..	810 10 0	Stationery	144 10 2		
<i>Royal Premium .. ..</i>	.. ..	.. ..	500 0 0	Miscellaneous Printing	246 3 9		
			52 10 0	Miscellaneous	214 17 7½		
<i>Publications:—</i>				<i>Library:—</i>		1647 3 10½	
Advertisements in Journal .. ..	.. ..	585 0 0		Salaries	425 0 0		
Sale of Journal .. ..	.. ..	430 4 10		Books and Binding ..	173 3 6		
Sale of 'Hints to Travellers' .. ..	.. ..	50 12 9		Compiling Catalogues ..	182 2 0		
Other Publications .. ..	.. ..	78 0 0		Miscellaneous	100 13 3½		
Sale of Old Proceedings	.. ..	8 0 0		<i>Purchase of Captain Snow's Papers .. ..</i>	.. ..	100 0 0	
			1151 17 7	<i>Purchase of Dr. Brown's Library .. ..</i>	.. ..	100 0 0	
<i>Receipts for Scientific Instruction .. ..</i>	.. ..	.. ..	92 15 0	<i>Map-room:—</i>			
<i>Subscriptions, etc., received in error .. ..</i>	.. ..	.. ..	60 18 11	Salaries	552 0 0		
<i>Loan of Diagrams and Slides, etc. .. ..</i>	.. ..	.. ..	7 7 6	Purchase of Maps and Diagrams	78 10 6		
<i>Rent of Shop .. ..</i>	.. ..	.. ..	86 0 0	Repairs to Instruments	45 6 6		
<i>Sale of Society Tickets .. ..</i>	.. ..	.. ..	39 7 6	Cloth	34 8 0		
<i>Legacy by Mr. William Chandless .. ..</i>	.. ..	.. ..	500 0 0	Miscellaneous	43 4 9½		
<i>Legacy by Mr. James Jackson .. ..</i>	.. ..	.. ..	377 4 7	<i>Map-Drawing Room:—</i>		753 9 9½	
				Salaries	333 6 8		
<i>Dividends:—</i>				Miscellaneous	14 5 3		
North-Eastern Railway 3 per Cent. .. 1333.	.. ..	39 1 3		<i>Meetings:—</i>		317 11 11	
Great Indian Peninsula Railway 5 per Cent. Guaranteed Stock 4850l.	.. ..	263 19 0		Refreshments	93 13 4		
Great Western Railway 4½ per Cent. Debenture Stock [Davis bequest] .. 1800l.	.. ..	73 19 0		Lantern Slides	13 5 6		
London and North-Western Railway 3 per Cent. Debenture Stock [Murchison bequest] .. 1334l.	.. ..	38 13 8		Fellows' Tickets	11 7 6		
Caledonian Railway 4 per Cent. Preference Stock .. 2000l.	.. ..	77 6 8		Printing	160 7 0		
Norwegian 3½ per Cent. Bonds .. 1000l.	.. ..	83 16 8		Advertising	22 13 0		
New Zealand 4 per Cent. Stock .. 1000l.	.. ..	38 13 4		Attendance at Meetings	24 15 0		
New South Wales 3½ per Cent. Stock [Gill Memorial] .. 1028l. 5s. 6d.	.. ..	34 15 10		British Association ..	15 0 0		
India 3½ per Cent. Stock 1000l.	.. ..	33 16 8		Reporting	49 17 6		
India 3½ per Cent. Debentures .. 1000l.	.. ..	31 8 4		Hand Maps	42 13 7		
Consols 1064l. 10s. 3d.	.. ..	28 6 4		Anniversary Dinner ..	57 15 0		
.. [Peck Fund] .. 1000l.	.. ..	26 11 8		Soirée	168 5 0		
.. [Back bequest] 561l. 0s. 6d.	.. ..	14 18 4		Special Meetings	15 5 0		
.. [Trevelyan bequest] 810l. 4s. 0d.	.. ..	13 10 8		Miscellaneous	107 5 9		
.. [Chandless bequest] 440l.	.. ..	2 18 6				782 3 3	
Metropolitan 3½ per Cent. Consolidated Stock 1000l.	.. ..	33 16 8				191 4 2	
			775 12 7	<i>Medals and other Awards</i>			
				<i>Education:—</i>			
				Scientific Instruction ..	160 5 0		
				Oxford and Cambridge Universities	300 0 0		
				Owens College	50 0 0		
				Educational Prizes and Lectures	189 2 9		
				Miscellaneous	15 4 0		
				<i>Publications:—</i>		694 11 9	
				Printing Journal	1087 13 9		
				Postage and Addressing	530 4 4		
				Separate copies	47 2 0		
				Maps	896 2 8		
				Illustrations	101 19 9		
				Payments to Contributors	300 0 0		
				Editor of Publications ..	200 0 0		
				Miscellaneous	106 1 10½		
				Index to Proceedings ..	131 15 9		
				Supplementary Papers	36 7 6		
				<i>Expeditions:—</i>		3138 7 7½	
				Grant to Sir W. M. Conway	300 0 0		
				Instruments for Travellers	108 18 9		
				<i>Chandless Legacy:—</i>		408 18 9	
				Purchase of 440l. Consols	.. ..	500 0 0	
				<i>Jackson Legacy:—</i>			
				Purchase of 400l. Metropolitan Stock .. ..	.. ..	398 1 0	
				<i>Receipts in error refunded</i>	.. ..	45 2 0	
				<i>Balance in Bankers' hands, Dec. 31, 1896</i>	631 13 0		
				<i>Do. Accountant's do.</i>	17 16 9½		
						649 9 9½	
			£ 11,470 4 10½			£ 11,470 4 10½	

I have examined the above Account, with the books and vouchers of the Society, and certify it to be correct.

3, Church Court, Old Jewry, E.C.
March 31, 1897.

W. R. KEFN,
(Chartered Accountant.)

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1896-97. 113

STATEMENT showing the RECEIPTS and EXPENDITURE of the Society from the Year 1848 to December 31, 1896.

	Year.	Cash Receipts within the Year.	Cash Amounts Invested in Funds.	Deducting Amounts Invested in Funds; actual Expenditure.
		£ s. d.	£ s. d.	£ s. d.
'Includes Treasury Grant of 1000 <i>l.</i> for the East African Expedition.	1848	698 16 5	.. ..	755 6 1
	1849	778 3 0	.. ..	1088 7 6
	1850	1636 10 5	.. ..	877 2 0
'Includes Treasury Grant of 2500 <i>l.</i> for the East African Expedition.	1851	1054 11 8	.. ..	906 14 7
	1852	1220 3 4	.. ..	998 12 1
'Includes Legacy of Mr. Benjamin Oliveira, 17 <i>s.</i> 1 <i>d.</i>	1853	1917 2 6	.. ..	1675 6 0
	1854	2545 7 8	.. ..	2197 19 3
	1855	2594 7 0	.. ..	2636 3 1
'Includes Legacy of Mr. Alfred Davis, 1890 <i>l.</i>	1856	3372 5 1	539 15 0	2814 8 1
	1857	3142 13 4	278 0 0	2480 19 0
'Includes Legacy of Sir Roderick Murchison, 1000 <i>l.</i>	1858	3089 15 1	.. ..	2944 12 6
	1859	3471 11 8	960 0 0	3423 3 9
	1860	6449 12 1	468 17 6	5408 3 7
'Includes Mr. James Young's Grant for Congo Expedition, 2000 <i>l.</i>	1861	4792 12 9	1368 2 6	3074 7 4
	1862	4650 7 9	1389 7 6	3095 19 4
'Includes 1000 <i>l.</i> 1 <i>s.</i> 6 <i>d.</i> , sale of Exchange Bills.	1863	5354 9 3	1837 10 0	3655 4 0
	1864	4977 8 6	1794 5 0	3647 7 0
	1865	4905 8 3	1041 5 0	4307 4 5
'Includes Mr. James Young's Grant for the Congo Expedition, 1041 <i>l.</i> 1 <i>s.</i>	1866	5085 8 3	1628 15 0	4059 15 0
	1867	5462 7 11	1029 0 6	3943 17 4
	1868	5991 4 0	1867 3 9	4150 17 10
'Includes Parliamentary Grant of 3000 <i>l.</i> to Cameron Expedition.	1869	8659 16 0	2131 5 0	4646 0 8
	1870	8042 6 1	2802 6 0	3845 10 6
'Includes Donation of 800 <i>l.</i> by Mr. C. J. Lambert.	1871	8637 3 7	1000 0 0	3736 4 4
	1872	8119 7 9	1999 4 6	5871 13 2
	1873	7761 18 10	2015 1 8	6897 12 6
'Includes Legacy of Admiral Sir George Back, 540 <i>l.</i>	1874	8753 5 10	499 0 0	7876 2 3
	1875	7934 15 10	2002 7 6	5683 4 10
	1876	11611 11 8	.. ..	6870 13 1
'Includes Legacy of Sir W. C. Trevelyan, 500 <i>l.</i>	1877	7956 1 11	2538 2 0	3840 17 11*
	1878	8124 10 0	3000 0 0	6361 9 6
'Includes 1005 <i>l.</i> 8 <i>s.</i> 2 <i>d.</i> , sale of Exchange Bills.	1879	8979 14 10	1551 10 10	6990 14 2
	1880	8599 18 4	1567 5 1	5454 1 10†
'Includes 1000 <i>l.</i> received from Mr. B. Leigh Smith.	1881	8509 19 5	.. ..	5362 5 6‡
	1882	8943 15 0	.. ..	3779 10 7
	1883	9599 9 6	1001 5 0	5624 2 11
'Includes 500 <i>l.</i> on loan from Bankers.	1884	8944 11 7‡	.. ..	9296 0 5
	1885	8738 12 3	.. ..	5555 3 10‡
'Includes 996 <i>l.</i> 8 <i>s.</i> 10 <i>d.</i> , sale of India Debentures.	1886	7968 9 0	1000 0 0	7767 18 0‡
	1887	8607 16 2	.. ..	5493 10 3
'Includes Donation of 1000 <i>l.</i> from Miss Gill.	1888	8653 5 0	.. ..	7908 18 6
	1889	8234 7 7	1000 0 0	7026 15 10
			On deposit.	
'Includes Legacy of the Earl of Derby, 1000 <i>l.</i>	1890	9831 16 2	850 0 0	8218 5 10
	1891	8322 16 8	1000 0 0	3171 3 9
'Includes Legacies by Mr. W. Chandless and Mr. Jas. Jackson, 577 <i>l.</i> 4 <i>s.</i> 7 <i>d.</i>	1892	9299 18 7	.. ..	9012 7 5‡
	1893	11050 2 1	1150 0 6	11584 2 3
	1894	9853 4 6	.. ..	9683 0 5
	1895	10209 11 8	.. ..	10087 18 6
	1896	11023 1 8	898 1 0	9923 14 1

* This sum includes the Special Parliamentary Grant transferred to the Cameron Expedition Fund in February, 1877.
 † This amount includes the payment of two sums of 500*l.* each, contributed to the African Exploration Fund in this and the previous year.
 ‡ This sum includes the payment of 102*l.* 8*s.* to the African Exploration Fund; also 71*l.* 9*s.* 1*d.*, the final payment for Cameron Expedition Fund.

STATEMENT OF ASSETS.—December 31, 1896.

	£	s.	d.
Freehold House, Fittings, and Furniture, estimated (exclusive of Map Collections and Library insured for 10,000 <i>l.</i>)	.. ..	20,000	0 0
Investments (amount of Stock), valued December 31 last, at	.. ..	28,383	0 8
Arrears due on December 31, 1896, 1289 <i>l.</i> Estimated at	.. ..	515	0 0
Balance at Bank	.. ..	£631	13 0
„ in Accountant's hands	.. ..	17	16 9‡
		<u>649</u>	<u>9 9‡</u>
Total	.. ..	£49,547	10 5‡

ESTIMATE FOR THE YEAR 1897.

								RECEIPTS.		
								£	s.	d.
Balance in Bankers' hands	..	..	..	..	..	..	..	649	9	9
Subscriptions	..	..	..	..	..	..	..	5400	0	0
Entrance Fees	..	..	..	..	..	..	..	1000	0	0
Life Compositions	..	..	..	..	..	..	..	700	0	0
Parliamentary Grant	..	..	..	..	..	..	..	500	0	0
Royal Premium	..	..	..	..	..	..	..	52	10	0
Rent of Shop	..	..	..	..	..	..	..	86	0	0
Publications	..	..	..	..	..	..	..	1200	0	0
Payments for Scientific Instruction	..	..	..	..	..	..	..	80	0	0
Payments made in error	..	..	..	..	..	..	..	50	0	0
Loan of Diagrams and Slides	..	..	..	..	..	..	..	5	0	0
Educational Lectures	..	..	..	..	..	..	..	19	10	0
Sale of Soirées Tickets	..	..	..	..	..	..	..	35	0	0
Dividends	..	..	..	..	..	..	..	780	0	0
Contribution from Mr. Horniman towards Pottinger Expedition	..	..	..	..	..	..	..	50	0	0
Total								£10,607	9	9
								EXPENDITURE.		
								£	s.	d.
House	..	..	..	..	..	..	..	530	0	0
Office	..	..	..	..	..	..	..	1570	0	0
Library	..	..	..	..	..	..	..	860	0	0
Bookshelves and Furniture for New Library	..	..	..	..	..	..	..	100	0	0
Map Room	..	..	..	..	..	..	..	732	0	0
Map-Drawing Room	..	..	..	..	..	..	..	360	0	0
Meetings	..	..	..	..	..	..	..	742	0	0
Gold Medal to Dr. Nansen	..	..	..	..	..	..	..	150	0	0
Nansen Meeting at Albert Hall	..	..	..	..	..	..	..	300	0	0
Medals and other Awards	..	..	..	..	..	..	..	200	0	0
Education	..	..	..	..	..	..	..	444	10	0
Publications :										
<i>Journal</i>	..	..	..	..	..	..	..	3300	0	0
'Supplementary Papers'	..	..	..	..	..	..	..	350	0	0
Expeditions	..	..	..	..	..	..	..	600	0	0
Payments in error returned	..	..	..	..	..	..	..	30	0	0
Balance available for contingencies	..	..	..	..	..	..	..	338	19	9
Total								£10,607	9	9

Publications.—The monthly *Journal* has been issued with regularity throughout the year; the twelve numbers for 1896 forming two volumes of 1442 pages, illustrated by 53 maps and 138 illustrations. The total cost of the edition of 5500 copies (including 530*l.* 4*s.* 4*d.* for free delivery to Fellows and Institutions) was 3269*l.* 4*s.* 4½*d.* From this is to be deducted the amount of 1015*l.* 4*s.* 10*d.* received from sale of copies to the public and from advertisements. The sum of 169*l.* 3*s.* 3*d.* was expended on 'Supplementary Papers' and Index to the new series of *Proceedings*.

Library.—During the past year, in addition to serial publications, 1355 books and pamphlets have been added to the Library. Of these, 770 have been presented and 585 purchased, the purchases including the late Dr. Robert Brown's collection of works on Marocco. The Society's map-mounter has put 449 pamphlets into boards; 279 volumes have been bound, and 50 volumes have been rebound or had their bindings repaired. The sum of 104*l.* 10*s.* 1*d.* has been expended on books, not including Dr. Brown's collection, and 66*l.* 14*s.* 6*d.* on binding.

The accessions of new books and the titles of articles in geographical publications have been published monthly in the *Geographical Journal*.

The *Subject Catalogue* has made considerable progress. Since last Annual Report 25,613 title-cards have been prepared, making a total of 64,491 up to May 5, and the greater part of the cards for works on Europe and Asia have been classified in a preliminary way under countries, while all the titles relating to each continent have been brought together.

Press-marking.—The press-marking of books in the Library is now practically completed, the only exception being the volumes of serial publications, the arrangement of which in the new room has still to be done.

Scientific Instruction.—During the past year 41 intending travellers have received instruction from Mr. Coles, in Practical Astronomy, in the Society's Observatory, and in surveying with the theodolite, prismatic compass, and plane-table, in the country, and 570 hours have been devoted to teaching. The cost of this to the Society in 1896 was 63*l.* 10*s.*

Arrangements have recently been made by which gentlemen who have gone through the whole course of instruction and passed an examination before a special committee are granted diplomas. One has been granted this year.

Instruments to the value of 35*l.* 6*s.* 6*d.* have been lent during the past year to the following travellers: Mr. R. T. Turley (China), 82*l.* 2*s.* 6*d.*; Mr. F. S. A. Bourne (China), 27*l.* 9*s.*; Mr. F. B. Parkinson (Somaliland), 7*l.*; Mr. W. B. Harris (Marocco), 5*l.* 10*s.*; Mr. J. T. Bent (Socotra island), 11*l.* 5*s.*; Colonel A. Le Messurier, R.E. (New Zealand, etc.), 5*l.*; Captain Count Gleichen (Abyssinia), 37*l.*; Mr. A. H. Savage Landor (Central Asia), 62*l.*; Captain W. Capper (Central Africa), 5*l.*; Dr. G. E. Morrison (China), 25*l.* 1*s.*; Mr. Charles W. Andrews (Christmas island), 19*l.* 19*s.*

The instruments lent to the following gentlemen have been returned during the past year, with the exception of those which have been lost: Sir W. M. Conway (Spitsbergen), 1896; Mr. T. Bevan (New Guinea), 1887; Lieut. S. Vandeleur, D.S.O., Scots Guards (Uganda), 1894; Mr. A. P. Maudalay (Central America), 1890; Mr. H. C. Robinson (New Guinea), 1896; Mrs. Bishop (China, Korea, etc.), 1894; Mr. F. B. Parkinson (Somaliland), 1896; Dr. Kerr Cross (Central Africa), 1891; Captain H. H. P. Deasy (Central Asia), 1896; Mr. W. B. Harris (Marocco), 1896.

The following is a list of travellers who still have instruments lent to them in their possession: Mr. E. Douglas Archibald (for cloud observations in England), 1885; Sir H. H. Johnston (British Central Africa), 1889 and 1894; Rev. A. Hetherwick (South-East Africa), 1891; Mr. C. W. Campbell (Korea), 1893; Mr. J. C. White (Sikkim), 1893; Mr. R. M. W. Swan (South-East Africa), 1893; Mr. R. T. Coryndon (Mashonaland), 1894; Mr. C. M. Woodford (Pacific islands), 1894; Captain A. St. H. Gibbons (South Central Africa), 1895; Mr. F. C. Selous (South Central Africa), 1895; Sir William Macgregor (British New Guinea), 1895; Captain L. R. Arthur (Congo Region), 1895; Captain F. D. Lugard, D.S.O. (South Central Africa), 1896; Mr. R. T. Günther, transferred to Mr. B. Darbishire (for plotting work in England), 1896; Mr. W. S. Bruce (for practice in Scotland), 1896; Mr. R. T. Turley (China), 1896; Mr. F. S. A. Bourne (China), 1896; Mr. J. T. Bent (Socotra island), 1896; Colonel A. Le Messurier, R.E. (New Zealand, etc.), 1897; Captain Count Gleichen (Abyssinia), 1897; Mr. A. H. Savage Landor (Central Asia), 1897; Captain W. Capper (Central Africa), 1897; Dr. G. E. Morrison (China), 1897; Mr. Charles W. Andrews (Christmas island), 1897.

Map Room.—The accessions to the Map Room Collection during the past year comprise 708 Maps on 1045 sheets; 32 Atlases (including continuations) containing

1266 sheets of Maps, 826 Photographs, and 186 Lantern Slides. Of these, 75 Maps on 298 sheets, 9 Atlases, 109 Photographs, and 186 Lantern Slides have been purchased.

The important donations to the Map Room Collection during the past year have been mentioned in the *Geographical Journal*.

THE BALLOT FOR THE NEW COUNCIL.

The PRESIDENT then announced that, according to the report of the scrutineers, the list as prepared by the Council had been duly elected.

The list is as follows, the names of new members, or those who change office, being printed in *italics*:—

President:—Sir Clements R. Markham, K.C.B., F.R.S., F.S.A. *Vice-Presidents*: Right Hon. George N. Curzon, M.P.; Sir George D. Taubman Goldie, K.O.M.G.; Sir Rawson W. Rawson, K.C.M.G., C.B.; General R. Strachey, R.E., C.S.I., F.R.S.; Admiral W. J. L. Wharton, C.B., F.R.S.; *General Sir Chas. W. Wilson*, R.E., K.C.B., K.C.M.G. *Treasurer*: Edward L. Somers Cocks. *Trustees*: Right Hon. Sir John Lubbock, Bart., F.R.S., M.P.; Cuthbert E. Peek. *Secretaries*: Major Leonard Darwin, R.E.; James F. Hughes. *Foreign Secretary*: Sir John Kirk, K.C.B., G.C.M.G., F.R.S. *Councillors*: W. M. Beaufort; Lord Belhaven and Stenton; *W. T. Blanford*, LL.D., F.R.S.; *Hon. G. C. Brodrick*; *Colonel George Earl Church*; *Ney Elias*, C.I.E.; *Colonel W. Everett*, C.M.G.; Colonel J. Farquharson, C.B., R.E.; *Admiral Sir Anthony H. Hoskins*, G.C.B.; Right Hon. Lord Loch, G.C.B., G.C.M.G., etc.; Rear-Admiral Albert Hastings Markham; A. P. Maudslay; John Murray, LL.D.; General Sir H. W. Norman, G.C.B., G.C.M.G.; *Surg.-Major Sir George S. Robertson*, K.C.S.I.; Earl of Scarbrough; P. L. Sclater, F.R.S.; *Lord Stanmore*, G.C.M.G.; Major Hon. M. G. Talbot, R.E.; Colonel Sir Henry R. Thuillier, R.E., K.C.I.E.; Admiral Hon. W. J. Ward.

THE ANNIVERSARY DINNER.

In the evening the anniversary dinner took place at the Whitehall Rooms of the Hotel Métropole. Sir Clements Markham, K.C.B., F.R.S., President, presided, and was supported by many members of the Council, and about 200 Fellows and their friends. There were among the guests the Swedish and Danish Ministers, the High Commissioner for Canada, the Agents-General for New South Wales, the Cape of Good Hope, New Zealand, and Western Australia, the Bishop of Ballarat, John Vincent Barrington, Sir John Bramston, Mr. James Bryce, M.P., Sir B. Burnside, Lord Colchester, Sir Mortimer Durand, Sir R. Giffen, Mr. G. A. Henty, M. P. Lessar, Dr. Leyds, Prof. Norman Lockyer, Sir Herbert Maxwell, Mr. Schomburgk M'Donnell, Monkswell, Admiral Noel, Sir Henry Roscoe, Lord Walsingham, Sir H. Waterfield, Rev. S. A. Steinthal, Lieut. S. Vandeleur.

The PRESIDENT, after proposing the loyal toasts, next gave that of "The Navy and Army," which was responded to by Admiral NOEL and General Sir H. NORMAN. He then proposed "The Medallists and Recipients of our Awards," the toast being acknowledged by Lieut. VANDELEUR. The toast of "The Sister Societies" was also proposed by the PRESIDENT, and was responded to by the Rev. S. A. STEINTHAL, of Manchester. The next toast was that of "The Vice-Presidents." This was proposed by the PRESIDENT, who coupled with it the name of Sir George Taubman-Goldie.

Mr. CURZON proposed the toast of "Our Guests," to which Lord WALSHINGHAM, Sir SAUL SAMUEL, and Sir HENRY ROSCOE replied. The toast of the "The President" was proposed by Lord BELHAVEN AND STENTON, and acknowledged by the PRESIDENT.

Twelfth Ordinary Meeting, May 31, 1897.—Sir CLEMENTS MARKHAM, K.C.B.,
President, in the Chair.

ELECTION.—*Clarence Beckford.*

The Paper read was:—

“Nupe and Ilorin (Nigeria).” By Lieut. Seymour Vandeleur, D.S.O. (Scots Guards).

Thirteenth Ordinary Meeting, June 18, 1897.—Admiral W. J. L. WHARTON,
C.B., F.R.S., Vice-President, in the Chair.

ELECTIONS.—*Major T. D. Backhouse; Samuel Bakewell Bates; Captain Wilkinson D. Bird, Queen's Royal West Surrey Regiment; Alfred J. G. Chalmers; Major Edward Clerk; John E. Cooke; William Alfred Harrison; Captain B. T. Kirkpatrick, Leinster Regiment; Lieut. Cecil Henry Lloyd, 1st Battalion South Lancashire Regiment; Colonel St. John F. Michell, Indian Staff Corps; Philip Muan; William Frederick Rahan; Prof. Louis Auguste Michel Raveneau.*

The Paper read was:—

“Sub-Oceanic Changes.” By Prof. John Milne, F.R.S., F.G.S.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian, R.G.S.*

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademia.	Mag. = Magazine.
Ann. = Annals, Annales, Annalen.	P. = Proceedings.
B. = Bulletin, Bollettino, Boletim.	R. = Royal.
Com. = Commerce, Commercial.	Rev. = Review, Revue, Revista.
C. Rd. = Comptes Rendus.	S. = Society, Société, Selakab.
Erdk. = Erdkunde.	Sitzb. = Sitzungsbericht.
G. = Geography, Geographie, Geografia.	T. = Transactions.
Gen. = Gesellschaft.	V. = Verein.
I. = Institute, Institution.	Verh. = Verhandlungen.
J. = Journal.	W. = Wissenschaft, and compounds.
M. = Mittheilungen.	Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

- Austria.* *Deutsche Rundschau G.* 19 (1897): 337-347. *Petkovišek.*
Die Bergstadt Idrin in Krain. Von Johann Petkovišek. *With Map and Illustrations.*
- Austria—Bosnia.* *Rev. G.* 40 (1897): 58-64. *Gaffarel.*
Une excursion en Herzégovine et en Bosnie (septembre, 1896). Par P. Gaffarel.
- Balkan Peninsula, etc.* *Philippson.*
Geologisch-Geographische Reiseakzissen aus dem Orient. Von Dr. Alfred Philippson. (Sonderabdruck aus den “Sitzungsberichten der Niederrheinischen Gesellschaft für Natur- und Heilkunde zu Bonn,” 1896-97.) Bonn, 1897. Size 8½ × 5½, pp. 48. *Presented by the Author.*
- Articles on the nearer East, including a trip from B. Igrad by Sofia to Constantinople

by rail, the Bosphorus and Hellespont, cruises in the Ægean sea, Samothrace, and the Troad. They are all treated from the point of view of physical geography.

Cyprus. *Contemporary Rev.* 71 (1897): 892-908. **Geddes.**
Cyprus, Actual and Possible: a Study in the Eastern Question. By Patrick Geddes.

Prof. Geddes describes his recent visit to Cyprus, discusses the resources of the island, makes practical suggestions for the improvement of the impoverished people, and speculates as to the solution of the Eastern Question.

France. *Science (n.s.)* 5 (1897): 644-647. **Gulliver.**

Notes on French Geography. By F. P. Gulliver.

Dr. Gulliver discusses briefly the physical geography of the Pays de Bray and the Marais de Saint Gond.

France—Mont Blanc. **Janssen.**

Four Days' Observations at the Summit of Mont Blanc. By M. J. Janssen.—Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington, 1896. Size 9½ × 6, pp. 237-247.

Translated from the *Annuaire du Bureau des Longitudes* for 1894.

France—Mont Blanc. *C. Rd.* 124 (1897): 972-975. **Vallot.**

Sur les plis parallèles qui forment le massif du Mont Blanc. Note de M. J. Vallot. *With Illustration.*

Combats the theory of the "fan-structure" of the strata of Mont Blanc, and contends that the rocks form simply a folded synclinal.

Germany. **Baedeker.**

Northern Germany as far as the Bavarian and Austrian Frontiers. Handbook for Travellers by Karl Baedeker. With 33 Maps and 56 Plans. Twelfth Revised Edition. Leipzig: Karl Baedeker; London: Dulau & Co., 1897. Size 6½ × 4½, pp. xxxiv. and 442. Price 8 marks. Presented by Messrs. Dulau & Co.

Greece. *Globus* 71 (1897): 249-255. **Oppel.**

Die Griechen nach Zahl, Verbreitung und Abstammung. Von A. Oppel.

Holland. *Contemporary Rev.* 71 (1897): 858-866. **Cornish.**

Outdoor Life in Holland. By C. J. Cornish.

Iceland—Sailing Directions. **Jenkins.**

Sailing Directions for the Fiords, Ports, and Anchorages of Iceland. To which is added Brief Instructions for the Harbours, Lights, Tides, and Weather in the Færøe Islands. Compiled . . . by H. D. Jenkins. London: James Imray & Son, 1896. Size 9½ × 6, pp. viii. and 110. *Chart.* Price 4s. Presented by the Publishers.

This work includes the observations of Lieut. Wandle on the ice and currents of Iceland noticed in the *Journal* for May (vol. ix. p. 573), in connection with which it may be observed that the statement there made, that no sailing directions for Iceland had been published since 1822, was taken from Lieut. Wandle's paper of 1879.

Norway—Varanger Fiord. *Quarterly J. Geolog. S.* 53 (1897): 137-156. **Strahan.**

On Glacial Phenomena of Palæozoic Age in the Varanger Fiord. By Aubrey Strahan, M.A. *With Plates.*

The Raised Beaches and Glacial Deposits of the Varanger Fiord. By the same.

Scandinavia—Historical. *Riv. G. Italiana* 4 (1897): 195-203. **Roviglio.**

Della Scandinavia e di un passo oscuro di Paolo Diacono per il Prof. Ambrogio Roviglio.

On the meaning of the term "Scandinavia" as applied in the writings of Paul the Deacon.

Turkey—Constantinople. **Müller.**

Letters from Constantinople. By Mrs. Max Müller. London: Longmans & Co., 1897. Size 8 × 5½, pp. viii. and 196. *Illustrations.* Price 6s.

United Kingdom—England. **Foster.**

The Chiltern Hundreds. By Albert J. Foster, M.A. London: J. S. Virtue & Co., 1897. Size 8 × 5½, pp. 220. *Sketch-Map and Illustrations.* Price 5s. Presented by the Publishers.

An effort to extend public interest in the archæology and history of some of the most beautiful parts of the county of Buckingham, pleasantly written and fairly well illustrated.

United Kingdom—Geological Survey.**Geikie.**

Department of Science and Art. Annual Report of the Geological Survey of the United Kingdom and of the Museum of Practical Geology, for the year ending December 31, 1896. By Sir Archibald Geikie, D.C.L., etc., Director-General. London: Eyre & Spottiswoode, 1897. Size 10 x 6½, pp. 108. *Index Maps. Presented by the Geological Survey.*

United Kingdom—Wales. Quarterly J. Geolog. S. 53 (1897): 157-176.**Davison.**

On the Pembroke Earthquakes of August, 1892, and November, 1893. By Charles Davison, S.C.D. *With Maps.*

ASIA.**Afghanistan—Káfiristan. J.S. Arts 45 (1897): 573-581.****Robertson.**

Káfiristan: its Manners and Customs. By Sir George Scott Robertson, K.C.S.I.

Sir G. S. Robertson sums up and extends his conclusions as to the origin and character of the Kafir tribes of the Hindu Kush, already given in his book on the country.

Asia.**Septans.**

Lieutenant-Colonel breveté Septans. *Les Expéditions Anglaises en Asie. Organisation de l'Armée des Indes (1859-1895), Lushai Expédition (1871-1872), les trois campagnes de Lord Roberts en Afghanistan (1878-1880), Expédition du Chitral (1895).* Paris: H. Charles-Lavauzelle [1897]. Size 10 x 6½, pp. 352. *Maps. Price 6s.*

An excellent and impartial account of the military expeditions by British troops on the borders of India, intended for the instruction of French colonial officials.

Chinese Miscellany.**Mesny.**

Mesny's Chinese Miscellany. A Text Book of Notes on China and the Chinese. In two volumes. By William Mesny. Shanghai, 1896-97. Size 11 x 8½, pp. (vol. i.) 524; (vol. ii.) 520. *Price each vol., 30s. Presented by the Author.*

These volumes represent a vast amount of observation and personal experience accumulated during the many years of Mr. Mesny's life in China. Although only in part geographical, the notes on place-names, public works, and the customs of the people are of distinct value. The work is not easy of reference, and although there is an index, the fact of many of the references being Chinese words, and not their English equivalents, makes it less useful to one ignorant of Chinese than it might be.

India.*J.R. Asiatic S. (1897): 239-279.***Baden-Powell.**

A Study of the Dakhan Villages, their Origin and Development. By B. H. Baden-Powell.

This study deals with the constitution of the village-communities of the Deccan.

India.*Nineteenth Century 41 (1897): 865-882.***Lyall.**

India under Queen Victoria. By Sir Alfred Lyall, K.C.B., G.C.I.E.

India—Cloud Statistics.**Downing.**

Cloud Statistics for Stations in India near the Path of the Moon's Shadow on January 21-22, 1898. By A. M. W. Downing, M.A., D.Sc., etc. Reprinted from the *Monthly Notices of the Royal Astronomical Society*, vol. lvii. No. 5 [March, 1897]. Size 8½ x 5½, pp. [8]. *Presented by the Author.*

The statistics of hourly average cloudiness for the latter part of January along the line of the total solar eclipse of 1898, bringing out the great superiority of the stations in the west of India for observing.

India—Cutch.*Quarterly J. Geolog. S. 53 (1897): 223-244.***Blake.**

On some Superficial Deposits in Cutch. By the Rev. J. F. Blake, M.A. *With Map and Sections.*

This article contains an interesting description of the Ran of Cutch, the exclusion of the sea from which the author is inclined to attribute to silting up by wind-blown and rain-washed sand. He shows conclusively that the main geological agent in Cutch is now, and has been for ages past, the wind.

India—Godaveri delta. Blackwood's Mag. 161 (1897): 852-868.

An Indian Romance: a Lesson of the Famine.

A picturesque and most interesting paraphrase of an official bluebook on the engineering works in the delta of the Godaveri, which have effectually secured that extensive region against famine.

- India—Hyderabad.** *Fortnightly Rev.* 61 (1897): 911-922. **Rock.**
 The New Era in Hyderabad. By Joseph Rock.
 An historical sketch of recent events in the great Mohammedan State of Hyderabad.
- India—Madras.** *Mem. Geolog. Surv. India* 25 (1895): 1-218. **Footo.**
 The Geology of the Bellary District, Madras Presidency. By R. Bruce Footo. *With Map and Plates.*
- India—N.W. Provinces and Oudh.** **Crooke.**
 The Tribes and Castes of the North-Western Provinces and Oudh. By W. Crooke, B.A. 4 vols. Calcutta: Office of the Superintendent of Government Printing, India, 1896. Size 10 x 6½, pp. (vol. i.) ccxvi. and 294; (vol. ii.) 500; (vol. iii.) 500; (vol. iv.) 516. *Plates. Presented by the Indian Government.*
 This large work differs from other ethnological treatises on the North-West Provinces by supplying a vast amount of detailed information as to the manners and customs of the different castes. The compiler insists on the importance of the work having been undertaken at the present time, when caste is in a state of transition owing to the rapid Brahmanization of the Dravidian races of the mountain region. The book consists of an anthropological introduction, giving many particulars of anthropometrical measurements and a discussion of the origin of caste, and of the existing tribal divisions and their customs. The body of the work is an alphabetical description of the various tribes and castes, illustrated by numerous photographs of the people described. There is a copious index.
- India—N.W. Provinces.** **Crooke.**
 The North-Western Provinces of India, their History, Ethnology, and Administration. By W. Crooke. London: Methuen & Co., 1897. Size 9½ x 6, pp. xii. and 362. *Map and Illustrations. Presented by the Publishers. Price 10s. 6d.*
 This will be separately noticed.
- India—N.W. Provinces—Naini Tal.** **Holland.**
 Report on the Geological Structure and Stability of the Hill Slopes around Naini Tal. By T. H. Holland. Calcutta: Office of the Superintendent of Government Printing, India, 1897. Size 10 x 7, pp. viii. and 86. *Map and Sections. Presented by the Director, Geological Survey of India.*
 A special note will be given in the Monthly Record on this Report.
- India—Punjab, Hazara.** *Mem. Geolog. Surv. India* 26 (1896): 1-302. **Middlemiss.**
 The Geology of Hazara and the Black Mountains. By C. S. Middlemiss. *With Map and Plates.*
- Malay Archipelago—Java.** **Oudemans.**
 Die Triangulation von Java ausgeführt vom Personal des geographischen Dienstes in Niederländisch Ost-Indien. Fünfte Abtheilung. Ergebnisse der Triangulation Zweiter Ordnung im Auftrage des Ministeriums der Kolonien und unter Mitwirkung von J. C. A. Van Asperen, M. L. J. Van Asperen, W. G. Tennissen, und E. Engelenburg. Bearbeitet von Dr. J. A. C. Oudemans. Haag: M. Nijhoff, 1897. Size 14 x 11, pp. 258. *Maps. Presented by the Editor.*
 This is a further instalment of the publication of the great triangulated survey of Java, this volume dealing with the construction of the triangles of the second order breaking up the great primary triangles.
- Russian Asia—Bokhara.** *Deutsche G. Blatter* 20 (1897): 66-91. **Rickmers.**
 Reise nach Ost-Bochara. Von Willy Rickmer Rickmers.
 An interesting account of a journey through Bokhara in 1896.
- Siberia.** *Rev. G.* 40 (1897): 246-270, 321-347. **De Baye.**
 De Moscou à Krasnoïarsk. Souvenirs d'une mission. Par Baron de Baye. *With Map and Illustrations.*
 This extremely interesting narrative describes a journey undertaken with the object of discovering archaeological specimens, particularly of the Stone age, but it abounds with descriptions of the men and scenes of to-day.

AFRICA.

- Africa.** **Septans.**
 Lieutenant-Colonel breveté Septans. Les Expéditions Anglaises en Afrique. Ashantee, 1873-1874; Zulu, 1878-1879; Egypt, 1882; Soudan, 1884-1885;

- Ashantee, 1895-1896. Paris: H. Charles-Lavauzelle, 1897. Size 10 x 6½, pp. 500. *Maps. Price 6s.*
- An excellent and impartial account of the "little wars" carried on by British expeditions in Africa, intended for the instruction of French colonial officials.
- Central Africa—Katanga.** Cornet.
Observations sur les Terrains Anciens du Katanga faites au cours de l'expédition Bia-Francoqui (1891-93). Par J. Cornet. Liège: Imp. H. Vaillant-Carmanne, 1897. Size 10 x 6½, pp. 170. *Plate. Presented by the Belgian Geological Society.*
- German East Africa.** M. Deutsch. *Schutzgeb.* 10 (1897): 60-63. Ambronn.
Geographische Ortsbestimmungen, ausgeführt von Herrn Hauptmann Ramsay bei Gelegenheit verschiedener Reisen in Ostafrika. Berechnet von Dr. L. Ambronn.
- German East Africa.** Arning.
M. Deutsch. *Schutzgeb.* 9 (1896): 233-246; 10 (1897): 46-60.
Die Wahehe. Von Wilhelm Arning.
- German East Africa.** M. Deutsch. *Schutzgeb.* 10 (1897): 95-142. Lieder.
Reise von der Mbamba-Bai am Nyassa-See nach Kisware am Indischen Ocean. Nach dem Tagebuche des Geologen Lieder. *With Map.*
- German West Africa—Kamerun.** M. Deutsch. *Schutzgeb.* 10 (1897): 25-45. Sjøstedt.
Die Säugethiere des nordwestlichen Kamerungebietes. Von Dr. Yngve Sjøstedt.
- German West Africa—Togo.** M. Deutsch. *Schutzgeb.* 10 (1897): 73-87. Mischlich.
Reisebericht des Missionars A. Mischlich in Bismarckburg. *With Map and Illustrations.*
- Socotra.** Nineteenth Century 41 (1897): 975-992. Bent.
The Island of Socotra. By the late J. Theodore Bent.
This possesses the melancholy interest of being the last literary work of the late Mr. Theodore Bent. It gives a description of his visit to Socotra last winter, details of which will duly appear in the *Geographical Journal*.

NORTH AMERICA.

- American Fishes.** Jordan and Evermann.
Smithsonian Institution. United States National Museum. Bulletin of the United States Museum, No. 47. The Fishes of North and Middle America: a descriptive Catalogue of the Species of Fish-like Vertebrates found in the waters of North America, North of the Isthmus of Panama. By David Starr Jordan, Ph.D., and Barton Warren Evermann, Ph.D. Part. i. Washington, 1896. Size 10 x 6½, pp. ix. and 1240. *Presented by the Smithsonian Institution.*
- Canada.** J. Geology 5 (1897): 257-262. Dawson.
Are the Boulder-Clays of the Great Plains Marine? By George M. Dawson.
The evidence brought forward by Dr. Dawson seems to point to a marine origin for the boulder-clays in question.
- Canada.** J.R. Colonial I. 23 (1897): 398-424. Smith.
Western Canada—Before and Since Confederation. By Sir Donald A. Smith, G.C.M.G.
- Canada—Labrador.** Low.
Geological Survey of Canada, G. M. Dawson, C.M.G., etc., director. Part I. Annual Report, vol. viii. Report on Explorations in the Labrador Peninsula along the East Main, Koksoak, Hamilton, Manicouagan, and portions of other rivers in 1892-93-94-95. By A. P. Low. Ottawa, 1896. Size 9½ x 7, pp. 388. *Plates and Maps.*
This is the full official report of Mr. Low's exploration in the Labrador peninsula, which has already been described in the *Geographical Journal*.
- Canada—North-West Territory.** Tyrrell and Dowling.
Geological Survey of Canada, G. M. Dawson, C.M.G., etc., Director. Part D. Annual Report, vol. viii. Report on the Country between Athabasca Lake and Churchill River, with Notes on Two Routes travelled between the Churchill and Saskatchewan Rivers. By J. Burr Tyrrell, assisted by D. B. Dowling. Ottawa, 1896. Size 10 x 7, pp. 120. *Map and Plates.*
A valuable piece of pioneer work, combining geographical and geological surveys. The map shows the geological structure of the country along the lines of route.

- Canada—Historical.** *B. American G.S.* 29 (1897): 41-54. **Douglas.**
The Consolidation of the Iroquois Confederacy; or, What Happened on the St. Lawrence between the Times of Cartier and Champlain. By James Douglas.
- United States—Alaska.** *Globus* 71 (1897): 255-260. **Greim.**
Die Gletscherbai in Alaska und ihre Erforschung durch John Muir. Von Dr. G. Greim. *With Map and Illustrations.*
- United States—Alaska.** *Globus* 71 (1897): 297-302. **Windt.**
H. de Windts Reisen an der Beringstrasse. *With Illustrations.*
- United States—Coast and Geodetic Survey.**
Report of the Superintendent of the U.S. Coast and Geodetic Survey, showing the progress of the work during the fiscal year ending with June, 1894. Part ii. Appendices relating to the Methods, Discussions, and Results of the Coast and Geodetic Survey. Washington, 1895. Size 12 x 9½, pp. 616. *Charts and Plates. Presented by the U.S. Government.*
The Report contains ten appendices descriptive of determinations of gravity, geodetic positions, magnetic conditions, and tides in the United States, including Alaska. The titles of the more important are given separately in this bibliography.
- United States—Connecticut Valley.** *J. School G.* 1 (1897): 72-78. **Orr.**
The Geographic Features of the Connecticut Valley in Western Massachusetts. By William Orr, jun.
- United States—New York State.** *J. School G.* 1 (1897): 103-110. **Jamson.**
The Climate of New York State. By J. M. Jamson.
- United States—New York State.** *B. American G.S.* 29 (1897): 16-40. **Tarr.**
The Physical Geography of New York State. Part iv. By Ralph S. Tarr. *With Maps and Illustrations.*
- United States—Niagara.** *P.R.I.* 15 (1897): 269-279. **Martin.**
The Utilisation of Niagara. By Thomas C. Martin. *With Sections.*

CENTRAL AND SOUTH AMERICA.

- Brazil—Amazon.** *P.R.I.* 15 (1897): 217-226. **Siemens.**
Cable Laying on the Amazon River. By Alexander Siemens.
This will be specially referred to in the *Journal.*
- Chile—Chiloé.** **Maldonado.**
Estudios geográficos é hidrográficos sobre Chiloé. Por Roberto Maldonado C. Santiago de Chile, 1897. Size 10¼ x 7, pp. cxxxviii. and 380. *Map and Plates.*
- South America.** **Habel.**
Ansichten aus Südamerika. Schilderung einer Reise am La Plata, in den Argentinischen Anden und an der Westküste. Von Jean Habel. Berlin: D. Reimer, 1897. Size 11¼ x 8, pp. xii. and 76. *Map and Plates. Presented by the Publisher.*
This finely illustrated volume will be specially noticed.
- South America—Maps.** *B.S.G. Lisboa* 15 (1896): 489-568. **Mendes.**
America austral. Cartas escriptas du America nos annos de 1882 a 1883. Por A. Lopes Mendes, s.s.g.l. Terceira parte (conclusão).
- Tropical America.** *B. American G.S.* 29 (1897): 55-60. **Nicholas.**
Economic Importance of Geological and Physical Conditions in Tropical America. By Francis C. Nicholas. *With Map and Sections.*
A note will be given on this paper.

AUSTRALASIA AND OCEANIC ISLANDS.

- Australasia.** **Semon.**
Im australischen Busch und an den Küsten des Korallenmeeres. Reiseerlebnisse und Beobachtungen eines Naturforschers in Australien, Neu-Guinea und den Molukken. Von Richard Semon. Leipzig: W. Engelmann, 1896. Size 9¼ x 6¼. *Maps and Illustrations.*
This admirable work will be specially noticed.
- Lord Howe Island.** **Russell.**
The Climate of Lord Howe Island. By H. C. Russell, B.A., C.M.G., etc. [Read before the Royal Society of N.S. Wales, October 2, 1895.] [1 leaf.] Size 9 x 6.
A very brief abstract of eight years' observations.

Meteorology.**Hunt.**

Types of Australian Weather. By Henry A. Hunt. With Forty Diagrams. Size 9 x 6, pp. 40. *Presented by the Author.*

New Caledonia—Coffee.**Moncelon.**

B.S.G. Comm. Bordeaux 20 (1897): 97-109, 129-145, 178-196.

Le café à la Nouvelle-Calédonie. Par Leon Moncelon.

A full description of the coffee plantations and the process of preparing coffee in New Caledonia.

New Zealand.

New Zealand Handbook, with Map. Issued by the Emigrants' Information Office, 31, Broadway, Westminster, S.W. London: Emigrants' Information Office, 1896. Size 8½ x 5½, pp. 38. *Price 1d. Presented by the Agent-General for New Zealand.*

New Zealand.

New Zealand. Crown Lands Guide, No. XIV. Auckland District, corrected up to April 1, 1896 (pp. iv. and 40); ditto, corrected up to October 1, 1896 (pp. iv. and 42); Wellington District, corrected up to September 1, 1896 (pp. iv. and 12); Canterbury District, corrected up to October 2, 1896 (pp. iv. and 6). Wellington, 1896. Size 13½ x 8½. *Presented by the Agent-General for New Zealand.*

Particulars of the crown lands in the several provinces of New Zealand open for selection by settlers, with the rules of procedure for obtaining grants.

New Zealand—Tarawera. *Scottish G. Mag.* 13 (1897): 246-259.**Cadell.**

A Visit to Mount Tarawera. By Henry M. Cadell, of Grange. *With Maps and Illustrations.*

The article is illustrated by striking photographs of the phenomena of the hot-lake district, and of the site of Wairoa before and after the destructive eruption of 1886.

New Zealand—Year-Book.**Dadelzen.**

The New Zealand Official Year-Book, 1896. By E. J. von Dadelzen, Registrar-General. Wellington, 1896. Size 8½ x 5½, pp. vi. and 564.

The official description of the colony of New Zealand, with statistics for 1896.

Samoa—Famine.*Petermanns M.* 43 (1897): 68-70.**Bülow.**

Die Dürre des Jahres 1896 auf der Insel Savaii, Samoa-Inseln. Von W. v. Bülow.

On the Samoan famine of 1896.

POLAR REGIONS.**Antarctic.***Globus* 71 (1897): 281-289, 302-309.**Lindeman.**

Die neueren Reisen zur geographischen Erforschung der Südpolarregion und der deutsche Plan. Von M. Lindeman.

A sketch of antarctic enterprise from the earliest times, and of the compilations regarding ice and climatic conditions made by German scientific men. Special prominence is given to the somewhat neglected work of Bellingshausen in 1821, to the whalers, and to the expedition of Dumont D'Urville.

Antarctic.*Naturwiss. Wochenschrift* 12 (1897): 208-211.**Mewes.**

Aufgaben und Stand der Südpolarforschung. Von Rudolf Mewes.

The author upholds the practicability of a small German private expedition to the antarctic regions, such as he had planned for this year, but has been obliged to postpone until next year. The cost he estimates at under £10,000.

Arctic.*Scottish G. Mag.* 13 (1897): 225-246.**Nansen.**

Some Results of the Norwegian Arctic Expedition, 1893-96. By Dr. Fridtjof Nansen. *With Map.*

A reprint of the articles in the *Geographical Journal*.

Arctic Regions.**Jaeger and Schlichter.**

Problems of Nature: Researches and Discoveries of Gustav Jaeger, M.D. Edited and Translated by Henry G. Schlichter, D.Sc. London: Williams & Norgate, 1897. Size 9 x 6, pp. 262. *Presented by the Publishers.*

The late Dr. Jaeger, amongst other matters, devoted some attention to arctic exploration, and a chapter in the volume named above is devoted to that subject. From considerations of animal-distribution and of ocean currents, he was led to believe

that the land around the north pole has been, and is still being, greatly reduced in amount. This consideration also led him in 1865 to state his belief that no land, but an ocean, would be found at the north pole, a conjecture singularly confirmed by Nansen's expedition.

Greenland. *J. Geology* 5 (1897): 229-240. Chamberlin.

Glacial Studies in Greenland. X. By T. C. Chamberlin. *With Illustrations.*

Greenland—Magnetic Observations. *Terrestrial Magnetism* 2 (1897): 32-34. Putnam.

Results of Magnetic Observations on the Greenland Expedition of 1896. By G. R. Putnam. *With Map and Diagram.*

Polar Exploration. Markham.

The Promotion of Further Discovery in the Arctic and the Antarctic Regions.

By Clements R. Markham, C.B., F.R.S.—Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington, 1896. Size 9½ × 6, pp. 317-341.

Reprinted from the *Geographical Journal*, vol. iv., 1894.

MATHEMATICAL GEOGRAPHY.

Geodesy. *C. Bd.* 124 (1897): 941-945. Lallemand.

Sur la précision comparée de divers modes de repérage de la verticale dans les observations astronomiques, géodésiques ou topographiques. Note de M. Ch. Lallemand.

The result of comparing determinations of the vertical by means of contact of three points with a surface of mercury, observation of the nadir in a mercury artificial horizon, and the use of the spirit-level showed that the last-named method was by far the most accurate.

Horizon—Definition. *Rev. G. Italiana* 4 (1897): 183-194. Saija.

Sulla definizione scientifica dell'orizzonte. Nota di G. Saija.

A collection of definitions of the term *horizon* from various authorities ranging from 1297 to 1890.

Latitude Changes. Rees.

Variation of Latitude. By J. K. Rees. Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington, 1896. Size 9½ × 6, pp. 271-279.

A very clear exposition of the nature of the latitude changes detected by modern astronomers in the form of a lecture delivered to the New York Academy of Sciences in 1895.

Surveying. Clancey.

Aid to Land-Surveying (Small Edition), in English only, accompanied by 237 Illustrations on the subject, and containing numerous useful tables, by J. C. Clancey. Fourth Edition. Revised and enlarged. Calcutta: W. Newman & Co., 1895. Size 13½ × 8½, pp. iv., 80, 28, 8, and 10. Price 8s. *Presented by the Author.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Limnology. *J. School G.* 1 (1897): 65-72. Brigham.

Lakes: a Study for Teachers. By Albert P. Brigham.

A simple discussion of the phenomena of lakes.

Meteorology. Russell.

Periodicity of Good and Bad Seasons. By H. C. Russell, B.A., C.M.G., etc. [Read before the Royal Society of New South Wales, June 3, 1896.] Sydney, 1897. Size 10 × 6½, pp. 36. *Diagram. Presented by the Author.*

An argument, fortified by statistics relating to Australia and India, that the general characteristics of climate follow a nineteen-years cycle. The author gives a diagram for India from 1778, and Australia from 1788, showing the alternations of good and bad years, and he ventures to prolong it until the year 1908 for Australia, predicting good years in 1897, 1898, 1901, 1902, 1906, and bad years for the rest. A table is given of all recorded droughts in Europe and Asia back to the year 298 A.D.

Ocean Currents. Russell.

Current Papers, No. 2. By H. C. Russell. [Read before the Royal Society of N.S. Wales, September 2, 1896.] Size 9 × 6, pp. 10. *Chart.*

A note in this paper, happily erroneous, and not affecting its subject, refers to help received from "the late Dr. Neumayer, director, up to the time of his death, of

the Meteorological Observatory at Hamburg." The map of bottle-drifts between Cape Horn and New Zealand records the results of 157 recovered floats. It is curious to note that none of those launched by the Dundee whalers in 1892-93 appear to have been recovered.

Oceanography. *Rev. Scientifique* (4) 7 (1897): 581-586. **Knudsen.**

Le plankton marin et les gaz de l'eau de mer. Par M. Martin Knudsen.

On the influence of marine organisms on the dissolved air of sea-water.

Oceanography. **Wharton.**

The Physical Condition of the Ocean. By Captain W. J. L. Wharton, F.R.S.—Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington, 1896. Size 9½ x 6, pp. 343-358.

Reprinted from the *British Association Report* for 1894.

Historical Geography. **Forbes.**

Antarctica: a vanished Austral Land. By Henry O. Forbes.—Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington, 1896. Size 9½ x 6, pp. 297-316.

Reprinted from the *Fortnightly Review* for 1894.

Terrrestrial Magnetism. **Rücker.**

Terrrestrial Magnetism. By Prof. A. W. Rücker, M.A.—Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington, 1896. Size 6½ x 6, pp. 173-189.

Reprinted from the *British Association Report* for 1894.

NEW MAPS.

By J. COLES, *Map Curator, R.G.S.*

ARCTIC REGIONS.

Arctic Regions. **Heilprin.**

The Arctic Regions, comprising the most recent explorations of Robert E. Peary, Fridtjof Nansen, and F. Jackson. By Prof. Angelo Heilprin. Drawn by J. W. Ross. The Geographical Society of Philadelphia, 1897.

EUROPE.

Channel Islands. **Collins.**

Twelve Charts of the Tidal Streams near the Channel Islands and Neighbouring French Coast. By F. H. Collins. Published by J. D. Potter, London, 1897. *Presented by the Publisher.*

This atlas contains twelve charts, representing the direction of the tidal streams around the Channel islands, and as far as the neighbouring coast of France. Each chart represents the direction of the tide at any place at any hour before or after the time of high water at St. Peter's Port, and where the rate of the tide is known, its velocity is inserted in a circle at the end of the arrow indicating its direction. The plan on which the charts have been constructed is an exceedingly simple one, and the information they contain is in exact accordance with that given in the Admiralty 'Channel Pilot,' Part II.

England and Wales.

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Historical Geography.

Poole.

Historical Atlas of Modern Europe from the Decline of the Roman Empire, comprising also maps of parts of Asia and of the New World, connected with European History. Edited by Reginald Lane Poole, M.A., PH.D. Lecturer in Diplomatic History in the University of Oxford. Part viii. Oxford: The Clarendon Press; London, Edinburgh, Glasgow, and New York: Henry Frowde, M.A.; Edinburgh: W. & A. K. Johnston. 1897.

Part viii. contains: Map 34, Germany under the Saxon and Salian Dynasties, 919-1137, by Reginald Lane Poole, M.A., PH.D.; Map 56, France during the Hundred Years' War, by James Tait, M.A.; Map 62, The Spanish Kingdoms in the Sixteenth Century, by the late Ulick B. Burke, M.A. Each map is accompanied by notes, which cannot fail to be of service to students.

ASIA.

Manchuria.

Borodovski.

Map of Manchuria, compiled by L. Borodovski. Scale 1 : 3,300,000 or 45·2 stat. miles to an inch. St. Petersburg: Ministry of Finance. *Russian character.* Presented by Major-General Venukoff.

Siberia, Franz Josef Land, etc.

Nansen, Jackson, and Wilkitzki

Russisch Asien und Franz-Josef-Land zur Uebersicht der Sibirisch-Mandschurischen Eisenbahn und der Aufnahmen von F. Nansen, 1893-96; F. Jackson, 1894-96; und A. Wilkitzki, 1894-95. *Petermanns Geographische Mitteilungen*, Jahrgang 1897, Tafel 9. Gotha: Justus Perthes, 1897. Presented by the Publisher.

AFRICA.

Tunis.

Service géographique de l'Armée, Paris.

Tunisie. Carte de Reconnaissance. Scale 1 : 200,000 or 2·7 stat. miles to an inch. Dressé, gravé et publié au Service géographique de l'Armée. Paris. Sheet No. xxxiii. Price 0 fr. 70 cents.

AMERICA.

Cuba.

Amabile.

Carte générale de l'île de Cuba. Dressée d'après les documents officiels les plus récents, indiquant la marche de l'armée révolutionnaire et les lignes fortifiées espagnoles "La Trocha del Mariel" et "La Trocha del Júcaro." Scale 1 : 2,000,000 or 31·6 stat. miles to an inch. Par V. Mestre Amabile, Ancien Officier de Marine. Paris, 1896.

Washington.

Anderson.

Sectional Map of Western and Central Washington, U.S.A. Scale 1 : 1,360,000 or 5·3 stat. miles to an inch. Compiled and published by the O. P. Anderson Map and Blue Print Co., 1897, Seattle, Washington. Presented by O. P. Anderson, Esq.

For all purposes of reference, with regard to the western and central portions of the State of Washington, this will be a useful map. It shows all county boundaries, land sections, railway systems, and Indian reserves.

The World.

Vivien de Saint-Martin and Schrader.

Atlas Universel de Géographie. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. Amérique du Sud en 5 feuilles. Feuille 4. Paris: Hachette et Cie.

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published at the Hydrographic Department, Admiralty, during March and April, 1897.

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(J. D. Potter, agent.)

		Charts Cancelled.	
No.			Cancelled by
973	Entrance to St. Germans or Lynher river.	New Chart. Entrance to St. Germans or Lynher river	
1118a	Plan of Bressay sound or Lerwick harbour on this sheet.	New Chart. Bressay sound or Lerwick harbour	1
2331	Barū sound, Benskar harbour.	New Chart. Hangö head to Barū sound	1
1633	Anchorage on the west coast of Newfoundland.	New Chart. Anchorage on the west coast of Newfoundland	
712	Plans of Hoche harbour and Neddy harbour on this sheet.	New Chart. Anchorage on the west coast of Newfoundland	
336	River Niagara.	New Chart. River Niagara and Welland canal	
38	Plan of Jashk bay on this sheet.	New Chart. Jashk bay	2
1605	Montague rocks.		
221	Kaloyeri rocks.		

Charts that have received Important Corrections.

No. 1118, The World:—Coal and telegraph chart. 1951, England, west coast Liverpool bay. 2814A, Scotland, west coast:—Loch Linnhe, southern part. 21 Gulf of Finland:—Hogland to Seakar, north shore. 72, Port of Huelva, entrance to rivers Tinto and Odiel. 193, Mediterranean, Linosa island:—Lipodusa island. 1483, Adriatic sea:—Porte Chioggia, Malamocco and Lido, the channels leading to Venice. 1679, Harbours and anchorages in the Greek archipelago. 1086, Turkey:—Gulf of Kassandra to Thaso and Lemnos islands. 964, Black sea:—Cape Lukul to Balaklava bay. 1241, Ice chart of the south hemisphere. 1565, Newfoundland:—Sops arm. 490, Lake Erie, west end. 14 South America, north coast:—Cabo do Norte to Maranham. 1922, British Columbia:—Fraser river and Burrard inlet. 2337, Alaska:—Sitka sound. Africa, west coast:—Cape Lopez bay to St. Paul de Loanda. 38, Baluchistan, Masket to Karachi. 737, India, west coast:—Arnala island to Kundari. 94 Eastern archipelago, eastern portion. 2409, West coast of Formosa and Pescadore channel. 2347, Japan:—Nipon, Kiussiu and Shikoku, and part of the Koo 511, Manchuria:—Trinity bay to the eastern Bosphorus. 2508, Manchuria, Barraouta harbour. 1644, Bering sea:—Komanduraki islands. 134, Harbours and anchorages in the New Hebrides.

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Atlantic Ocean.

Admiral 6

Monthly Current Charts for the Atlantic Ocean. London: Published at Admiralty, March 20, 1897, under the superintendence of Rear-Admiral W. J. Wharton, C.B., F.R.S., Hydrographer. *J. D. Potter, agent. Price 7s.*

A notice of this atlas appears in another page of this number.

United States Charts.

U.S. Hydrographic Office

Pilot Charts of the North Atlantic and North Pacific Oceans for June, 1897. Published at the Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Samoa and Hawaii.

Swi

Four Photographs of Samoa and Hawaii, taken by Colonel A. Swinton, *Presented by Colonel A. Swinton, R.A.*

These photographs supplement the series previously presented to the Society by Colonel A. Swinton, R.A. They are as follows: (1) Village—Samoa; (2) Mt. Samoa; (3) Woman of Samoa; (4) The crater, Kilauea, Hawaii.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photograph, it will be useful for reference if the name of the photographer and address are given.

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SKETCH MAP
of
NORTHERN AND CENTRAL
SZE CHUAN.

to illustrate the journey of
M^{RS} I. L. Bishop.
1896.

English Miles.



1 : 2,500,000 = 39 5-11 Inch.

Author's route. ~~~~~

Hong-ki

Kien-ing

29

28

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W. H. K. & Y.
Leland Stanford, Jr.
1891





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The Geographical Journal.

No. 2.

AUGUST, 1897.

VOL. X.

SUB-OCEANIC CHANGES.

By JOHN MILNE, F.R.S., F.G.S.

INTRODUCTION.

THE object of the present paper is to draw attention to a certain class of geological changes which are in operation beneath the seas and oceans. The evidences we have of changes which take place on the land are as varied as they are numerous, but directly we reach a depth a few fathoms below low-water mark, we find ourselves on the boundary of an area represented by three-quarters of the surface of this planet, where it is usually supposed that geological changes are extremely slow. All the evidence we have relating to the abysmal level floors of oceans, where sediments accumulate with immeasurable slowness, and where ocean cables, unless destroyed in consequence of electrolytic action or faults in insulation, remain intact for twenty or more years, supports this view.

Directly we leave these level plains and approach submarine banks like those of Newfoundland, submarine ridges like that which runs down the central Atlantic, the steep slopes of the submarine plateaus which fringe continents and islands even though we may be in depths of 2000 and even 4000 fathoms of water, the evidences of great and sudden changes in the details at least of sub-oceanic contours grow more numerous day by day. It is in localities like these where cables are broken, not in consequence of defects inherent in themselves, but often directly in consequence of their burial beneath masses of materials which have apparently slid down from neighbouring banks. On the inner borders of continental plateaus, which are the submerged portion of the continental domes, detritus accumulates by marine erosion, whilst near to the mouths of rivers sediments which have been derived

* Paper read at the Royal Geographical Society, June 18, 1897.

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from catchment basins of great area are deposited to form banks and ridges. These materials from continental areas are accumulated on areas which are comparatively small, so that the rate per superficial unit at which the land is being lowered is probably very much less than the rate at which it is being raised beneath the sea. This mechanical concentration of *débris* leads to the formation of banks which, on their outer faces, as will be shown later, are subject to sudden yieldings.

The causes of sub-oceanic yieldings in rocks and sediments are, broadly speaking, twofold. First, there are bradyseismical actions represented by secular folding, thrust, or crush. Sudden accelerations in these movements constitute earthquakes, which may be accompanied by the formation of a line of faults and landslips. Secondly, we look to sedimentation and erosion and the consequent creation of unstable contours, which may be destroyed by seismic action, facial sliding, basal crush by overloading, or the action of submarine springs and ocean currents. If we regard landslips on the land as the final result of certain geological processes which have created instability, then those which occur beneath the sea may be taken as evidence of somewhat similar activities. In many, if not in the majority of instances, submarine dislocation is a sliding effect resulting from overloading, whilst on land critical conditions are reached by activities which are subterranean.

Submarine volcanic action, which no doubt is an important factor in altering sub-oceanic form, inasmuch as attention has often been directed to the same, will only be briefly mentioned.

The sub-oceanic phenomena to which it is desired to call special attention will be treated in the following order:—

1. *Bradyseismic Action.*

Seismic and volcanic activity—its frequency, cause, and effects.

2. *Sedimentation and Erosion.*

Submarine landslides.

Overloading with facial sliding or basal crush.

Submarine springs.

Current effects.

Changes in shallow water.

3. *Changes evidenced by Cable Interruptions.*

4. *Conclusions.*

Importance of a seismic survey of the world.

For the facts relating to cable interruptions, although much has been drawn from the publications and notifications of "Le Bureau International des Administrations Télégraphiques," I am greatly indebted to my friend Mr. M. H. Gray, without whose assistance I should have been able to say but little; to Mr. F. le B. Bedwell, R.N.; to Mr. H. A. Saunders; and to other gentlemen and engineers connected with the laying of ocean cables.

SECTION I.

Sub-oceanic Bradyseismic Action.

The existence of oceanic islands formed of stratified materials and the more or less folded strata of the continents themselves testify to the fact that upward movements have taken place in ocean beds. Submerged forests and other phenomena indicate that local lines at least have been submerged. Again, when we consider sub-oceanic, continental, and insular plateaus, or the ridges and banks—as, for example, those which follow a north-south line of considerable elevation down the mid-Atlantic—in relation to the distribution, both past and present, of the fauna and flora of widely separated countries, we see that the hypotheses of a submerged Atlantis, Lemuria, Antarctica, and other lands, are not altogether without foundation. The fact that round the borders and upon the summit of hidden domes and tablelands there are at present displays of seismic and volcanic activity, leads to the belief that sub-oceanic bradyseismic action is yet in progress, and we therefore have movements taking place beneath the ocean similar to those which, during an historical period or even a lifetime, have been repeatedly observed on coast-lines.

Distribution of Seismic Activity.—Amongst the earlier attempts to produce a work showing the general distribution of seismic activity throughout the world is the copious catalogue of Giacomo Antonio Buoni, entitled ‘*Del Terramoto Dialogo*,’ published in Modena in 1571. Two hundred years later, no doubt in consequence of the unusual seismic and volcanic activity which at that time was so pronounced throughout the world, a seismological renaissance was evoked, and catalogues and treatises on earthquakes became prominent features in current literature. Whilst this was taking place in the West, in the East, at least in Japan, ‘*Jishin Nendaiki*,’ or earthquake chronologies, were being published. Amongst the more important publications of this century are the voluminous catalogues of Alixis Perry, and the lists of Mallet, Fuchs, and Montessus di Ballore. Enormous as some of these lists appear, directly we compare them with those of the only country which for some years past has been thoroughly surveyed—I refer to Japan—their incompleteness is seen in the fact that they give an earthquake-frequency for the whole world less than that which we know to be true for the fractional portion of the same represented by the Japanese Empire. The history of the seismic survey of Japan and its character are as follows.

In 1880 the present writer, with the assistance of Mr. Toshiwo Nakano, communicated with officials and others in all the principal towns of Japan, asking them to furnish information as to the number of shocks they usually felt per year, and at the same time to give, as far as they were able, some account of the shocks which had occurred

during previous years. The replies were numerous, and one conclusion derived from the analysis of the records was that in Japan there were, on the average, three or four shocks per day, which was the frequency calculated by Prof. Heim for the whole globe (*Trans. Seis. Soc.*, vol. iv. p. 30). Encouraged by these results, in the following year—to determine the extent of country shaken by a given shock and its origin—bundles of postcards were sent to many towns and villages within a distance of about 100 miles from Tokio, with a request that every week one of them should be returned with a statement respecting earthquakes which had been felt. The result of these communications showed that nearly all the shocks came from the seaboard on the east or north-east, and that very few originated from the mountains on the west or south-west. The barricade of postcards was then extended to a point some 450 miles north of Tokio, and ten important stations were furnished with seismographs. As the result of observations extending over two years, it was definitely shown that the greater number of earthquakes originated on the seaboard or beneath the ocean, whilst the mountains and volcanic regions were singularly free from these disturbances.

The establishment of these, and other important results, in 1884 led the Imperial Government of Japan to establish observing-stations throughout the empire, or over an area of 140,000 square miles. In 1895 there were 968 of these stations, of which 39 had instruments.

The general results which have been obtained, bearing upon the subject-matter of this paper, from these various surveys are as follows.

Earthquakes the Origin of which are Submarine.—The earthquakes which have a submarine origin may be divided into three groups—

1. Those which have been felt and recorded on land, and which, therefore, may be assumed, in the generality of cases, to have originated on a coast-line or within a few hundred miles off in the ocean.

2. Those which have been recorded on shipboard out at sea, either as tremors or as severe movements. Many of these disturbances are probably volcanic.

3. Those which have not been felt on land, but have been distinctly recorded there. In this group we find many of the earthquakes which shake the world.

As illustrative of the frequency of the first group, I will quote from observations made in Japan ("On 387 Earthquakes observed during Two Years in North Japan," by John Milne, *Trans. Seis. Soc.*, vol. vii. pt. ii.). Between 1881 and 1883 in North Japan the writer found that, out of 419 shocks, no less than 218 of them had originated beneath the ocean. There had been 137 which had originated on or near the seaboard, and therefore some of these had been of sub-oceanic origin, whilst only 64 had originated inland. A large number of these earthquakes came from the deep water off the mouth of the Tonegawa, the largest

river in Japan, which, as it approaches the sea, crosses the alluvial plain of Musashi.

Between 1885 and 1892 no less than 8331 earthquakes were recorded in Japan—that is, on the average during this period of eight years there were about one thousand shocks per year (*Trans. Seis. Soc.*, vol. xx.). A glance at the map showing the distribution of origins of these disturbances, shows that nearly all of them have originated along the eastern seaboard, and have been frequent near the alluvial plains. Between January, 1885, and December, 1888, when seismic activity was in a normal state—that is to say, when there were no long series of after-shocks—2018 earthquakes were recorded, of which at least 1034, or 50 per cent., originated beneath the sea. In Japan, therefore, along a coast-line of 1140 miles, there has recently been at least about 250 submarine shocks per year. In some years there have been 500.

From a seismic map of the world, I should estimate that round the Pacific there are at least ten sub-littoral districts where earthquake-frequency may be about half that of Japan. If this is accepted as probable, the sub-littoral seismic activity of the Pacific is represented by 2500 shocks per year, some of which have been accompanied by submarine landslips and consequent changes in the configuration of the ocean bed. When these latter are great, it is assumed that ocean-waves are created. If we consider the seismic activity round the coasts of the other oceans and seas which cover our globe as being, when taken together, equal to that of the Pacific, then for the world, out of a possible 10,000 shocks per year, 5000 of them have their origin on the sub-oceanic continental slopes.

To get information about the second group, or earthquakes which have originated far from land, we have to turn to the voluminous catalogues of Perry, Mallet, Kluge, di Ballore, Fuohs, and other statisticians. Such extracts have been made by Dr. Emil Rudolph in his papers, "Ueber Submarine Erdbeben und Eruptionen" (*Beiträge zur Geophysik*, Band i. and ii.), who gives us an account of 333 sub-oceanic earthquakes and eruptions. Because the greater number of these shocks are of volcanic origin, they will be more specifically referred to in the next section. The distribution of these is various, but here and there they herd together, indicating localities where changes are comparatively rapid. One favourite locality for submarine disturbances is in the Equatorial Atlantic, about 20° W. long., and again at 30° W. long., near to St. Paul's. For each of these regions Dr. Rudolph gives about thirty-seven shocks, in depths of water exceeding 1000 and 2000 fathoms.

The chief source of information for our last group is, however, derived from the records of horizontal pendulums. Taking a list of them published in the *Transactions of the Seismological Society*, vol. xx., by the late Dr. E. von Rebeur-Paschwitz, out of 301 records

obtained in twenty-seven months, there are only 25 which can with certainty be traced to their origin. Out of the 176 which remain, 105 were almost simultaneously recorded at places so widely separated as Potsdam, Wilhelmshaven, Strassburg, Nicolaiew and Tokio, and therefore cannot be disposed of as being due to some accidental disturbance of an instrument, or to small shocks of local origin. Each of them was a disturbance affecting a very large area, and indicates an initial impulse of great magnitude. What is true for the observations in Europe has also been true for my own observations in Japan, and also in the Isle of Wight, the only difference being, that in Europe the stations were from 300 to 600 miles apart, whilst in Japan and the Isle of Wight the stations were usually near to each other, and never more than 30 miles apart. In some instances, however, earthquakes of unknown origins were recorded in Japan and Europe, and it is fair to assume that in these instances the whole world had been shaken.

One disturbance noted by the author in Japan on June 3, 1893, had a duration of five and a half hours. It was also recorded in Birmingham, Strassburg, and Nicolaiew, at which latter place the duration of motion extended over eleven hours. Amongst unfelt earthquakes, both for magnitude and duration, it exceeded all that have yet been recorded.

Because the character of the unfelt movements, the origin of which cannot be traced, is identical with the character of those which have been traced to earthquakes originating at great distances, it is, for the present at least, assumed that the cause of the former is similar to the cause of the latter. If this is the case, the only place towards which we can turn to find the origin of the former appears to be beneath our oceans, and when they are of a magnitude approaching that of June 3, their origins must have been very far from land, otherwise a sensible shaking would have been observed upon the nearest shores.

If we take the three classes of records to which we have referred in conjunction, the conclusion to which they point is not simply that the submarine evidences of seismicity are more numerous than those on land, but also that they are very much more intense.

The Character of Submarine Seismic Districts.—If we compare together the characters of the districts where earthquakes of submarine origin are frequent with those where they are practically unknown, the differences are striking. In the former the land, as shown on the seaboard, usually consists of strata which are geologically new; it exhibits evidences of recent elevation, some of which can be traced to historical times, whilst its average slope from the mountains in the interior down beneath the ocean is, over a considerable distance, relatively very steep.* The unit of distance over which such slopes have been

* See note upon the "Geographical Distribution of Volcanoes," by J. Milne. *Geological Magazine*, April, 1880. Also "Address to the Geological Section," by Prof. O. Lapworth, LL.D., F.R.S., *Brit. Ass. Reports*, 1892.

measured is taken at 2°, or 120 geographical miles. The following are a few examples of such slopes :—

West Coast, South America, near Aconcagua	...	1 in 20·2	} Seismic districts.
The Kurils from Urap ... ..	...	1 in 22·1
Japan, west coast of Nippon ... ..	...	1 in 30·4
Sandwich islands northwards ... ..	...	1 in 23·5
Australia generally	1 in 91	} Non-seismic districts.
Scotland from Ben Nevis ... ..	...	1 in 158
South Norway ... ..	...	1 in 73
South America, eastwards ... ..	...	1 in 243

The conclusion derived from this is, that if we find slopes of considerable length extending downwards beneath the ocean steeper than 1 in 35, at such places submarine earthquakes, with their accompanying landslips, may be expected. On the summit of these slopes, whether they terminate in a plateau or as a range of mountains, volcanic action is frequent, whilst the earthquakes originate on the lower portions of the face and base of these declivities.

Seismic Strain, Deformation, Thrust, and Crush.—We assume that the contours referred to in the last section are mainly the result of rock-movement, and that seismic strain, due to a tendency to further adjustment, is greatest where earthquake origins are most frequent. The home of the volcano is evidently the place where the rocks have been most deformed, whilst that of the earthquake is at the base of steep sub-oceanic slopes where most deformation is in progress. The nature of the forces in operation producing this deformation are twofold. First, there is the horizontal thrust, so strongly emphasized by Lapworth, which may or may not tend to increase the height of the mountain ranges bounding its line of action; and, secondly, a factor dependent on gravity, which, acting on the side of subærial and marine denudations, tends to lower them. Earthquakes are for the most part spasmodic accelerations in processes with these characters.

The distortions observed in fossils and pebbles, the difference in thickness of contorted strata, and the “creep” in coal-mines, all indicate that great pressures may set up movements in stratified materials corresponding to a flow. Mr. William Barlow, in a paper on the “Horizontal Movements in Rocks” (*Quart. Jour. of the Geol. Soc.*, November, 1888), as evidence of this, calls attention to the contortions and foldings observed in glacial drift produced by a load above, the dip seen on the face of the Grand Cañon of Colorado, and the slight elevation observed in the area surrounded by cliffs known as the “San Rafael Swell.” These and other appearances may be regarded as instances of “creep” upon a large scale, when materials have been squeezed out from beneath superincumbent strata.

In studying bradyseismical movement, we usually take cognizance of that which is most apparent. This is the vertical component of a

displacement, whilst the horizontal movement may be entirely overlooked. The geotectonic structure of many countries, however, shows us that displacements by horizontal thrust have taken place on an enormous scale, and it is not unlikely that these forces, accelerated by the effects of crush, are yet in operation round the basal contours of continental areas. Sub-oceanic earthquakes are therefore announcements that sub-oceanic bradyseismic action is in progress, and because these disturbances are more numerous round the submerged frontiers of continental domes and in mid-ocean than they are on land, it may be concluded that the distortions and displacements due to bending, thrust, and crush are greater beneath the sea than they are upon continents and islands.

Earthquakes and Landslides.—In addition to these bradyseismical effects, which only produce appreciable changes in sub-oceanic contour after the lapse of long intervals of time, there are the effects which accompany the actual shaking, which we may assume are not far different from those effects which we see produced by earthquakes originating on land. Many earthquakes which we feel, although they may create alarm and shatter chimneys, do not produce any effect upon rocks and cliffs. This, however, does not preclude the idea that shakings of equal intensity would not produce effects upon submarine slopes, where, as compared with similar slopes on land, critical conditions may more nearly approach in character to the mechanism of the hair trigger. Severe earthquakes on land are almost always accompanied by great landslides, and mountains which may for ages have been green with forest growth by the sliding away of materials on their sides, suddenly present the appearance of having been whitewashed. The probable effect of similar shakings originating beneath the ocean in the vicinity of steep slopes needs no explanation.

Another effect which sometimes accompanies these disturbances, and which may have been their cause, is the creation of a fault 50 or 150 miles in length, by which the country on one side of this, relatively to that on the other, has been suddenly raised or lowered 20 to 30 feet. Earthquakes of this nature, if of submarine origin, would naturally produce similar effects over large areas, and, if the magnitude of the displaced materials, whether by landslides or faulting, were large, as compared with the depth of the superincumbent waters, would also give rise to sea-waves.

One of the most recent examples of effects of this description was that which occurred on June 15, 1896, off the north-east coast of Japan. On the evening of that day a submarine earthquake occurred in this locality which was recorded in the Isle of Wight, and, from the magnitude of the diagrams, it may be assumed that the world was shaken from pole to pole. Following this shaking, great sea-waves spread over the North Pacific ocean. The explanation of this phenomena is that

the earthquake was produced by fracture of the rocks, not at a point, but over a considerable length, which movement, being accompanied by the displacement of huge masses of material, gave rise to the sea-waves. The sub-oceanic contour of this locality, where the depth of the water increases at the rate of 1000 fathoms in 25 miles until the 4000-fathom line of the Tuscarora Deep is reached, lends itself to this supposition. The only difficulty we experience is to estimate the volume of the material which must have been more or less suddenly displaced at these great depths to have produced so great a disturbance on the surface of the ocean. It is not likely that it was less than that of the greatest landslide of which we have historical record as having occurred upon the surface of the Earth.

The data we have for calculating the position of the origin of these great disturbances are numerous and exact. Our knowledge of the dissipation of earthquake energy, as represented by its destructivity as it radiates, indicates that an earthquake which dislodged sufficient material to disturb the whole of the North Pacific ocean must, at the very least, have originated 100 miles away from Miyako, on the north-east coast of Nippon, at which places a few houses were shattered.

If the mean depth of the water along the wave-path be h , and T be the interval of time between the arrival of the sea-wave and the vibratory wave, as pointed out by Hopkins, the distance of the origin from the point where the latter observations were made, may be approximately expressed as

$$= \sqrt{gh} \cdot T$$

From charts the value for h is about 2000 fathoms, whilst T , as deduced from accurate records of seismographs and tide-gauges, is at least twenty-one minutes.

Introducing these values into the above equation, the distance of the origin from the land is 180 geographical miles. Again, if V_1 be the velocity of the vibratory wave, which near to an origin we know to be about 7000 feet per second, and V_2 be the velocity of the sea, which we know from measurements on previous waves approaching this coast to be about 600 feet per second, then the distance of the origin of the coast may be expressed as

$$= T \frac{v_1 v_2}{v_1 - v_2}$$

Introducing the given values for T , v_1 , and v_2 , the required distance becomes about 140 geographical miles.

This last calculation, strangely enough, brings us exactly to the base of the western boundary of the Tuscarora Deep, above which there is 4000 fathoms of water. This is a place from which many earthquakes have originated, affording evidences, particularly in this

instance, of sudden sub-oceanic changes along the basal frontier of a continent, the magnitude of which it is difficult to estimate.

Submarine Volcanic Action.—If highly heated rocks saturated with water were the only condition necessary for a display of volcanic action, such activities might be as marked in ocean basins as round their margins. The geological distribution of volcanoes, however, shows that before a volcanic magma can expand and find exit on the surface, the pressure due to superincumbent strata must be relieved, which is apparently obtained when they are sufficiently crumpled upwards to form mountain ridges. If, therefore, we seek for volcanic action beneath the sea, we may expect to find the same along submarine ridges, and if we discover the same, as we do along the central ridge of the Atlantic, the conclusion is that along such a ridge an upward brady-seismical movement is in progress, and not far from the region of eruptions there should be a region of earthquakes.

In certain instances, apparently, as is the case with the Aleutians and the Kurils, so many eruptions have taken place along a submarine ridge that a continuous and almost connected chain of islands has been formed. On the flanks of the most southern of the latter group recent marine strata have been raised, which, taken in conjunction with the fact that hardly a year passes without some new eruption being noted, whilst submarine shocks of earthquakes are frequent, indicates that Japan may in time become connected with Kamschatka.*

Any attempt to enumerate the various submarine ridges of volcanic activity at present evidenced by these outcrops would be beyond the scope of the present paper. One curious form of evidence, indicating the existence of volcanic activity entirely hidden in ocean depths, is referred to by Mr. W. G. Forster, in his paper on "Earthquake Origin" (*Trans. Seis. Soc.*, vol. xv. p. 73), from which we learn that cables have, after their interruptions, been recovered from which the gutta-percha had been melted—probably by water at a high temperature. The cables referred to are near the Lipari islands and between Java and Australia.

Some idea of the frequency of earthquakes and volcanic shocks originating in the ocean may be obtained from a paper by Dr. Emil Rudolph. From his descriptions, which are derived from the catalogues of Perrey, Mallet, the archives of the London Meteorological Office, etc., the following table has been drawn up:—

North Atlantic, 1724–1886	...	...	...	...	28 disturbances.
Azores, 1843–1884	...	...	...	...	20 "
Cape Verde islands, 1854–1883	...	...	...	...	4 "
St. Paul's, 1845–1886	...	...	...	...	22 "

* See 'Notes on the Kuril Islands,' by Captain H. J. Snow, F.R.G.S., published by the Royal Geographical Society.

Equatorial Atlantic, 1747-1878	43 disturbances.
West India, Leeward islands, 1839-1886	17 ..
South Atlantic, 1616-1875	10 ..
West Mediterranean, 1724-1865	11 ..
East Mediterranean, 1820-1886	20 ..
Gulf of Mexico and Caribbean sea, 1751-1884	17 ..
Indian ocean, 1818-1883	28 ..
North Pacific, east side, 1790-1885	22 ..
South Pacific, east side, 1687-1885	47 ..
North Pacific, west side, 1773-1681	14 ..
South Pacific, west side, 1643-1885	10 ..
East Indian archipelago, 1796-1883	20 ..
Total	333

The records generally are more frequent as we approach modern times, and, to some extent, for those seas and oceans where there have been the greatest number of observers. Dr. Rudolph regards all his records as referring to shocks of volcanic origin, and, if they agree with his definition of *Seebeben*, which are shakings originating in the ocean and propagated as elastic waves, we concur in his views.

SECTION II.

Sedimentation and Erosion.

In this section of the paper it is not the intention to emphasize work that has been already published respecting the accumulation and erosion of sediments at the mouths of rivers and along shore-lines, but to show that because submarine landslips are phenomena of frequent occurrence, the inference is, that not only on the margins of coasts, but also in the deep sea, there are causes in active operation which culminate in such sudden displacements. Landslips beneath the sea will, like those upon the land, occur upon the faces of steep slopes. One very important phenomenon leading to the production of the former, which differentiates, at least some of them, from the latter, is that there is beneath the sea a group of landslips which are probably due to the accumulation of sediments until a natural angle of slope is exceeded, when a facial sliding takes place. In other instances the yieldings may be the result of a basal crush, erosion by the escape of submarine springs or the action of unusual currents, and also, as we have already pointed out, to mechanical shaking produced by earthquakes.

Although many illustrations might be adduced, showing the existence of submarine cliffs which may suddenly yield under influences which cause yielding of sediments upon slopes, the sounding-lead, when dropped off the edge of submarine banks, the steeper faces of continental plateaus, the mouths of great rivers, and along sections of certain coasts, often reveals the existence of steep slopes over a distance of from one to several

miles. Illustrations of slopes varying between 1 in 1 or 45°, and 1 in 15 or 4°, will be given when speaking of districts where cables have suffered fracture. Average slopes of this nature, if we may draw any inference from what is seen on land, imply that the upper parts of such surfaces are inclined at a greater angle, and the lower parts at a lower angle, than that which is indicated by the average. The forms of stability for loose materials piled up on land are fairly well known, but the corresponding form for the same materials accumulated beneath water is not known. For example, the writer's investigations, renewed and carried on by George F. Becker (*Amer. Jour. Sci.*, xxx. 283), have shown that the form of a volcano like Fuji may be expressed by the equation—

$$\frac{y}{c} = \frac{e^{-\frac{x}{c}} - e^{-\frac{r}{c}}}{2}$$

where $c = \frac{2k}{r}$

and y = radius of the figure ;

x = distance of any horizontal plane from the base ;

r = the specific gravity of the material ;

k = coefficient of resistance to crushing.

This logarithmic curvature is seen to depend upon the density and resistance to crushing of the component materials, and it indicates that if we desired to increase the height of a mountain like Fuji, to resist the effect of the additional load, the area of its base would have to be increased. The mountain has reached a limiting form. In its upper portion it has a slope of 30°, but as we proceed downwards this rapidly decreases, so that at its base it is practically asymptotic to the plain from which it rises. Its average slope from base to summit is about 15°, or 1 in 4, and any cause tending to increase this would be followed by crushing or sliding. Such a mountain, if it were immersed in water, where the coefficient of friction between its component parts could be decreased, might, like Graham island, gradually subside to form a shoal or bank. The top of such a bank would be rounded, but the upper part of its sides we should expect to be steeper than the lower part.

To gain some idea of the angle of stability of short slopes of material like sand deposited beneath water, the following experiments were made:—

On the Deposition of Sand beneath Water.—Very fine dry sand was allowed to fall from a funnel on the bottom of a large but empty aquarium until it grew up as a heap against its side. By placing a piece of tracing paper on the glass, a tracing was taken of the contour of the mound thus formed. This was a cone, the sides of which had a slope of 35°. An equal volume of sand was added to the first cone,

which grew slightly in height, but its trace showed sides parallel to the one first formed. In a similar manner a third and fourth cone was formed, and the sides of these four cones, which are numbered 1, 2, 3, and 4, yet remained parallel (Fig. 1). After this a similar set of cones were formed in the aquarium whilst it was filled with water, the result of which was that cones 5, 6, 7, and 8, were formed, each of which, owing to the downward current produced by the falling sand, had at its apex a cup-shaped crater. In one case the inner slope of one of these craters reached 29° . The outer slopes of these cones at their summits did not exceed 30° , from which they sloped downwards at a continually decreasing angle to meet the plane from which they rose.

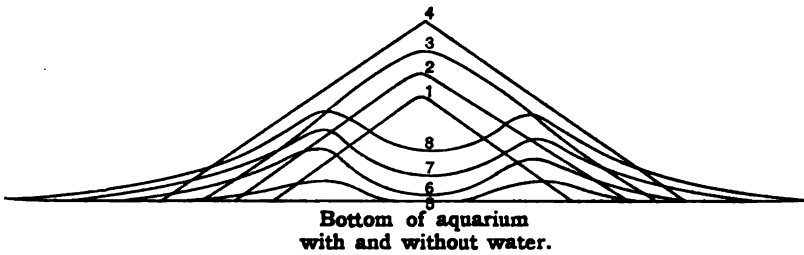


FIG. 1.

The average slope of these cones was 16° . The highest cone was only 6 inches, whilst the greatest base was about 1 foot 10 inches. The depth of water through which sand fell in a stream to build cones $2\frac{1}{2}$ inches in height, was 9 inches. Because the forms of these heaps of sand beneath water were in great measure due to hydrodynamic action, to escape such effects the next experiments were as follows:—

A tin cone, $6\frac{1}{2}$ inches in diameter and $2\frac{1}{2}$ inches in height, was packed with dry sand and then inverted on a glass plate. When the cone was removed, the cone of sand with a sharp apex remained standing, although its sides had a slope of 38° . By very gentle tapping on the glass plate the sharp apex became rounded, and the slope of the sides quickly fell to 33° , after which the little mound was stable. The same mould was next packed with very wet sand, and after inversion on the glass plate, the whole was immersed in water and the cover *very gently* removed, and placed, still beneath the water, on one side. The apex quickly became rounded, and the upper part of the resulting form, as obtained by a tracing, became like Fig. 2, the diameter of the base increased from $6\frac{1}{2}$ inches to $6\frac{3}{4}$ inches, whilst the lower portions of the two sides had slopes of 40° and 33° . This heap was very stable even when the water was agitated, and the glass plate on which it stood could be lifted without producing any marked change in form.

The last experiment was to allow fine dry sand to fall through water as a very fine stream from a nozzle about $\frac{1}{16}$ inch in diameter, and to

settle at the bottom of a tank. The falling stream had the appearance of a cloud of thin smoke, and after half a day a heap accumulated about 5 inches in height. The top of this heap was rounded, and its sides had slopes of 32° and 34° . The outward growth of this heap beneath its smoke-like cloud of falling sand was by intermittent facial sliding, and was very suggestive of what may happen on larger banks beneath the sea.

The same sand, but very dry, falling from the same funnel in air, also gave a cone with sides of 34° . When it fell from a funnel with a $\frac{3}{16}$ -inch nozzle, this was reduced to 30° or 31° .

The information that can be deduced from these experiments is small. Because what is true for embankments and large heaps of sand upon the land is apparently true for heaps only a few inches in height,

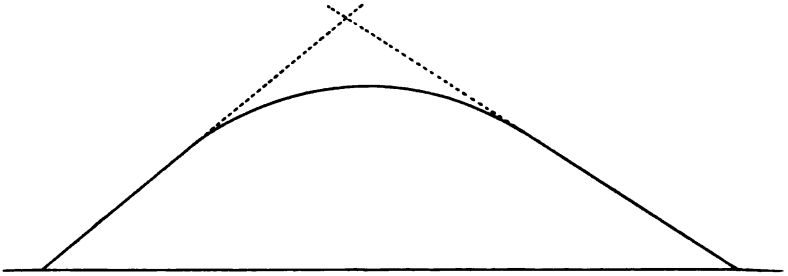


FIG. 2.—FORM OF UPPER PORTION OF A MOUND OF WET SAND BENEATH WATER.

we might therefore assume that small mounds of sand deposited beneath water would at least approximate in form to those of larger heaps deposited under fairly similar conditions. If this is admitted, we then arrive at the following conclusions:—

1. Sediments deposited under the influence of currents accumulate in slightly flatter forms than those of similar materials built up on land.
2. Peaks, edges, and corners of loose materials, which may be fairly stable on land, are beneath water, even when it is still, quite unstable and quickly become rounded.

3. A mound or bank, when thus rounded, is very stable even under the influence of strong currents, but the unstable form may be quickly reproduced by the accumulation of new sediments.

The only inference bearing on the subject-matter of the present paper is that, if by any means we know that sub-oceanic deposits are accumulating as slopes like those we see on land, the upper portions of the same are from time to time unstable, and facial sliding may be expected.

Landslips by Overloading and Facial Shear.—One form of submarine landslip which may be considered is that which may be found on the submerged faces of a delta. When a river enters an ocean because its channel is suddenly widened, and it comes in contact with the relatively

still water, its velocity is suddenly checked, and the bulk of its sediments are deposited to form a bar or submarine extension of a delta or a *levée*. In the latter case the line of the river channel is continued beneath the sea, and to the right and left of this submarine banks are formed. Such banks will have their steeper sides facing the channel, while as their boundaries grow upwards we know that in some instances they have assumed a gully-like form. When we compare the large catchment areas from which certain rivers derive their sediments with the comparatively small areas on which the bulk of these are deposited, it is not astonishing that these deposits have a rapid growth. Farther than this, because these accumulations are formed of loose materials collected together under the influence of gravity, and where we have currents, under the influence of hydrodynamic action, it seems reasonable to suppose that the resulting contours, as shown on the faces of banks, in many instances at least, represent forms which have reached a limit of stability. If, therefore, such *submarine* natural slopes have an existence, whether they are more or less stable than those of similar materials formed on land, it would seem that the banks they represent might from time to time be subject to sudden modification due to the sliding of masses of material on their faces, such slidings being produced by a facial shear by overloading or an increase in the angles of stability by the wearing action of currents. Spasmodic yieldings of this character would, for example, be most frequent when rivers were bringing down the largest quantities of sediment, or at times when currents on a coast alter in direction and intensity, and what is true for the yielding of a delta face would also be true for yieldings of materials accumulating on a submarine bank.

Yielding of Sedimentary Materials by Basal Crush.—Not only may banks yield by sliding on their faces, but when they are of great height it seems possible that the materials forming their lower portions may be caused to yield horizontally under the influence of the load which lies above them; in short, what has been assumed as true for rock masses under almost continental pressure is probably true for loose materials.

Example of approximations to these conditions are illustrated, as we have already pointed out, in the form of any volcano which has been built up by the accumulation of ash around a central orifice.

Submarine Springs.—Another cause tending to disturb, not simply the faces of delta formations, but the accumulations of loose materials covering the steeper slopes fringing the submarine plain which bounds most continents, is the not altogether hypothetical assumption of the existence of submarine springs, which in some instances at least are of marked magnitude.

Striking illustrations of underground streams are to be met with in many countries, whilst the existence of their equivalent may be inferred

from the copious flow of water from certain artesian bore-holes. One class of artesian bores to which attention may be directed are those in alluvial plains parallel and near to rivers. Examples of these exist at Itabashi near Tokio, in Osaka, apparently at Christchurch in New Zealand, and at other places. The phenomenon at the former of these places, where from shallow holes water gushes up copiously, seems best explained by the assumption that it comes from an ancient river-course roughly parallel with the adjacent river on the surface, and therefore deriving its head from the slope of an ancient valley of denudation, and not from the synclinal form of folded strata. Whatever may be the explanation of a stream practically beneath a stream, the fact remains that there are in the places cited, and possibly in very many others, very large bodies of subterranean water flowing seawards.

In Tokio, beyond the mouth of the Sumida, an indication of the escape of this or other subterranean streams may be inferred, because in the bay we find at least two fresh-water springs.

Another indication that enormous quantities of fresh water escape beneath the sea is found in the fact that, when we compare the rainfall in the catchment basin of a river with the quantity it discharges, after making due allowance for evaporation, the balance which remains and only to be accounted for by absorption is sometimes large.

From the experiments of Dr. Gilbert, F.R.S., which were for many years carried out at Rothamstead, St. Albans, with Sir James Laws, the percolation through loam with a subsoil of clay, both mixed with flints, although this does not bear a fixed relation to the rainfall, may be roughly taken at 50 per cent. of the same.

Robert L. Jack, F.G.S., in a report on "Artesian Water in the Western Interior of Queensland" (*Geological Survey Bulletin*, No. 1: Brisbane, 1893), attributes its existence in a large measure as being due to the absorbent properties of a certain series of sandstones, which he calls the bibulous Blythesdale braystones. From these beds, because they probably crop out beneath the sea, there is likely to be submarine leakage. As evidence of this Prof. David is quoted, who describes powerful springs at Port Macdonell, a little distance off shore. Again, Mr. G. S. Griffith says that "along the south coast of Australia, between Warrnambool and the Murray mouth, the sea literally bubbles up with fresh water." These artesian beds, Mr. E. F. Pittman says, probably extend beneath the Lower Eocene to the north-west part of Victoria and part of South Australia to the Coorong, where he believes fresh water escapes from the beach.

Whether the particular beds do or do not crop out beneath the sea, a striking fact connected with Australian rivers, as pointed out by Mr. H. C. Russell, F.R.S., is that, whilst the Darling only discharges 1¼ per cent. of the rainfall on its basin, the Murray discharges 25 per cent. The drainage area of these two rivers being under very similar climatic

conditions, the conclusion is that in the former basin a large quantity of water is continually disappearing underground by absorption.

Without attempting to multiply examples which show that fresh water from the land escapes beneath sea-level, from what we know about rainfall, its evaporation and absorption, and the geotectonic conditions governing the flow of underground waters, that much of this escapes beneath the sea on the fringes of plateaus surrounding continents and islands, is apparently a legitimate hypothesis. Granting this, then it would seem that deposits collecting around and above the submarine exits may from time to time be suddenly loosened and a landslip occur. At certain places where there is a seasonal variation in the escape of such waters, these occurrences would be periodical. Examples of submarine landslips, which are most frequent at particular seasons in deep water off the mouths of great rivers, will be given in the section relating to Cable Fractures.

Ocean Currents.—The last causes which may produce submarine dislocations to which we desire to draw attention are fluctuations in direction and intensity of ocean currents. It is difficult to say to what depths the effect of ocean currents are at various seasons perceptible, but many of them, like the *Kuro Siwo* of the Pacific, are vast bodies of water the fluctuations in the flow of which, as exhibited on the surface, are very great. The extent to which this latter body of water varies in the distance to which it may be perceptible between winter and summer, is roughly some 500 miles. Mr. Alan Owston, of Yokohama, a deep-sea yachtsman, tells me that a few days before the disaster of June 15, 1896, when North-Eastern Japan was inundated with sea-waves and some 27,000 lives were lost, there was strong evidence that this current had been pushed well in towards the coast. The schooner *Anaconda*, whilst proceeding southwards, had to work so close in shore that at night they anchored.

Professors Ijima and Mitsukuri, in Mr. Owston's yacht the *Golden Hind*, whilst dredging during the summer of 1896, could do but little deep-sea work in Sagami bay, owing to the unusual inset of the Kuro Siwo, which the Misaki fishermen on the adjoining coast say happens about once every six years. An indirect evidence of what seems to have been a fact was that the inset of the current killed the wind. As evidence of this, Mr. Owston tells me that he has often observed steamers passing out of Yokohama bay with their smoke, under the influence of a general breeze, blowing right ahead. Outside the bay, where they meet a 3-knot current, the wind has failed, and the smoke has been upright or left behind. Although a current may kill a wind possibly by influencing the atmosphere above it in a contrary direction, there is no doubt that wind piles up water and creates an unusual flow in its direction, to return more or less rapidly when the wind has ceased.

Assuming, then, that in these and other manners there are great seasonal and erratic changes in ocean currents, it does not seem improbable

that these may affect submarine banks, and possibly even cliffs, and disturb the isostasy of submerged materials along coasts. Examples where submarine subsidences have accompanied or followed heavy gales will be given in Section III.

Submarine Changes in Shallow Water.—Any attempt to give a detailed account of changes which take place in comparatively shallow water is somewhat outside the scope of this paper, but that such changes have an existence there seems to be little room for doubt. In the discussion of a paper on "Littoral Drift" by W. H. Wheeler, M. INST. C. E. (*Proc. Inst. C. E.*, No. 2934, vol. cxxv.), we learn, on the authority of Rear-Admiral Wharton, F. R. S., that on the Yarmouth Roads where ten years ago there were deep channels there are now banks. The same is true for the Downs, whilst the Goodwin sands are different to what they were one hundred years ago, and all these changes have taken place beneath low-water mark. The late Sir John Coode, going down in a diving-dress, had seen the shingle on Chesil bank moving at a depth of 10 fathoms.

From the *Proceedings of the Institute of Engineers*, vol. xix. p. 670, we learn that chalk ballast thrown overboard 7 to 10 miles off shore in 10 fathoms of water has been brought ashore by gales in large quantity. Another evidence of movement of materials beneath low-water mark is the fact that particles of rock left by blasting have been brought up by moderate seas from depths of 30 feet. No doubt observations with these characters might be greatly multiplied, with the result of showing that the beds of certain shallow seas, by the slow movement of fine materials, are gradually changing in their contours.

What has been done in the preceding section is to show, as the result of direct observation, that submarine seismic and volcanic activities are strikingly great, the former even exceeding that which takes place on land. From this it is inferred that submarine bradyseismic action is great. The facts which have been given relating to sedimentation and erosion and consequent dislocation taking place beneath the sea are few in number, but it is pointed out that there are very strong reasons for supposing their existence. In the next section it will be shown that these reasons for the existence of dislocations are substantiated by many observations.

(To be continued.)

EXPLORATIONS IN THE COUNTRY WEST OF LAKE NYASA.*

By R. I. MONEY and Dr. S. KELLETT SMITH.

IN the spring of 1895, an expedition left England for the purpose of examining and exploring certain territories of the British South Africa Company north of the Zambezi. Command was held by the late Dr.

* Map, p. 236. For country beyond the limits of map, see vol. v. p. 288 of the *Geographical Journal*.

J. A. Moloney, formerly of the Stairs expedition to Katangaland, and there accompanied him nine white men, including in their number a surveyor, a geologist, a surgeon, and prospectors. Disembarking at Chinde, on the East African coast, and proceeding up the now well-known Shire river route, the expedition landed at Bandawe, on the west shore of Lake Nyasa. Here preparations were at once commenced for the inland march.

The difficulties and troubles attending the formation of a large caravan are many, even under the happiest circumstances. At Bandawe they were increased tenfold, partly by the character of the natives, but chiefly by the fact that the lake-shore people in this district have been so raided and split up by the Ngoni in years past, that there remains no great chief from whom one can engage a necessary number of carriers. Calico failed to charm, for those willing to work refused the risks of the march, knowing that they are always welcome at the coffee plantations in the Shire highlands. The men who offered themselves would only engage as soldiers, so that ultimately we were obliged to send a small advance party into the interior for the purpose of seeking carriers on the Ngoni plateau. In the mean time, we busied ourselves with arrangement of loads and all necessary duties preparatory to a march. Not the least of these was the matter of drilling "askari." The average black of these parts is incapable of concentrating his attention upon any one thing for more than a few consecutive minutes; his train of continued thought is remarkable for its brevity; his memory concerning those things which the white man would have him remember is that of a little child; his faculties are hard tried before they can fully grasp the subtle difference between "right turn" and "left turn;" he has a firmly rooted idea that "medicine" is at the back of all good shooting, and trusts, in his preliminary stages, rather to the efficacy of an elephant hair plaited around the stock of his rifle than to his own great physical advantage of fine sight. On the other hand, he is imitative to a degree, and manipulates his rifle well as long as his instructor exemplifies the intricacies of drill before him. Though he knows not that it is a law, the great law of nature, "kill and be killed," thoroughly imbues him, consequently his "banduk" receives an amount of care and solicitude which betokens a conviction of its possibilities. Fighting and all that appertains thereto vitally interest him. He practises under the superintendence of a sharper-witted fellow-ranker until the impressions of words of command take on some permanence. Finally, he is a fatalist, and at his best makes a good soldier.

In a little time carriers began trooping down from the highland, not before we were anxious for them, for one always bears in mind the commencement of the rainy season. They were inexperienced, so the loads were limited as a rule to fifty pounds. This they could manage,

and the only things that really caused trouble were the Maxim guns and a collapsible boat.

The country we were about to enter may be roughly described as a great plain, stretching away in continuity with the Tanganyika plateau in the north, falling with a gentle slope west and south to the Loangwa and Zambezi rivers respectively, and presenting towards Lake Nyasa a hilly escarpment, gradually declining with the southward grade of the land, so that opposite Bandawe the summit is 5670 feet above sea-level, while a degree south of this it is 4127 feet.

The road from Bandawe to Hora runs for some distance through the level lake fringe, passing many villages and intersecting great gardens of cassava. It then skirts the foot of the hills for a little distance before diving into them at right angles. Here commenced the stiff part of the march. The native path is always tortuous, and there was any amount of "collar work" as we breasted ascents, varying the seemingly eternal climb with a plunge across a valley now and then, the descent to which demanded "brakes hard down." So on for 30 miles of difficult country. Watercourses we passed in plenty, most of them dry. The Rivu, Kakewa, and Luweya rivers, entering Lake Nyasa, were welcome camping-grounds, the two latter being fine perennial streams, flowing through scenery as picturesque as one could desire. The hills are clad with forest practically untouched by hand of man, and for this reason, perhaps, owing to the want of thinning, the trees, except along the river-banks, do not grow to any great size. White quartz abounds. We were interested in the discovery of a rough earthenware pipe, in form like an agricultural drain-pipe, and of similar pattern to those which we afterwards came across, forming part of the native iron-smelting furnaces in the south. No other evidence of iron-working in this immediate neighbourhood was encountered. Perhaps still more interesting was the finding of a crucible and Marlin stone, similar to those occurring near ancient gold-workings in Mashonaland.

The latter part of this journey lay through a fine and pleasing park-like country. Coppes and wooded slopes, good sweet grass, and rich surface soil might delude one into thinking one's self at home again. It looked a perfect game country, and doubtless had been so before the plague in 1892 and 1893 played havoc in the land. The first signs of habitation were met with in the shape of cultivated patches of mapera and ulopoko, carefully walled round with stout fences as a protection against wild animals. Later came scattered villages; and finally, after a passage along the valley of the Kasitu, the great populous plain of Hora, with its huge salient rock rising up some 1500 feet above the surrounding land. This plain may be taken as 4810 feet above sea-level, and therefore some 3290 feet above Nyasa. The climate is bracing, and free from the enervating winds which sap one's energy

on the lake. Years ago the Free Church of Scotland founded a mission station here, and the continued health of the present missionary, Mr. McCallum, his wife, and their little son, shows the suitability of the land for the white man. Cattle thrive well, as do goats and fat-tailed sheep; while millet, mapera, Indian corn, pumpkins, beans, peas, tomatoes, sweet potatoes and yams, ground nuts, and cassava yield good crops, even under the primitive methods of cultivation adopted by the natives.

At Hora one fact quickly became patent, viz. that here we had to deal with a people of very different stamp from those of the lake-shore. True their minds, like those of their lowland brethren, ran in narrow circles with curious and irrelevant tangents, and with an ever-present



FOOT JOHNSTON.

personal centre; but their bearing had something in it of a free native dignity which attested the lordship of the land; they seemed conscious of race tradition and of a heritage of power. The best born of them were jealously observant of ceremonial and precedence in their palavers. Their emotions are probably limited; surprise and fear are certainly there, but the facial expression thereof is ever checked or determined by the diplomacy of the moment. Their feelings are under strong control; one is even reminded of the *nil admirari* stage of university studentdom, all which was a contrast to and relief from the chattering and childishly excitable natures of the lake shore. Twice only did we

see great chiefs outrage "form" by being taken off their guard. The first time was when a mad dog invaded our Hora camp, on which occasion M'zuka-zuka, of the blood royal, scrambled incontinently from the ground to the summit of a pile of provision cases at the first sound of alarm. Afterwards he descended more slowly, explained his haste by his knowledge of the consequences of a bite from such an animal, and finished by taking snuff with an extra curve of the wrist and tapering of fingers. The second time was at our little fort; of this anon.

The Ngoni, with whom we are now in touch, are the dominant power in the whole of that land between Lake Nyasa and the Loangwa river. Since the track of our expedition lay in this country, a *résumé* of their known history may be useful to the better understanding of their characteristics and customs. In this we must acknowledge great help from Dr. Elmslie's writings, and especially from the personal accounts of Mr. McCallum and Dr. Laws.

The Ngoni, it seems, were originally known as the Hlongwa, and inhabited the Tugela and Umpisi districts of Natal. Here they became subject to Chaka, who allowed them, however, to retain their own chief Zwangendaba. Chaka's rule, never of the gentlest, ultimately became so severe as to be unbearable, and consequently we find that the Hlongwa, probably in the second decade of the present century, fled from their country and struck north, under Zwangendaba, to seek a new home. At about the same time fled also Moselikatsi with his Matabele, and took a similar direction. Whether the two tribes met or not is a matter of doubt. Some maintain that they fought together for the good land which the Matabele now inhabit. Certainly a most tough battle took place years ago between natives south of Zambezi, and, to help the point, on one occasion when Jingujani, an old induna now with Mpeseni, visited us at the fort, we asked him of Moselikatsi. The old man looked surprised, and answered in some excitement—

"Moselikatsi! Speak not to me of Moselikatsi. He killed my people. To me Moselikatsi is dead."

All this in the Zulu tongue and perfectly intelligible to our Zulu interpreters. This would, of course, corroborate the struggle of the tribes; but it is just possible that Jingujani, who was afterwards reticent on the subject, may have had in mind some account of Moselikatsi's doings when under Chaka's rule. Be this as it may, the Hlongwa crossed the Zambezi under Zwangendaba, near where Zumbo now stands, on June 16, 1825. As they crossed "the sun died in the middle of the back of the heavens, and the day was finished." Such memories are permanent with the blacks; they tell them to their generations. The coincidence of the eclipse is certain, and our records, therefore, together with collateral circumstances, give us the date of their crossing. Up they came through the highlands west of Nyasa, plundering, killing, and slaving as they went, driving all before them, until they came to

the Fipa country south-east of Tanganyika. Here they settled for a time, and here Zwangendaba died.

The manner of his death is told by his people with all the simple and dramatic force of their speech.

"Zwangendaba lay sick in his hut. Around him were his sons and the indunas, and he rose up from where he lay and named Mtwaro, his son, chief after him. Then he said to them that he, Zwangendaba, had never seen the white man, but that they would, and when the white man came they were to be friendly to him. And then Zwangendaba became himself like the colour of a white man, and fell down, and his spirit went to the hilltops of the Fipa."



LAKE NYASA, FROM BANDAWE.

All which, being interpreted, means probably that Zwangendaba died syncopated, taking on the peculiar ashen-grey colour that such a condition produces in the light-toned black, and gave utterance to the peculiar prophecy of the white man's coming which has been spoken so many times in Africa by chiefs who have never themselves beheld a white man.

After Zwangendaba's death came internal dissension. Mtwaro was a weakling, and, conscious of it, resigned the power to his brother Mombera, who, strong even in his youth, could yet not control the other sons royal nor the more powerful of his father's indunas. Some of the people elected to continue the northward journey. All communication

between them and the parent stock is now cut off. In 1891 they were living to the south of Victoria Nyanza, and offered a temporary resistance to Lieutenant von Siegl, when that officer proceeded to occupy Taborah. Stairs, in his expedition to Katangaland, saw some of them at this latter place. They were called "Wangoni," and described as "bearing on their head busbies like those of our Foot Guards, but made of feathers instead of bearskin. Their arms consisted of three heavy spears and a shield of buffalo hide. . . ." A like spectacle to those we ourselves came across at Hora and in Mpeseni's country. The main body followed Mombera and his brothers southward to the land which they now occupy, and were subsequently joined by a moiety which had continued for a little time in the Fipa district under Mperembe. Thus was founded the Ngoni kingdom round about Hora.

A second period of disruption led to the migration of a large portion of the tribe towards the headwaters of the Tembwe, Sandile, Mkumbwa, and neighbouring tributaries of the Loangwa, where they are now firmly established under the rule of Mpeseni. At the same time a further number followed the headman Chiwere to the hill district south-west from Kotakota. Few, if any, of Zwangendaba's people are to be found elsewhere, although the followers of the late Chekuse, in the country south of Nyasa and west of the main waterway, took the same tribal name.

The change of name in the original tribe is to be noted. At first the Hlongwa, with the clan designation "Pakati," they now call themselves Ngoni, with the clan name "Jeri"—the latter taken from a tribe enslaved in the Fipa district, upon whom they impressed their own name of Pakati. The clan name "Jeri" is used at the present day by all those of Mombera's people who boast the blood royal. The Tumbuka and Nyanja people knew them also as Mazitu and Maviti, both names indicative of those roving, predatory habits which were only too palpable to their neighbours.

Such in brief is the early history of the Ngoni. The evidences of their Zulu origin are indisputable—their appearance and bearing; their traditions and superstitions; their speech, modified a little by contact with other tribes, and with some of the "clicks" gone, but still undoubtedly Zulu; their customs and habits of life; their prominence in warfare; their idea of building up a powerful tribe by bringing the people around into a state of domestic slavery, and training up as warriors the most promising of the young men.

Present politics at Hora are in a state of some uncertainty, owing to the lack of a paramount chief. Mtwaro died seven years ago from what was probably tuberculosis of the knee-joint. In consequence of his death, the few white men connected with the mission work in the country ran a peculiar risk, although at the time they knew it not. Witchcraft was suspected, and an ordeal by *muave* or *mtau* ordained.

This means the drinking of a decoction of bark containing active principles akin to those of *strophanthus*, and which results either in vomiting or death. People may be represented at an ordeal by animals, to whom the drug is administered in pellets; thus, at the trial in question, McCallum was present in the shape of a fowl, which had been begged from him as a gift, and other whites were there as dogs and goats. The results are probably largely under the control of the compounders of *muave*, who, by dosage or admixture with an emetic root,



NATIVE IRON-SMELTING FURNACE.

can regulate the action of the poison. The burden of Mtwaro's death was finally laid at the door of an inoffensive old native whose condemnation involved no further issues.

Monbera died in 1891 from apoplexy, leaving sons who were then mere children. Since that time affairs have been controlled by a council, at the head of which is Ngonomo, the chief of the late king's indunas. A fine old man he is, well over 6 feet in height, and erect despite his age. His life must indeed have been a strange and adventurous one.

A mere commoner, raising himself to the position of leader of Mombera's forces, and holding now the most influential position among a people jealous of their rights and respecting rank to the full, can only be a man of diplomacy and skill. His demeanour, his oratorical deliverances to those around him, which, not understood by those of us who had the luck to hear him, nevertheless impressed us by their sound and gesture; the evident deference paid to him, by even his superiors in blood, show all this. The time is now ripe, however, for the choosing of a new chief from Mombera's sons, and during our stay at Hora, a meeting, the third of its kind, was held for this purpose. The individual interests of Mombera's surviving brothers, who object to being ruled by a young nephew, combined with Ngonomo's grasp of power, rendered the whole thing a fiasco; and there are good grounds for believing that the latter used the fact of our presence as a powerful argument for the purpose of prolonging his regency. He refused to visit our camp while the main body was there, although he had been most friendly to our advance party and had entertained them at his kraal; and subsequently, when the main body had left, came in and hobnobbed with the rear-guard. We could never bring him further than a promise—a promise always evaded by an excuse. One day he was sick, another he had gone on a journey to worship at the grave of his fathers, and yet again he professed to have taken umbrage at one of his sons having been challenged by a sentry. Thus he went to the council with a free hand, excited his hearers by declaring that our presence meant war with which a young chief could not cope, and ended up by a dance at his kraal in which the spears were shaken in the direction of our camp. Possibly he was just as assiduous afterwards in cooling the heated blood.

Six months later, after the Mwasi attack, he showed some respect for the demands of the Administration by refusing sanctuary to the fugitive Chibisa; and, at the same time, messages in a friendly tone were transmitted through the Administration messengers by M'zuka-zuka and others of the Jeri.

It was our intention, upon leaving Hora, to throw out a wing from the expedition, which, travelling light, should proceed directly to the Loangwa, then cross that river and continue down its further bank to rejoin the main column towards the south of the plateau. Unfortunately, this effort proved abortive. In three days our men reached Kasembi's villages on the upper branches of the Bukuru, and that chieftainess assured them repeatedly that the next water towards the west at this particular season was distant a full five days' march. The look of the country, a long gentle rise away from the river to the horizon, was confirmatory of the report. Carriers firmly refused to proceed under any inducement whatever, and the project was therefore reluctantly abandoned.

The caravan now turned south, marching in three bodies by different

routes to Kasungu. Signal fires on hills by night showed that Ngonomo watched our exit from the country. One of us who retraced his steps after three days' journey, found all outlying villages closed, and met a small party of young warriors in all their panoply, who, however, were passive. Rumour had it that concerted action had been arranged between Ngonomo and the Kasungu chief; but the native tale as usual bore its huge discount, and we passed unmolested. Probably it was all a little act played to the gallery as the last scene in Ngonomo's artful drama.

Leaving the immediate plain of Hora, the country became broken—small hills with intersecting watercourses, with here and there great



CARAVAN ON THE MARCH.

rich-looking vlees. All the channels were now dry, the course of the wet-season streams, in many cases evidently of considerable volume, being represented by an occasional water-hole. This continued for two days, when we crossed the Mazimba river and passed Mosoro's. Then succeeded six days of thickly wooded country. Elephant spoor was here seen for the first time, a herd having crossed the path but a little while previously. The rate of march, forced by scarcity of possible camping-grounds, precluded much lateral search; but evidence of previous occupation existed in the shape of numerous disused iron-smelting furnaces, which all showed signs of hasty abandonment, charcoal and calcined ore being strewn about, together with cooking-pots and grass baskets.

The working of iron is certainly the most advanced art in this region of Africa. The ore is mined, smelted, and fashioned by the natives with great skill. Outside many of the villages stands the village smithy, merely a roof of shade boughs and grass supported by stakes. Here congregate the village gossips, who justify their presence by an occasional turn at the bellows. The tools are primitive, a rock for an anvil, a weighty stone for the sledge, and pieces of iron bound to wooden handles for the finer shaping and ornamental work. The bellows consist of two goatskins, each furnished with an open mouth like a purse, and connected up by a piece of bamboo pipe to a narrow clay union nozzle about 9 inches long. The blower sits on the ground, seizes the mouth of each skin in either hand, and raises and lowers them alternately, first with the mouth open and with a quick upward stroke to take in the air, then with the mouth closed and a tremulous downward pressure to force the blast. By this rude process, a hot charcoal fire is maintained, and the work turned out is excellent for the primitive implements used. Knives of great utility, and which take a good rough cutting edge; arrowheads and spears, many of them curiously barbed and twisted, and some showing a knowledge of the value of the "blood-groove;" axes for battle and for general purposes, ornamented with linear patterns and beaded edges, and with the blades set at an acute angle to the shaft so that every ounce of power is transmitted in the direction of the blow.

Kasungu derives its name from a hill, which rears its solitary head in the centre of a populous flat some 80 square miles in area. Its summit we found to be 4784 feet above sea-level, whilst our camp near its base was 3337 feet. The inhabitants of the district are a mixed race, chiefly Wachewa, and the chief Mwasi by no means commanded our admiration.

His position was certainly not an enviable one, his territory forming as it were a kind of buffer state between Mombera's Ngoni and those under Mpeseni in the south. To both of these he paid tribute, and further complications arose from the fact that he was swayed to a great extent by Arab influence. At the time of our arrival he was affording refuge to Saidi Mazungu, an Arab who some years ago was guilty of murderous treachery towards white men at Fort Maguire. The later development is told in the recount of the Nyasaland Administration during 1896, when it was found necessary to occupy his country and to punish him for his misdeeds. On this occasion he turned out an army computed at 18,000 men, not a surprising number when one considers the many villages then under his rule.

The Kasungu people defend their villages with a thick hedge of a species of euphorbia, or in some cases with a trench and earthwork. One such, Mangwasa's by name, was a perfect labyrinth of ant-clay walls. In the centre stood a high pole, on the top of which was perched

a very large and repulsive ape. This beast was evidently carefully fed and tended by the inhabitants—a strange thing, for these low-type savages are, as a rule, by no means attentive to the well-being of unproductive animals.

Many of Mwasi's people profess Mohammedanism, probably from contact with Jumbo's town and the Arab influence at Kotakota, on Lake Nyasa. Their religious principles, however, are crude and eminently elastic, stretching quite beyond the teachings of the great sanitarian, who seems to be credited here with more of vice than of virtue. A few symbols of Phallic worship, existing in hut decoration, were interesting; but, like the opposed triangles with their containing circle, or the



RIVER SCENE.

horseshoe on the stable door at home, they were "caviare to the general."

Comparing the Ngoni with the weaker tribes, such as the Wachewa or Wabisa, one could not help but notice their greater manliness. Had they any wish to conceal information, then they avoided the camp; had they objection to our presence, then they thought of driving us out by fighting. On the other hand, Mwasi, professedly unfriendly to and mistrusting the white man, visited us, begged cloth from us, and finally served up poisoned milk. Whatever of courage he and his people as a whole possessed was certainly of the negative type.

Emerging from the Kasungu plain and travelling west, no more natives are met with until Chenunda's kraal on the Rukusi. On the way thither the watershed is crossed at an elevation of 3800 feet above

sea-level, the rivers on the east being tributary to Lake Nyasa, those on the west flowing into the Loangwa and Zambezi rivers. Quartz and granite now disappear, giving way to shale and schist. The watershed is taken as the boundary between the British Central African Protectorate and the British South Africa Company's territory.

Chenunda is quite an insignificant chief. His few villages seem to be a kind of training-ground for the young bloods of Mpeseni's Ngoni. It was quite a common occurrence for a small band of them, perhaps no more than a dozen in number and on their own initiative, to rush a kraal at dawn, seize whatever took their fancy, assegai opposers, and clear off before the neighbours could collect to help, with their spoil of women and food. The poor inhabitants seem paralyzed for the time, and respond with a fitful fire from their few ancient flint-locks—a kind of warfare with minimum danger. Just before our arrival a raid had taken place. The Ngoni left behind one of their number prisoner, a boy whose father had taken him out "hunting." His captors dare not kill him, for well they knew the Ngoni revenge, and so they waited for a day or two until the raiders returned with their chief, and ransomed the lad with their own stolen goods. Such the "blooding" of the youngster!

Chenunda's people were on the verge of famine, all ill-fed, and many of them mere skeletons. This seemed to be the usual condition towards the latter end of the dry season. Not that the land was harsh, but because excessive planting and large crops simply excited the cupidity of the Ngoni. Thus their labour was limited to the growing of a simple necessity. They possessed no cattle; a few goats and fat-tailed sheep, with some fowls and pigeons, represented the extent of their live stock.

The country here is again attractive to the prospector. Quartz reefs abound, frequently iron-capped and invariably running north-east and south-west. Granite once more appears.

As the dry season was at this time well advanced, water became more scarce, and longer marches were necessary. The expedition now consisted of nine white men, one hundred "askari" (soldiers), and five hundred carriers. With such a large number the pace was of course slow, and we were obliged on one occasion to travel all night to reach the next camping-ground. On this march the degree of accuracy with which the native can space time was strikingly shown. The tripod of a Maxim gun had to be carried in one piece. This was a rather heavy load for one man, so two were told off to relieve one another at intervals of a sentry watch. They were left entirely to themselves. The first change was made at 2 a.m., with a cloudless, brilliant, starry sky, within one minute of the two hours; the second change at 4 a.m., with a bright moonlight, within five minutes; the third change at 6 a.m., with the sun's disc just appearing, within fifteen minutes. Doubtless,

knowledge of the position and movements of the stars enabled the above accuracy to be obtained, while the uncertain light of dawn possibly caused the greater error. The natives certainly recognize some of the constellations and give them names. A few of them were able to make diagrams on the ground of the relative positions of the component stars. Venus, in their language, they call "the wanderer of the night." The moon is to them all important, the "birth" of a new moon being quite an event, and the first view thereof the signal for a great chorus of salutation and rejoicing. The phases are recognized and accurately calculated. Some maintain that the earth is round, others that it is flat,



WALL OF KAMBWIRE'S KRAAL, FROM INSIDE.

but all are excellent in woodcraft and are rarely in error over a compass point.

The march from Chenunda's to our destination at Mafuta's was really hard. The heat was trying even to the blacks, who were forced to fashion rude sandals of goatskin to protect their feet from the scorching of the ground. Food was scarce, the spoils of the rifle became luxuries, for the pest, now in the south, had swept the country, destroying cattle, buck, and even elephants on its resistless progress from the north to the Zambezi. Water was our chief anxiety; the supply was very small, and that not above suspicion of things which thirst alone could disregard. Fortunately, the memory of privation is short, and

one can laugh now at the recollection of one member, the anniversary of whose natal day brought him a solitary meal of a cupful of Indian corn enriched by a bony, "smelly" catfish, caught by luck in a mud-hole.

Thirty miles down the Rukusi brought us to Kambwire's. This place is on what formerly was the main slave route from the Lake Bangweolo district of Central Africa to the coast *via* Lake Nyasa. The energetic action of the officials of the British Central Africa Administration has caused this to be abandoned, and whatever traffic may remain is now diverted chiefly into Portuguese territory. Matakenya, a Portuguese half-caste, who was the principal raider, has also lately died, and we may hope, therefore, that with the advent of the white man the last traces will disappear.

Approaching the villages, we were greeted by the sound of an enormous war-drum, made entirely of wood, carved and hollowed from a single trunk, and borne by two men on a shoulder pole. The chief himself, to whom advance messengers had been sent, attended to give us welcome (?). He sat with his headmen out on the plain, in the shadow of a great Mbawa tree. In this spot we eventually pitched our camp, and a most uncomfortable camp it was. The wind got up each morning about 9 a.m., a hot sickly wind with a choking dust which effectually dispersed whatever of energy the cool of dawn had given. Often it took the form of a whirlwind and then ensued a very nasty few minutes. Sand in clouds which prevented sight, a rush of askari, and the hanging on to gny-ropes and end poles; afterwards, the crawling out from collapsed tents, eyes, ears, mouth, and nostrils choked, with the hunting for scattered kit, and a mourn over the lost comforts of a smashed camp-bed.

Kambwire is a slight, rather aristocratic-looking personage, with delicate taper hands and small feet. He smoked his pipe with quite the grand air, and always had a retinue of body-servants to minister to his wants. Locomotion was performed on the shoulders of a sturdy slave, with a once gorgeous state umbrella between his majesty and the sun. The cares of government sat heavily on the old man. Mpeseni's Ngoni were a thorn in his side and necessitated perpetual vigilance.

A feud with his neighbour Chuaula, of the Sandile river, might at one time have been a relief, but just then Chuaula was having the best of it, *i.e.* he was five women captives and a few tusks of ivory to the good, and Kambwire therefore invoked our aid to patch up a peace. His kraal was surrounded by a mud wall some 12 to 15 feet high, loopholed and parapetted for attack; but the whole scheme of defence was deficient, inasmuch as the wall served not only as fortification, but also as the outer containing boundary of a ring of square huts whose roofs were of most inflammable grass. The inhabitants, chiefly Wabisa, were a mixed lot, due to slave-traders having left behind the sick and weak of their caravans. A peculiarity was the large number of men with only

one eye. It seems that the chief delighted to punish, and a favourite penalty was the boring of eyes with bamboo spikes or the heated blades of assagais.

Opportunity was taken to send a branch expedition down the Rukusi river to its junction with the Loangwa river. This latter, at the time of our visit, was low.

Some idea of the volume of water, and the difference between the dry weather and rainy season flow, may be gathered from the cross-section shown. When measured on November 8, a man could walk across, and the water was nowhere more than 18 inches in depth. The banks are 40 feet in height, and the country beyond them is flooded during the



CAMP AT LOANGWA RIVER.

rains. There is thus, taking the measured breadth of the river-bed, a volume of water of at least 44,000 square feet in sectional area, as against a trickling stream in the dry season. The adjacent land is level for some distance on either side of the river—on the east, covered with a low poor scrub; on the west, more densely wooded, but with open glades.

From Kambwire's we proceeded to Chuaula's, on the Sandile river. This road illustrated well the winding course of a native path. In the course of one day, for example, the column marched west, south, then north-east, and finally took its proper direction of south-west.

One camp *en route* was made at the Mchire or Salt river, a small

stream of the purest and brightest-looking water we saw in Africa. Its appearance was delusive; it contained in solution salts of high specific gravity, and although not entirely unpleasant to the taste, yet it tended to increase an already aggravating thirst. Bubbling up from springs in a sheltered coppice, it ran a short course, and then sank into a great hummocky "sponge," where travelling was dangerous, inasmuch as apparently sound turf formed but a thin crust over a slimy bog. The supply must be perennial. Game in great variety had congregated here for the sake of water.

Chuaula is an independent Wabisa chief, of much the same standing as Kambwire, and with subjects of a similar mixed type. He too is raided by Mpeseni's Ngoni and defends his villages by dense thickets and bamboo palisades. Only a small portion of land was under cultivation, just sufficient to supply the tribe with food. The same arguments against extensive planting hold here as at Chenunda's and Kambwire's. At Mwasi's alone, of all the places out of Ngoniland, was there any food to spare at the end of the dry season, and this for the reason that Mwasi's people were numerous enough to make resistance to raiding-parties, and that Mwasi had patched up a *modus vivendi* both with Ngonomo and Mpeseni.

The Sandile river was at this time quite dry, but water could be obtained by digging at a depth of 3 feet. Curiously enough, we found here a regular cloth industry. Cotton is grown, spun, and woven on a primitive loom into a strong and serviceable calico, which is worn either in its natural grey colour or dyed to a black. The knowledge of the art is probably the fruit of Arab intercourse. The people as a whole were very miserable and poor. Many of them showed mutilation, for Chuaula keeps a kind of execution grove where justice (?) is dispensed, and extremities lopped off for the slightest offence. Of the carriers recruited here, some had lost one hand and a few both. Our camp was visited by a professional dancer in this latter condition. It seems that, when dancing before Chuaula, one of his wives pressed forward and obstructed the chief's view. This was the offence, and the want of respect on the part of his family was visited upon him. The rude surgery of the battle-axe gave good results as far as the stumps went, but the loss of hands under the circumstances of life is simply an atrocious penalty.

From Chuaula's, while the main column took its way into Mpeseni's country, a small party proceeded under Lieut. Biscoe to the south and west. Msoro on the Rupande, Bendwe on the Komongereri, and Momba on the Lusengazi were visited and their positions fixed. The inhabitants thereof were friendly and hospitable, although they had never seen the white man before.

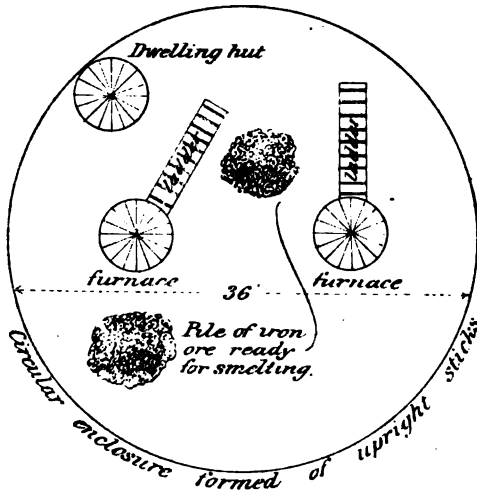
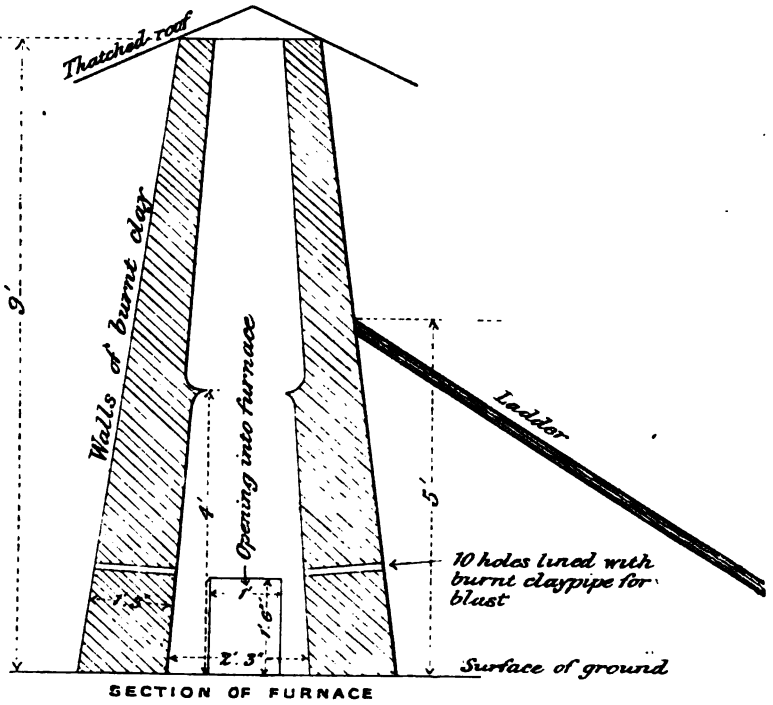
The wet season was now commencing in earnest. The first rain came in the shape of a premonitory shower on October 6, after which the gathered clouds dispersed and we experienced intensely hot, dry

weather. Screen thermometers at the Kambwire camp gave a temperature of 108°. The majority of the clinical thermometers, graduated to 110°, were found broken by expansion of the mercury; they had been stored, however, in Congo cases which were painted in dark colours. On November 24 came a sudden and terrific thunderstorm, after which the rains were more and more regular until we looked for a downpour each afternoon, lasting as a rule from 2 p.m. until sundown. So on, with the exception of a fortnight's cessation in the middle of January, until the end of April, when lighter showers betokened the beginning of the dry weather. The rainfall in 1895-96 was particularly heavy, as shown by the excessive flooding of the Loangwa tributaries and also by the greater rise in Lake Nyasa and the Shire river.



LOANGWA RIVER.

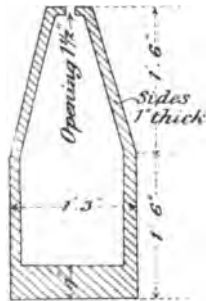
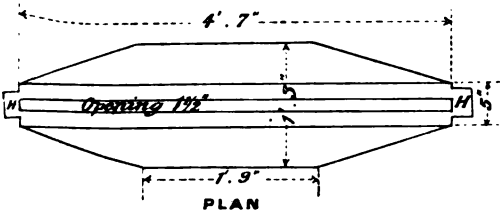
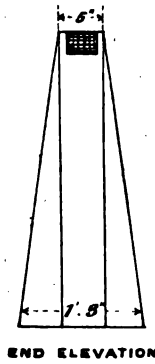
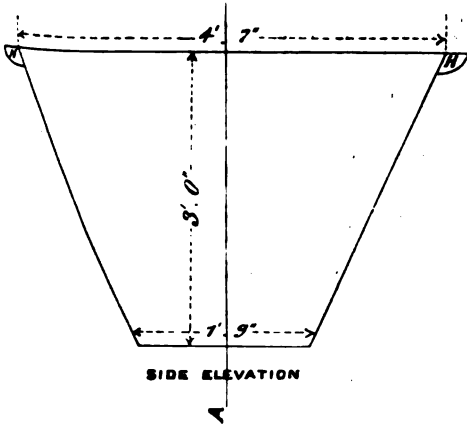
Our approach to Mpeseni's country was made under better circumstances than we had anticipated. Mpeseni bears an evil reputation—perhaps deserved, and possibly exaggerated. Joseph Thomson, who visited him on his return from the Bangweolo Expedition in 1890, was fain to get away under cover of night. Mr. Sharpe, now acting commissioner of the British Central Africa Protectorate, also had an unsatisfactory time. Ground for alarm certainly existed in each case; it is very doubtful, however, whether Mpeseni himself at the time gave any aggressive orders or was guilty of any manifestation of bad will towards the whites. We received a more cordial reception. Advance messengers were despatched with a present of coloured prints, Arab



NATIVE SMELTING FURNACE (DISUSED)

cloths, and other things dear to the savage heart; and in return Mpeseni sent out two sub-chiefs, who brought gifts of cattle and sheep and acted as guides on the way.

When the country of the Ngoni was entered, it was evident that we



Carried slung on a pole by ropes through handles H.H.



KAMBWIRE'S DRUM.

were once again amongst an active and energetic people under a powerful chief, and where life and property were secure. We were reminded much of the condition of things at Hora: we had again the fertile plains, the hill ranges, the rushing rivers, and the high veldt beloved

of the Ngoni. Villages lay thick on the ground, free from the confining limits of a ditch or palisade, disdaining for the most part even the protection of a reed wind-break. The whole of the land, hillsides too, were cleared and prepared for the maize crops. Cattle, sheep, and goats were in plenty; but here, as elsewhere, the pest had left a mark not yet effaced. The inhabitants were most friendly, providing what ever additional carriers we needed and the chiefs escorting us from camp to camp.

Finally, on December 5, the expedition arrived at its destination—a small village of three kraals under the tributary chief Mafuta. The position was good in every way—lie of land, supply of running water, timber for building purposes, communication with the lake-shore by an easy and direct road, and, lastly, command of the gut leading between the hills into the breadth of Central Ngoniland. Rains and swollen rivers forbade further marching, so here we fixed our camp at an altitude of 3300 feet above sea-level and commenced the building of permanent quarters.

Whilst this was proceeding, Dr. Moloney, accompanied by Lieut. Biscoe, paid a formal visit to Mpeseni. They were received in the king's hut, and were the first white men to be so honoured. Even then Mpeseni could not, or would not, throw off superstition; he refused to look upon the white man's face, and sat with his back towards them during the short palaver. Nothing of importance transpired, and it was reserved for subsequent visitors from our party to learn more of the personality of this renowned chief.

On December 29, Dr. Moloney and two others of the expedition left Mafuta's for the lake-shore. Those remaining proceeded with the construction of the fort. A site was chosen crowning the summit of a gentle hill, and with due regard to watering facilities. The dwelling-house was our first care, the floor raised well above the general level of the enclosure; then followed askari's quarters, huts for the capitacs, grain store, a cook-house, and, later, a watch-tower with firing-platform, giving command over the country around. Three rip saws and a cross-cut, matchets, axes, spades, and a chisel or two, were our available tools; forest trees, bamboos, grass and ant-heap clay were the materials. No nails or screws; everything tied together with raw-hide strips and "njombo" bark.

The general plan of the fort was diamond-shaped, with a bastion at each acute angle for the lodgment of the Maxims. The defence consisted of an earthwork thrown up against piles, and measuring 10 feet from the bottom of the trench. The trench itself was 5 feet deep, with a level bottom 6 feet wide, and a sloping outer wall and parapet carrying the total breadth to 20 feet. Bush was cleared away where necessary to a distance of 400 yards, all tree-stumps being left projecting a foot or so above the ground.

A second visit was paid to Mpeseni at his own invitation. His manners were certainly not cordial, but on this occasion he unbent so far as to visit the white man's tent quite unattended and to hold a long conversation. He claims to be the eldest son of Zwangendaba, and so regards himself as *the* Ngoni chief. When asked if Mtwaro were not the first-born, he gave a typical reply, "As the cow to the calf, as the elephant to the cow, so was I, Mpeseni, to Mtwaro."

His appearance is not prepossessing. His facial type is low, and a corneal opacity in one eye combines with a shifty light in the other to accentuate the natural cunning and cruel look of his countenance. His power is very real; none of his people dare approach him without



LOANGWA RIVER.

bending the knee and giving the royal salute, "Bayete." His approach to council is signalled by a verbal trumpeter, who thunders forth his attributes and titles with all the quaint inferences and parallels of their language. He was more than astonished at the mention of the incident of the Zambezi eclipse.

"You," said he; "how did you know that?" and, indicating a height with his hand, "you must have been quite small then—so!"

Considering the date, we agreed that we were then very small, and Mpeseni became probably more convinced than ever that the white man was full of witchcraft. For a time all went smoothly. Various indunas were constant visitors, and brought for our use presents of milk, pombé,

pumpkins, Indian corn, sweet potatoes, fowls, fat-tailed sheep, and goats, so that we grew quite rich in native wealth and revelled in the unwonted luxury of our table.

By-and-by, however, things began to change. The chief men stopped their visits; the native boys employed around the camp as goat-herds, etc., went back to their homes; a vague uneasiness began to spread among our own soldiers, and all kinds of rumours were brought to our ears. Gradually it was manifest that Mpeseni had, for some reason, taken alarm, and the explanation came when we heard of the attacks upon Mlosi and Mwasi by the Administration. Mpeseni, in consequence, naturally thought that our presence was the prelude to his own destruction and began to collect his young men. Things were not improved by the fact that Chibisa, brother of Mwasi and fugitive from justice after the Kasungu fight, being rejected at Hora, had come for refuge to Mpeseni's country. He, of course, urged our destruction, and found a ready ally in Singu, Mpeseni's son and leader of his fighting men. Fortunately, Mpeseni is still in the prime of life and vetoed Singu's precipitate schemes.

Needless to recount the various "excursions and alarms." The tension continued, and reached its crisis upon the arrival of representatives of the British South Africa Company, who had come up to take over the fort and to administer the country therefrom. Their coming was a thing to be remembered. Four Atonga troops arrived early in the morning with the news that two white men, with some soldiers and a big gun, had crossed the Sandile river and were travelling fast towards us. About mid-day we heard the signal rifles go and lined up our own squad ready for the "salute." The path ran clear from the fort for some 300 yards, and then bent and disappeared behind a native village. At this bend stationed himself our "drum major." Suddenly, amidst the silence of expectation, he started his devilish tattoo, and a moment later round swung Warringham and Middleton, two great bronzed colonial giants, each well over 6 feet, and we saw strange white faces and welcomed our relief exactly a year to the day from the start of the expedition.

Two days later came a great "indaba." Mpeseni sent to the fort, as his representatives, the indunas Jingujani, Manota, Lisiao, Nyama, and Newkwa, together with sub-chiefs and their followers to the number of a hundred or so. They all squatted in and about the verandah of our house, Jingujani and Manota nearest the white men, for they, by virtue of age and rank, were to be the spokesmen of the party. A little shuffling and rearrangement of seats, the taking of much snuff, and then Jingujani began a long speech, the burden of which was that Mpeseni wished to be friendly with the white men, but was not afraid to meet him in war, if such were necessary. Manota followed in the same strain and was supported by the other indunas. Then came a judicious

reply from ourselves, which finished the formal part of the palaver; all hitherto conducted in proper style and etiquette and with the help of two interpreters, the first of whom translated from the Zulu to Chinyanja, and the second from the Chinyanja to Swahili. This for effect.

Now, Warringham and Middleton were perfect Zulu scholars, and when this part of the "indaba" was finished, they turned round, the one to Jingujani, and the other to Manota, and commenced a conversation in the purest Zulu. A look of astonishment gradually gave place to an expression of perfect amazement, and then succeeded great exclamations of surprise, followed by a rush and a violent shaking of hands. Know-



VILLAGE SCENE, KOTA-KOTA.

ledge of their own language quite conquered the old indunas, who at once lost all reserve and wound up the day with a feast from a slaughtered ox.

After this all was peace, and the time came, when the rains were finished, for our return to the coast. Leaving Mafuta's, we took a direct route through Mwasi's to the lake-shore. The path is easy the whole way, and it would be possible, with expenditure of a little engineering skill in dealing with a few of the gradients towards the eastern edge of the plateau, to transform it into a good practicable waggon-road. At Kasungu a fort had been built by the Administration, from which the surrounding country was controlled. Communication between this and Kotakota is constant, and extension thereof to Fort Jameson will open

up a great stretch of fertile land, perfectly suited for the most part for occupation by Europeans and rich in many things.

Arrived at Kotakota, we were received by Mr. A. J. Swann, the government representative, who extended to us the most welcome and kindly hospitality, and did all in his power to help our progress down the lake. The waterway was followed, as on our entrance into the country, with the necessary divergence into the Shire highlands and touching Blantyre for the purpose of avoiding the Murchison cataracts. Chinde was the point of embarkation. Before leaving, we visited the little cemetery, only too largely grown of late, and were gratified to find that the grave of Captain Stairs is now marked by a fitting tribute to his memory.

THE MAP.—The authors are indebted to the Rhodesia Concessions, Limited, for permission to make use of the map and notes collected while in their service, and to Lieut. Biscoe for the use of his photographs. The map was made from astronomical observations taken by R. I. Money and Lieut. Biscoe, the positions being determined on the spot from these observations, which were worked out by R. I. Money, and on his return to England, after having his instruments examined at Kew, the observations were corrected and worked out anew. Barometrical and boiling point thermometer heights were likewise worked out on the spot, and again on his return to England after receiving the corrections from Kew. The track surveys made with a prismatic compass were adjusted to the positions fixed by astronomical observations.

APPENDIX.

NOTES AS TO MEASUREMENT OF DISTANCES.

A mile was carefully measured along a level but loose sandy road at Fort Johnston. Traversing this several times in marching order gave, as a basis for calculating distances, 1920 paces and 18 minutes to the mile. To this number of paces the pedometers were adjusted. In the rough country between Bandawe and Hora, where there was a good deal of stiff climbing, the pedometers, worn attached to the waist-belt, proved quite unreliable, recording a much less distance than that actually traversed. On the route from Mafuta's to Kotakota, where the country offered few obstacles to an even rate of marching, the pedometer, when worn inside and attached to the top of a canvas gaiter, recorded from 18 to 40 per cent. in excess of a time measurement. It was found that the average rate of a column of porters with loads, taken for a whole day in cool weather, or from 6 a.m. to noon in hot weather, excluding stops, averaged $2\frac{1}{2}$ miles per hour. At the first start they set off at about 3 miles an hour, but by the end of the first half-hour they had generally settled down to a steady pace of $2\frac{1}{2}$ miles. For the purpose of plotting the track surveys, a time measurement of $2\frac{1}{2}$ miles per hour was adopted. This time measurement generally gave an excess of from 10 to 15 per cent. over the distance as fixed by astronomical observations, which was doubtless due to the winding nature of the native paths.

ASTRONOMICAL OBSERVATIONS.

	Latitude S.			Longitude E.			Remarks.
	°	'	"	°	'	"	
Hora	11	39	46	83	32	4	{ Longitude mean of three observations Latitude mean, three observations
Kasungu	13	1	23	33	12	20	
Chenunda's	13	9	58	32	28	27	{ Longitude mean of three observations Latitude mean, one observation
Kambwire's	12	51	50	32	10	15	
Chusula's	13	8	48	31	54	57	{ Longitude mean of five observations Latitude mean, one observation
Mafuta's	13	32	17	—			
Kotakota	12	54	36	34	16	27	{ Longitude mean of two observations Latitude mean, one observation

VARIATION OF THE COMPASS.

	°	'
Fort Johnston	13	53 W.
Bandawe	12	25 W.
Kasungu	9	38 W.
Kotakota	13	26 W.

HEIGHTS BY BOILING-POINT THERMOMETER.

Place.	Height above mean sea-level.	Remarks.
	Feet.	
Hora	4710	Mean of five observations
Kasungu	3325	
Kasungu hill (top)	4784	" two "
Lungazi river	3140	
Diwa river	3355	Mean of two observations
Chenunda's	2972	
Kambwire's	1890	" three "
Loangwa river (top of east bank)	1791	
Mchire river	1903	" two "
Msansara river	1903	
Chusula's	1899	Mean of two observations
Chikwa river	2147	
Chikwawa river	2945	" three "
Uonae hill (at foot)	3287	
Dekasu's kraal	2911	Mean of two observations
Kudugwa's kraal	3503	
Mafuta's	3300	In Fort Jameson
Camp by Bukusi river	3438	
Camp 42	3696	Mean of three observations
Camp 43	3652	
Kimongo river	3894	Mean of three observations
Camp 46	3859	
Bua river	2372	Mean of three observations
Kotakota (on shore at lake)	1508	

TEMPERATURES.

Place.	Height above sea-level.	Month.	Shade.		Remarks.
			Maximum.	Minimum.	
	Feet.		°	°	
Chinde	—	June	72	61	In hotel room
On Shire river boat	—	July	81	59	In cabin of boat
Mandala	3300	"	87	66	In house
Matope	—	"	75	65	"
On upper Shire river	—	"	77	58	In cabin of boat
Fort Johnston	1450	"	91	58	In tent
Bandawe	1600	August	92	52	"
Hora	4710	"	80	54	"
"	—	September	88	51	"
Kasungu	3325	"	87	55	"
"	—	October	95	65	"
Chenunda's	2972	"	104	65	"
Chuaula's	1900	November	109	67	"
Mafuta's	3300	December	89	64	"
Kotakota	1580	January	93	70	In fort
Mandala... ..	3418	"	79	70	In house
"	—	February	76	68	"

RECENT AFRICAN LITERATURE.

By E. HEAWOOD, M.A.

THAT the age of great exploring journeys in Africa is well-nigh over, and its place taken by one of steady political development, is shown by a glance at the principal African books of the past few months, a large proportion of which deal with the extension or maintenance of European influence in one quarter or another of the continent.

Our list is, however, headed by the record of a journey * which, from the extent of little-known country traversed, seems to belong rather to the past than the present order of things. Dr. Donaldson Smith has much to tell of dangers and difficulties successfully overcome, whether arising from the determined opposition of Abyssinian soldiery, the fierce attacks of Galla tribes, or the necessity of journeying through trackless forests or waterless deserts. The book is written in a lively and piquant style, and—possibly from the author's readiness to look at the bright side of things, and his appreciation of the untrammelled life in the African wilds—we carry away from its perusal a far pleasanter picture of Central Africa than is supplied by many books of travel. He speaks in high terms of the beauty and healthiness of much of the country, and lays stress on its commercial and agricultural value. Sportsmen will find much to their taste in Dr. Smith's numerous rencontres with the large game of North-East Africa, with which his rifle played constant havoc.

* 'Through Unknown African Countries.' By A. Donaldson Smith, M.D., F.R.C.S. Illustrated. London: Arnold, 1897.

Unlike some recent writers, he puts much faith in the express rifle (the .577), which he preferred to the eight-bore even against elephants and rhinoceros. The geographical results of the journey have already been so fully dealt with in our pages that it is needless to refer to them here. It may, however, be remarked that the difficulty Dr. Smith finds in supposing the Omo to make itself a way westward across the barrier of mountains seen to the north of Lake Abbaya does not exist if, as seems probable and is indicated in a recent map published in *Petermanns Mitteilungen*, the whole course of the river lies to the westward of the range.

Dr. Smith came in contact with many interesting tribes, from the powerful Boran Gallas to the Dume pygmies and the Adone negroes of the Jub. He shows a genuine liking for his Somali followers, and a quick apprehension of the various traits of character exhibited by the races met with. In a supplementary chapter he gives his views with regard to the present political situation in the countries he passed through, differing materially in his conclusions from other recent writers. He urges the necessity of curbing the arrogant pretensions of King Menelek to sovereignty in the countries south of Abyssinia, and holds that all civilized nations should concur in putting down the "brutal rule" of that sovereign. He considers that the Abyssinians would be unable to resist a well-organized force brought against them. The book is well illustrated, and contains, in appendices, reports by various scientists on the zoological and other collections made by the author. The maps are those already published in this *Journal*.

In Mr. Selous's latest book,* we have a narrative of the earlier stages of the Matabele insurrection by one who not only took a large part himself in the events recorded, but possessed ample opportunity of learning at first hand the details of occurrences at which he was not actually present. But the book is not a mere record of facts. It is useful as presenting the ideas of a shrewd observer on many questions affecting the future of South Africa, and although the author shows a keen sense of the injustice of the accusations which have been levelled against the white settlers, he is evidently actuated by an honest desire to show matters in their true light, and to point the way to a solution of existing problems in accordance with the best interests of the country and its inhabitants, both European and native. As regards the causes of the insurrection, Mr. Selous holds that, while the irksomeness of the labour regulations to a race indolent by nature, and the hardships arising from the rinderpest were important factors in the case, the Matabele were really surprised into revolt, in many cases against their better judgment, by a few leading spirits, who since the former war

* 'Sunshine and Storm in Rhodesia.' By Frederick Courteney Selous. London Rowland Ward. 1896.

had been awaiting an opportunity for revenge. He does not hesitate to avow his opinion that the removal of the white police was the event which made the rising possible, and thinks that with suitable precautions there should be no danger of its repetition. The country, he holds, is bound by the inexorable law of the survival of the fittest to be ruled by the white man, and the black man must either conform to his laws or succumb. The Dutch element is much larger than is generally supposed, and Mr. Selous points with satisfaction to the cordial relations maintained between them and the British during the revolt. The great desideratum in South Africa generally is the encouragement of goodwill between the two races.

Another chapter in the history of the gradual conquest of Africa by the white man is supplied by Captain Hinde,* well known as one of the lieutenants of Baron Dhanis in his successful campaign against the Arabs of the upper Congo in 1892-94. Dealing as it does with a region which may be truly described as one of the dark places of the Earth, it contains of necessity an abundance of harrowing details of bloodshed, cannibalism, and cruelty; but the importance of the events recorded as marking the final struggle for supremacy between European and Arab influence in Central Africa gives a special value to the detailed account of the campaign supplied by the author. Incidentally, much useful information is given with respect to the tribes of the Central Congo basin, one of the most interesting being perhaps that of the Waginia (Wenya or Wagenya of Stanley), the general ferrymen of the upper Congo, who, though spending their life on the water, are very bad swimmers, and do not even make their own canoes. Captain Hinde gives a vivid description of the oppressive stillness of the African forest, bearing out the statements of other observers as to the scarcity of animal life and the sombre tints of the vegetable world. The exploring work carried out by him on the upper Lualaba has already been fully described in the *Journal* (vol. v. pp. 420 *et seq.*).

Although likewise largely a record of fighting, Major Macdonald's book † is less concerned than either of the two last with the more revolting aspects of savage warfare, and, taken as a whole, presents a satisfactory picture of victories won in the cause of civilization in the extensive regions of British South Africa. The many-sided nature of Major Macdonald's work in the country, from his first arrival in 1891 to take charge of the railway survey, to his departure from Uganda in 1894 after the final pacification of that kingdom, makes him peculiarly fitted to write the history of the most momentous period in the

* 'The Fall of the Congo Arabs.' By Sidney Langford Hinde. London: Methuen 1897.

† 'Soldiering and Surveying in British East Africa.' By Major J. B. L. Macdonald, R.E. Maps and Illustrations. London: Arnold. 1897.

establishment of British influence in East Africa, and the completeness of his narrative is enhanced by the care he has taken to record the achievements of all who assisted in the work during the period in question. He gives a clear and unbiassed account of the unfortunate disturbances in Uganda previous to his arrival, based on his careful inquiries made under the direction of Sir Gerald Portal, and bears striking testimony to the great influence for good exercised by the missionaries in that country. He speaks generally in a hopeful vein with regard to the future of British East Africa, and is enthusiastic in his description of the Masai grazing-grounds, with their carpet of white clover, and fertile country waiting for inhabitants. The book contains several maps and some striking illustrations from the author's sketches and from photographs taken during the railway survey.

Under a somewhat misleading title,* Dr. Aurel Schultz describes a journey made over twelve years ago in company with Mr. A. Hammar, from Natal to the region of the Chobe and Okavanga rivers. The book forms a readable account of sport and adventure in South Africa, although the personal incident bears a somewhat large proportion to the geographical detail. It was, of course, only in the neighbourhood of the furthest point reached that any new country was traversed, but the information regarding the Chobe and Okavanga and the country between them is of value by reason of the meagre nature of the information supplied by other travellers to that region. The accounts of the vast herds of wild animals in the neighbourhood of the Chobe recall those of the pioneer travellers in South Africa early in the century. Between the Chobe and the Okavanga the country consisted mainly of dreary sand-belts, in which the travellers suffered from want of water. The latter river was struck at the town of Debabe or Indala—apparently the successor of the chief visited by Green—whose greed and treachery placed the party in some danger. Dr. Schultz speaks in glowing terms of the Okavanga and the country on its banks, and considers that the river is capable of becoming an important highway through the country. Geographically the most interesting point is the question of the bifurcation of the river. Dr. Schultz did not see the diverging-point of the supposed branch to the Chobe, but his conclusions, based on the discovery of an important stream entering the latter river from the west, were confirmed by the native accounts, while the general nature of the country renders such a bifurcation extremely probable. The book contains some good illustrations of scenery, and a map of the route by Bartholomew.

Before passing to works published abroad, mention must be made of the lately issued fourth volume of Mr. Lucas's well-known 'Historical

* 'The New Africa: A Journey up the Chobe and down the Okavanga Rivers.' By Aurel Schultz, M.D., and August Hammar, C.E. London: Heinemann. 1897.

Geography of the British Colonies,'* which relates to South and East Africa. It is divided into two parts, the first historical, the second geographical; and the great political changes which have taken place of late years in this part of the world renders the former particularly valuable. It is enough to say that the reputation for clearness and accuracy attained by the earlier volumes is fully sustained in the present issue.

Foreign works relating to Africa have been less numerous than usual during the past twelve months. Perhaps the most permanently valuable is Dr. K. Dove's account of the scientific results of his journey of 1892-93 in German South-West Africa, which has appeared as a supplementary number of *Petermanns Mitteilungen* (No. 120, 1896).† The journey was undertaken with a view to promoting the economic development of the colony, and particular attention was paid to the study of its climatic conditions as affecting the prospect of settlement by white men. The section devoted to climate is therefore by far the fullest, although many other points connected with the physical and economic geography of the country are also touched upon. Dr. Dove had to choose between securing a complete series of meteorological observations from a restricted area, or less detailed results from a larger extent of country, and, considering the objects in view, he wisely chose the latter, so that we now possess a good general idea of the climate of Southern Damaraland, in every way the most important part of the German territory. The observations also possess a special value from the care which Dr. Dove took to shelter the thermometers from the effects of the solar radiation, the want of which has often vitiated the results obtained by other observers. As in his previous writings, Dr. Dove lays stress on the healthiness of the country, and its suitability for cattle-rearing by settlers possessed of a certain amount of capital. The prospects of success in the working of minerals he regards as extremely doubtful.

Although relating to two of his earlier journeys in the Northern Sahara, M. Foureau's reprint of his official report, originally published in 1893, is to be welcomed on account of the very limited circulation which it then attained.‡ In addition to the traveller's journal, the report contains valuable records of meteorological and other observations, notes on the distribution of plants, etc., and is altogether a solid contribution to our knowledge of the desert regions south of Algeria. It

* Oxford: Clarendon Press. 1897.

† A popular account of the same journey was previously published by Dr. Dove as an independent work, with map and illustrations (Berlin: Allgemeiner Verein für Deutsche Litteratur. 1896). For a summary of the scientific results, see *Journal*, vol. iv. p. 271.

‡ Fernand Foureau, 'Au Sahara: Mes deux Missions de 1892 et 1893.' Paris: Challamel. 1897.

is to be wished that equally full reports of M. Foureau's later journeys may be published. The large-scale map which is added is a reproduction of M. Foureau's original itineraries, and does not contain the corrections introduced by his later journeys, but he hopes to publish in time a map which shall embody the whole of his observations.

Commandant Toutée's voyage of exploration on the middle Niger has been somewhat eclipsed by Lieut. Hourst's recent successful expedition, but the results were none the less valuable, and the account lately published* includes not only the incidents of the journey, but useful information on the peoples of the countries traversed, their manners and customs, industries, etc., as well as on the commercial possibilities of the Niger region. The author thinks highly of the use of the river as a highway to the French Sudan, pointing out that, whereas the journey from Timbuktu to Saint Louis occupies three months, his own return voyage from his farthest point up the river, three-fourths of the distance from the sea to Timbuktu, took only twenty-seven days, in spite of many hindrances. The region of the middle Niger is, he thinks, certainly worth the attention of Europeans in spite of the absence of mineral wealth and the small variety of articles of exchange yet available. It is only, however, powerful companies that will be able to make head against the initial difficulties of commercial enterprise. The map which illustrates the book is, unfortunately, on too small a scale to allow the detail to be clearly legible.

M. E. Foa publishes in separate books accounts of his big-game shooting, and of his travels, in 1891-93 in the Portuguese territory south-west of Lake Nyasa and north of the Zambesi.† This was then new and unknown country, and the existing maps, based on hearsay half-caste information of circ. 1820-1830, are widely wrong. M. Foa is an ardent and indefatigable hunter who has much to say on the habits of his game, and his first and larger work ‡ is extremely lively and interesting. The other book § contains a general account, well suited to French readers, of the various colonies between Cape Town and Lake Nyasa (all of which he touched or traversed), but its description of the new country north of the Zambezi is somewhat meagre, and the small-scale map adds nothing to our knowledge. Starting from Tete, M. Foa made his headquarters on Mount Chuüta, and then near Muchena, where a Portuguese garrison was massacred in 1888 by the chief of Makangaland. He visited Missale near the still undetermined charter-land frontier

* Commandant Toutée, 'Dahomé, Niger, Touareg. Récit de Voyage.' Paris : Colin. 1897.

† This notice of M. Foa's books is by Mr. J. T. Wills.

‡ 'Mes grandes chasses en Afrique Centrale.' Par Ed. Foà. Paris: Fermin Didot. 1897.

§ 'Du Cap au lac Nyassa.' Par Ed. Foà. Paris: Plon. 1897.

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(at about 14° 15' S., 33° E.), where gold-workings were opened and abandoned by some half-caste Tete traders sixty years ago. His previous trip to Undi, whose signature to mineral concessions was at that time in much request, nearly proved fatal. Four rivers cross the uninhabited plain, afterwards joining the Zambezi by one gorge. These were crossed by M. Foa dryshod and thirsty in October, but became impassable and 100 to 200 yards wide in November, so that famine stared him in the face, and he became, besides, embroiled in a native war. Finally, amidst unheard-of difficulties, he arrived at Chuüta after a seventy hours' fast.

A brief reference to one or two less strictly geographical works relating to Africa must suffice. Captain C. de la Jonquière supplies a useful sketch* of the history of the Italian connection with Eritrea, illustrated by maps. He treats the subject in a more dispassioned manner than is usual on the part of French writers on colonial questions, and thinks that Italy may still play an important part in the future of Abyssinia, if she is content to regard the substance rather than the name in her endeavours to make her influence felt. Captain E. de Vasconcellos, secretary of the Lisbon Geographical Society, has issued a succinct account† of the Portuguese colonies in their geographical, political, and economical aspects, the greater part of which naturally refers to Africa. It contains valuable details on the administration and resources of the colonies, based on reliable statistics. It may be noted that the trade of Angola is shown in a more favourable light than in Dr. Esser's paper, lately published by the Berlin Geographical Society.

As the first volume of an Italian scientific series, Giuseppe Sergi has published a detailed study‡ of the Hamitic race in Africa, regarded from a purely anthropological point of view. From an examination of the physical characters of the people of North Africa, especially the form of the skull, on the persistence of which as a race-characteristic he lays much stress, he regards the Hamites as forming, with most of the peoples of South Europe and possibly the Semites, a definite species of mankind, which he names "Eurafrican." Two main branches, the eastern and northern, are to be distinguished in Africa, the dividing-line coinciding roughly with the western limit of the Nile basin. The former includes, among other subdivisions, the Nubians and those of the Nilotic tribes which, in the mixture of races, have acquired the Hamitic characters in the most marked degree. The book is abundantly illustrated with examples of the various groups. In

* 'Les Italiens en Erythrée.' Paris: Charles-Lavauzelle.

† 'As Colonias Portuguezas.' Lisbon: Companhia Nacional Editora. 1896.

‡ 'Biblioteca di Scienze Moderne,' No. 1. 'Africa: Antropologia della Stirpe Camitica.' Turin: Bocca. 1897.

conclusion, a study by J. Toutain of the Roman colonization in North Africa,* issued as a publication of the *Écoles Françaises d'Athènes et de Rome*, deserves mention. Two chapters deal with the geographical position and distribution of the cities, the rest of the work giving a full account of their architectural and other characters, and of the life of their inhabitants.

THE FIRST CROSSING OF SPITSBERGEN.†

THE first achievements of Sir Martin Conway as arctic explorer are fitly chronicled in the sumptuous volume recently published for him by Messrs. J. M. Dent & Co. Those members of the Society who were present at the meeting on January 25 last, when Sir Martin gave a condensed account of his adventures and exhibited some of his trophies in the shape of photographs and sketches, will be glad to read the narrative in detail, and to revel once more in the weird scenes of solitude and desolation so largely responsible for the prevailing epidemic of "arctic fever." Sir Martin Conway's work in the province he has so peculiarly made his own is sufficiently well known and appreciated to render it unnecessary for us here to describe how this particular example has been carried out; we need only wish him all speed with the volume on the history of Spitsbergen exploration promised in the introductory chapter, and proceed to chronicle briefly what he and his colleagues have done to add to that history.

The peculiarity of arctic exploration hitherto has been that it is almost wholly the work of navigators. Our knowledge of the topography of nearly all the arctic archipelagoes is limited to that usually required by the marine surveyor, who notes the outs and ins of the coast-line, takes the bearings of the chief mountain summits, and is content to sketch the geographical features generally from the immediate neighbourhood of the coast. Lord Dufferin was probably the first to point out that Spitsbergen is, as Sir Martin Conway puts it, "a land of mountains and glaciers, of splintered peaks and icy bays"—altogether beyond the sphere of the navigator, but eminently worth visiting for the scientific mountaineer. The object of this expedition was accordingly to cross Spitsbergen, and reveal the topographical and geological character of the interior.

The first landing was effected at Advent Bay, the party consisting of Sir Martin Conway, Dr. J. W. Gregory, Mr. E. S. Garwood, Mr. A. Trevor-Battye, Mr. H. E. Conway, and two Norwegian sailors. It was supposed that a series of bogs would first have to be crossed, and that these would be succeeded by an inland plateau on which sledges could

* 'Les Cités Romaines de la Tunisie.' Paris: Fontemoing, 1896.

† "The First Crossing of Spitsbergen." By Sir W. Martin Conway, M.A., F.S.A. J. M. Dent & Co. 1897.

be used; but things turned out far otherwise, the Nansen sledges taken were seldom available, and the want of Samoyede sledges added greatly to the difficulties of transport. It was found that the north and south parts of the island, except for a belt along the western shore of Wijde bay, were chiefly covered with immense accumulations of ice, while the central part was a region of boggy valleys and mountain ridges, with occasional more or less fertile slopes. As scientific interest centred in the latter, it was decided to depart from the original idea of crossing the island two or three times along widely separated lines, and to make a detailed study of a more restricted area. The expedition accordingly crossed from Advent bay to Klok bay, from Klok bay to Sassen bay, and from Sassen bay to Agardh bay on the east coast, and back to Advent bay.

The work done in the course of the traverses mentioned is summarized as follows: thirteen mountain ascents were made, including Mount Starashchin and Horn Sunds Tind; 600 square miles were surveyed in the heart of the island, and a rapid outline survey made on either side of Wijde Bay; the most complete reconnaissance of the coasts ever made was accomplished, the main island being almost circumnavigated; observations were made of the west, north, and south coasts of North-East Land; a landing was effected on the Seven islands, and Wiches Land closely approached. Some six hundred photographs were obtained, and scientific collections of great value, especially to the geologist, were brought home. The latter are deposited in the museums at South Kensington and at Kew, and are to be reported on later. The great scientific interest of Spitsbergen lies in the fact that it enjoys the most temperate of arctic climates, and its plateaux are accordingly undergoing erosion and denudation of the most vigorous kind, the process of cutting out valleys and mountain groups being exhibited in rare perfection. The promised scientific results must therefore be looked forward to as a great contribution to physical geography, and we shall then appreciate all the more this account of the difficulties and dangers encountered.

ON A REVISED MAP OF KAISER FRANZ JOSEF LAND, BASED ON OBERLIEUTENANT PAYER'S ORIGINAL SURVEY.*

By Professor RALPH COPELAND, Astronomer Royal for Scotland.

ON the return of Dr. Nansen from his great journey across the arctic ocean, geographers learnt with surprise that the northern part of Lieutenant Payer's map of Franz Josef Land had proved of very little use to him on his journey southwards. This seemed to confirm the unfavourable opinion which had already been expressed by Mr. Jackson respecting the western part of the map, that persevering explorer having been unable to identify Payer's Richthofen peak, even when standing on the site of the mountain as laid down by the Austro-Hungarian expedition. This latter difficulty, however, admitted of a ready explanation: Richthofen peak had

* Map, p. 236.

been laid down by its discoverer from one point only, and from an estimated distance of about 60 miles. If, therefore, this distance had been over-estimated, the mountain would be not only misplaced on the map, but also exaggerated in height to a corresponding extent.

Nansen's case was altogether different; as is well known, he entered the region surveyed by Payer from the north-east, and found an open sea with a group of small islands where the Austrian explorer has placed a large glacier. Knowing Payer's great ability as a surveyor, from having been associated with him on the second German Arctic Expedition in 1869-70, I was painfully surprised at these extraordinary discrepancies.

On learning, however, that Payer had presented the original fair copy of his survey to the Royal Geographical Society, it occurred to me that I might possibly be able to trace the origin of the above-mentioned divergencies. My application to the Council of the Society for the loan of these valuable manuscripts was most courteously granted, and I was thus provided with the necessary materials for testing the accuracy of the Austro-Hungarian map.

It will be remembered how the *Tegetthoff*, imprisoned in the ice, was on August 30, 1873, carried within sight of the large group of hitherto unknown islands which its discoverers named Kaiser Franz Josef Land. For two months the foe carried the ship helplessly to and fro in the neighbourhood of the land, until it was finally frozen fast about 3 miles south of Wilczek island on October 31. During the two months' drift, bearings and sketches of the land were taken on eleven different days, beginning with the day of discovery. This section of the survey is recorded in twenty-seven lines on four sheets with Payer's usual painstaking skill; it is useful in confirming the general accuracy of the southern part of the map, as well as in locating Lütke and Orel islands, the eastern part of Salm island, and Cape Höfer.

The darkness of winter allowed only of flying visits to the shore, but on March 10, 1874, the task of exploration was begun in earnest by Payer. Within six days he occupied three of the most important stations of the survey—the summits of Capes Tegetthoff and Littrow, and the west tongue of Wilczek island, at the same time deciding on the general plan of operations. Lieutenant Weyprecht, the nautical commander of the expedition, undertook the measurement of a base-line on the ice starting from the ship, together with the connection of this base with two conspicuous points settled on by Payer. These points were: first, the summit of a symmetrical rock about 30 metres in diameter, situated on the low tongue of land just mentioned as forming the western extremity of Wilczek island; it is designated "VII." in Weyprecht's triangulation. The other point, "T," is the outermost but one, and the most regular in form, of a line of basaltic rocks running out from Cape Tegetthoff; it is well shown in the woodcut on p. 49, vol. ii., of Payer's 'New Lands within the Arctic Circle' (London, 1876). Both objects are visible for a great distance to the west and the north-east. Together with these points should be mentioned "V," a large cairn on the southern headland of Wilczek island, in which are deposited sundry documents, as well as a minimum thermometer. In the mean time Payer was to conduct a sledge-party to the highest attainable latitude, keeping up a running survey of the route traversed. This survey is depicted in about twenty panoramic views, with accompanying theodolite and compass readings made at as many different stations, ranging from Cape Brünn to Cape Brorok. These sketches were copied by Payer before the abandonment of the *Tegetthoff* in lines upon ten sheets of paper about 14 inches by 10 inches. If placed end to end, they would extend to a length of fully 65 feet. Interspersed with these sketches are a number of effective drawings,

which convey a vivid impression of the character of the scenery. Two of these are interesting as having been made when the temperature was nearly 56° Fahr. below zero. Altogether about 750 theodolite or compass readings are entered on these survey sheets.

A full account of Weyprecht's base and the adjoining triangulation is to be found in his "Astronomische und geodätische Bestimmungen der österreichisch-ungarischen Arctischen Expedition, 1872-74," published in the thirty-fifth volume of the 'Denkschriften' of the Imperial Academy of Sciences at Vienna, 1878. A recomputation of Weyprecht's measurements confirmed his deductions in all respects, and finally 18052.1 metres was adopted as the distance VII.—T, with an azimuth of $162^{\circ} 40' 9''$ from the south, referred to the meridian of VII. Weyprecht's values are 18049.0 metres and N. $17^{\circ} 19' 1''$ W., quantities agreeing almost exactly with the foregoing, taking into account the nature of the survey. The only discrepancy noted seems to be merely a slip of the pen affecting the two adjoining angles V.—VI. and VI.—A, measured at station IV., where $3^{\circ} 43' 5''$ and $42^{\circ} 39' 0''$ are to be substituted for $3^{\circ} 1' 5''$ and $43^{\circ} 21' 0''$. The uncertainty mentioned by Weyprecht respecting the important angle T—VII.—A ($= 146^{\circ} 27' 5''$) measured by Payer, is to a great extent removed by an examination of measures taken under favourable conditions on April 30, 1874, which give a value of $146^{\circ} 28' 75''$. I have made use of Weyprecht's figures. All the angles of the triangles were not measured, nor was the levelling-instrument used in the determination of the angles always exactly centred. Under these circumstances Weyprecht did not attempt an adjustment of the triangulation. Owing to the roughness of the ice, a direct measurement of the base was altogether impracticable; the lengths of the various sections were therefore found by means of a levelling-staff and the micrometer of a "Stampfer level." According to investigations made by Prof. Stampfer, the accuracy of a base measured in this way is somewhat greater than if carefully measured with a chain. In summing up the length of the base, the distance from the northern end of the base, the mizzen-mast of the *Tegetthoff*, to the first pole on the ice has been inadvertently omitted from the result stated by Weyprecht in Vienna fathoms, but the length of the base is correctly given in metres. The results for the azimuth of the base afforded by two instruments, were afterwards found to differ to the extent of 9.5 minutes of arc. Weyprecht decided to adopt the figures obtained with the more reliable instrument. The difference is of no great moment for a provisional survey of the kind contemplated.

The latitude and longitude of the observatory on the ice near the ship were determined by Weyprecht and Midshipman Orel in the most satisfactory manner. The longitude referred to the northern end of the base is $58^{\circ} 46' 39''$ E. from Greenwich. These figures, however, have still to be corrected for the error of the lunar tables, which, according to Newcomb,* made the moon's right ascension too large by about $9' 0''$ in the winter of 1873-4. The corresponding correction to the above longitude is *minus* $4' 6''$, hence the final longitude of the northern end of the base becomes $58^{\circ} 42' 33''$ E. The latitude is $79^{\circ} 50' 56''$ N.,† whence Weyprecht's

* 'Investigation of corrections to Hansen's Tables of the Moon,' p. 12. 4°. Washington: 1876.

† The provisional position given in 'New Lands,' and used in the published map, is $58^{\circ} 56' 0''$ E., and $79^{\circ} 51' 1''$ N.; the difference in longitude from the corrected final value is therefore 2.74 statute miles, by which distance Franz Josef Land has been hitherto placed too far east on the map.

reductions give the following corrected positions for the fundamental points of the survey:—

V.	79° 53' 28"	N. lat.	and	58° 40' 0"	E. long.	(Greenwich).
VII.	79 55 57	"	"	58 7 48	"	"
T.	80 5 12	"	"	57 51 3	"	"

By far the greater part of the survey was accomplished by Payer on the long sledge journey on which he and Orel succeeded in reaching Cape Fligely, 134 nautical miles north of the ship. In the accompanying map, nearly every station where Payer set up his theodolite or azimuth compass is marked with a small triangle. These points are sometimes on the tops of commanding elevations, but more usually they indicate the spot where a halt was made for the determination of the latitude at apparent noon, or for the measurement of azimuths. In the majority of cases it was necessary to determine these points by means of Pothot's problem, with or without the help of the observed latitude. A number of the best determined unvisited points are distinguished by a small circle. In criticizing the survey, it must not be overlooked that Payer's primary object on the second sledge journey was the attainment of the highest possible latitude. He was therefore under the necessity of deviating as little as possible from a direct north and south track. Under these circumstances, it was only possible to give continuity to the survey, by repeated bearings of conspicuous points at a distance to the right and left of the line of march. It is obvious that the best results can only be obtained when such lateral points are observed from at least three stations.

Frequently the compass azimuths of objects were read off in addition to their direction as shown on the circle of the theodolite. In these cases the true bearings of all the observed points could be deduced with the aid of the accompanying table of the variation of the compass.

MAGNETIC DECLINATION IN FRANZ JOSEF LAND, 1874-2.

The minus sign indicates that the compass needle pointed east of true north.

Latitude.	Longitude— 55° E.			56°.			57°.			58°.			59°.			60°.			61°.			62°.			63°.			64°.			65°.																																																																																			
	Decln.	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f	o	f																																																																																			
55 N.	-10 29	-11 1	-85	-11 43	-12 24	-13 5	-13 46	-14 27	-15 7	-15 47	-16 27	-17 7	-86	-11 46	-12 26	-13 5	-13 44	-14 23	-15 2	-15 40	-16 18	-16 56	-17 33	-18 10	-87	-13 5	-13 44	-14 22	-14 58	-15 36	-16 12	-16 47	-17 24	-17 59	-18 34	-19 7	-53	-14 19	-14 55	-15 31	-16 6	-16 41	-17 16	-17 49	-18 23	-18 55	-19 28	-20 0	-48	-15 26	-16 0	-16 34	-17 7	-17 40	-18 13	-18 44	-19 16	-19 45	-20 16	-20 48	-43	-16 27	-16 59	-17 31	-18 2	-18 33	-19 4	-19 31	-20 4	-20 31	-21 0	-21 31	-43	-17 27	-17 59	-18 31	-19 2	-19 47	-20 17	-20 45	-21 13	-21 41	-22 9	-38	-18 27	-18 59	-19 31	-20 1	-20 41	-21 10	-21 38	-22 6	-22 34	-36	-19 27	-19 59	-20 31	-21 1	-21 31	-22 0	-22 27	-23 5	-24 23	-34	-20 27	-20 59	-21 31	-22 1	-22 31	-23 0	-23 27	-24 5	-24 33	-34

This table was constructed by first computing the Gauss magnetic co-ordinates for the year 1829 for each 5° of latitude and longitude from Erman and Petersen's tables (*Astronomische Nachrichten*, No. 1900), and then filling in the intermediate values.* The difference (= -17° 51') between the magnetic declination thus

* For the computation of this table, as well as for valuable assistance in drawing and lettering the map, I have to thank Dr. Halm of the Edinburgh Royal Observatory. —R.C.

obtained for the *Tegetthoff's* position and the mean declination found by Weyprecht and Brosch, added to each of the computed values, then gave the quantities in the above table. This process assumes, first, that Gauss's quantities give the correct declinations for 1829, plus or minus a constant, within the area dealt with; and, second, that the secular change in declination from 1829 to 1874.2 has been uniform throughout that area. The readings taken at the south-western extremity of Crown Prince Rudolf's Land may serve as an example of the use of this table.

STATION—CAPE BROROK, APRIL 11, 1874, NOON. LATITUDE BY OBSERVATION,
81° 40' 14" N. COMPASS DECLINATION BY TABLE = - 16° 41'.

Object.	Compass-reading.	Magnetic bearing.	Approximate bearing.	Theodolite reading.	Correction to theodolite-reading.	True bearing.
Hohenlohe island, rook	S. 73° E.	= 287 0	303 41	148 20	+155 21	303 7
Hohenlohe island, west cape	S. 26½° E.	= 333 30	350 11	195 26	+154 45	350 13
Alexander Land, rocky cape 24 miles distant	S.W. (b. S.) ½ S.*	= 25 19	42 0	247 44	+154 16	42 31
Mean correction to theodolite-readings					+154 47	

The theodolite readings for the remaining objects observed from this station, eight in number, increased by the quantity 154° 47', give the following azimuths, which were employed, together with the three foregoing bearings, in the construction of this part of the map; at the same time, the greater estimated distances have been lessened by one-third:—

Object.	Theodolite reading.	True bearing.
Hohenlohe island, summit	168 0	322 47
" " cape (4 miles)	172 40	327 27
Alexander Land, low cape	227 20	22 7
" " rocky cape (16 miles)	245 0	39 47
" " (very distant cape)	—	—
Very high land (70 miles)	322 20	117 7
Low cape (1 mile)	339 0	133 47
Brow of cliff (quite near)	50 0	204 47
Low cape (near)	128 0	282 47

There are some parts of the map for which the materials of the original survey are no longer to be found, if indeed they still exist. These are—Petermann Land with Cape Vienna in the extreme north; the western shore of Crown Prince Rudolf Land, for which only the observed latitude of Cape Germania and the estimated

* There is an obvious error of a whole point, 11½°, in this reading, which I have not hesitated to correct. Almost without exception, the only errors in the survey occur in such magnetic bearings as are given in *points*. It is much to be wished that this antiquated notation should be avoided in future surveys.

latitude of Cape Fligely are available, Orel's compass bearings having unfortunately been lost or mislaid. The data for the true situation of Lamont island are also wanting, but they probably are to be found amongst the papers of the late Lieut. Weyprecht, who can hardly have failed to determine its position with all necessary accuracy at the time of its unexpected discovery on the retreat from the ship. The bearings and details of the Hayes islands are also wanting. There was, therefore, no option but to copy these features from the published map. The outline of King Oscar land has also been copied, but in this instance the bearing of the central peak, already given, serves to define its azimuth with respect to Cape Brorok.

On the other hand, Payer's survey enabled me to locate two islands which now for the first time appear in the map. With Payer's permission, they are named after Brosch and Orel, the two officers of the *Tegetthoff* who so ably contributed to the scientific results of the expedition. Of these, Brosch island is a bold rock or cliff to the south of Kuhn island, near which the survey shows a third very small island still unnamed. Orel island lies to the south-east of the Klagenfurt group; it is nearly covered with snow, through which a few rocks show on the side towards the south. It is well located by favourable bearings taken in part on October 19, 1873, at a time when the *Tegetthoff* seems to have remained stationary for a whole day in the well-defined position shown on the map. There is also a small island, or rather rock, in the strait between Schönau and Koldewey islands, scarcely worth mentioning did it not repeatedly occur in the survey. It occupies the centre of the cut on p. 106, vol. ii., of 'New Lands,' in front of Schönau island, Cape Berghaus lying to the right in the distance. The high ground far to the east in Wilczek Land, also now indicated for the first time, was seen by Payer from his station three-fourths of the way up Cape Tirol at 10 a.m. on April 18, 1874, its estimated distance being 40 nautical miles. I have not succeeded in making out the situation of the westernmost of the Hochstetter islands, for which the single bearing from Cape Frankfurt is therefore shown by a dotted line on the map. Every name used by Payer in his work, 'Die österreichisch-ungarische Nordpol-Expedition in den Jahren 1872-1874' (Wien, 1876), has been retained, excepting Cape Buda Pest, Rawlinson sound, and Braun island, the existence of which seems very uncertain. It is also far from certain that the northern part of Wilczek Land, as now drawn, is not made up of several snow-covered islands.

Certain lines in the sketches made at 7 p.m. on April 7, and at noon on April 9 seem to have been drawn under the impression that the land to the west was continuous right up to Prince Rudolf Land. This impression appears to have been first dispelled on the ascent of Cape Schrötter on the evening of April 9, by the discovery of the sound leading to the west between Karl Alexander Land and Prince Rudolf Land. Unfortunately, the survey leaves the latitude of the southern boundary of his sound more than usually uncertain.

Payer measured the heights of a number of the mountains, partly with the aneroid barometer and partly with the theodolite. The aneroid-readings for three points only are entered on the survey sheets, while there are twelve points for which theodolite elevations are available. These latter seem never to have been worked out, except in the case of Richtofen peak, the details of their computation may therefore not be uninteresting. In conformity with the notation of the original map, the heights are stated in Vienna feet, of which 3·1635 go to a metre; to reduce to British feet, multiply by 1·0371. The heights have been computed by the well-known formula :

$$h - h' = d \cos (z - \frac{1}{2}d' + \rho) \operatorname{cosec} (z + \rho)$$

where h is the height of the observed object; h' , that of the instrument at the observing-station, both above sea-level; d , the horizontal distance between the station

and the object in terms of the unit of height, d' , the same distance in arc; z is the observed zenith distance, and ρ the terrestrial refraction. If d' is expressed in minutes of arc, and d in Vienna feet, then $d = 5886.4d'$ in the latitude of the southern part of the map. The coefficient of refraction has been taken at 0.0894, as derived from the observations of the second German arctic expedition. To keep well within the mark, I have assumed the height of the instrument to have been 15 feet above sea-level at the ship and also at the station on or near an iceberg on May 3, 1874. Whenever the height of the theodolite above the surface enters into the computation, it has been taken equal to 5 feet. In the third and penultimate columns of the following tables, it will be noticed that the quantity sought is the height of the observing-station.

It may be well to add a few words respecting the trustworthiness of these results. The heights of Salm island, Cape Brünn, and the corner of Cape Tegetthoff, being derived from favourable angles of elevation, must be very nearly correct; with one exception, they are the only altitudes obtained directly from observations near the level of the sea. The altitude of Cape Littrow, being derived from that of Cape Brünn, is naturally somewhat less certain, and this uncertainty is increased in the deduction of the height of the summit of Cape Tegetthoff; but as this comes out 229 feet higher than the well-determined corner of that promontory—a difference which must be very near the truth, to judge from the various sketches which show both these features—it may be inferred that no great error has crept in. The Wüllerstorf mountains being fully 30 nautical miles from Cape Littrow, the angles of elevation of their summits are necessarily small, and correspondingly uncertain; the theodolite, however, was read in both positions for the higher summit, thus excluding any considerable error. Furthermore, we have the operation on the summit of Schönau island on April 22, making that station 1893 feet lower than the highest of the Wüllerstorf mountains, or 516 feet above the sea. This result does not differ excessively from Payer's estimate of 400 feet, considering the very round-about way in which the computed altitude has been derived—the line of sight having traversed 80 miles of air.

I come now to the much-criticized Richthofen peak. This mountain was seen and sketched by Payer, not only from the summit of Cape Brünn, but also from an indeterminable point several miles further west, where he obtained a better view of Markham sound than was possible from his trigonometrical station on the cape just named. The elevation of the peak from the summit of Cape Brünn was determined in both positions of the instrument, the readings being $0^\circ 22'$ and $0^\circ 30'$, giving $0^\circ 26'$ as the elevation. To make sure that the readings corresponded to an angle of *elevation* and not of *depression*, Payer made two diagrams of the relative positions of the nonius and the zero point of the circle. Half the difference of these readings gives an index correction of $4'$, in fair agreement with other determinations about that date. It is subtractive for the position in which Payer generally used the instrument. The distance, d' , I have assumed so as to locate the mountain on an island of unknown extent, described by Jackson as "high rocky." Its altitude then comes out 4296 Vienna feet, as entered on the new map. If the peak is assumed to be on the fifty-fifth meridian, the height will be reduced to 3330 feet, while it can be no more than 2880 feet if it is but 20 nautical miles from Cape Brünn. But it is not at all likely to be so near, or Payer could hardly have estimated its distance to be 60 nautical miles, when the Wüllerstorf mountains were distinctly visible, in nearly the opposite direction, at a distance which we now know to be 40 miles, and of which Payer must have had a good general idea. From these considerations it seems very probable that Richthofen peak is to be looked for at no considerable distance from the point indicated on the map, and that its height does not differ greatly from 4000 feet.

COMPUTATION OF HEIGHTS ABOVE SEA-LEVEL FROM MEASURES WITH
THE THEODOLITE.

Station	Ship.	Ship.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Cape Littrow.	Iceberg.	Iceberg.	Schönan island.	Cape Bränn.
Date ...	Aug. 31, 1873.	Aug. 31, 1873	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	March 13, 1874.	May 3, 1874.	May 3, 1874.	April 2, 1874.	May 2, 1874.
Object ...	Salm Island.	Hall island, south-west cliff.	Cape Bränn.	Cape Tegetthoff, summit.	Wüllerstorf mountains (2)	Wüllerstorf mountains (3)	Hill near Cape Oppol- zer.	Cape Triest.	Cape Triest.	Cape Bränn	Cape Tegetthoff, corner.	Wüllerstorf mountains (3).	Richthofen peak.
h' ...	150 ft.	150 ft	[1623.5 ft.]	1279.4 ft.	1279.4 ft.	1279.4 ft.	1279.4 ft.	1279.4 ft.	1279.4 ft.	15.0 ft.	15.0 ft.	[2409.0 ft.]	1628.5 ft.
d' (arc) ...	0° 19'60"	0° 37'40"	0° 10'65"	0° 5'10"	0° 30'45"	0° 30'60"	0° 15'52"	0° 23'95"	0° 12'70"	0° 4'55"	0° 4'55"	0° 26'15"	0° 37'60"
ρ ...	0° 1'75"	0° 3'34"	0° 0'95"	0° 0'46"	0° 2'72"	0° 2'74"	0° 1'39"	0° 2'14"	0° 1'14"	0° 0'41"	0° 0'41"	0° 2'34"	0° 3'36"
z ...	89° 32'00"	89° 54'00"	89° 45'50"	89° 37'50"	89° 53'00"	89° 51'00"	89° 54'50"	89° 59'50"	88° 51'25"	87° 21'50"	87° 21'50"	89° 28'50"	89° 31'00"
$h - h'$...	1209.9 ft.	1367.9 ft.	{ - 314.1 ft. - 5.0 ft.}	214.7 ft.	1016.7 ft.	1129.6 ft.	315.4 ft.	424.0 ft.	1608.5 ft.	1250.3 ft.	1250.3 ft.	{ - 1887.8 ft. - 5.0 ft.}	2668.0 ft.
h (Vienna feet) ... }	1225	1333	{ Cape Littrow, 1274}	1494	2296	2109	1595	1703	1623	1265	1265	516	4296

Aneroid-readings were taken apparently on three ascents only—those of Capes Tegetthoff, Littrow, and Brünn—and only on the last occasion was the temperature of the air recorded both at the summit and at the base of the elevation. The available materials, interpolated where necessary, are shown below, together with the resulting heights, *h*, computed by Rühlmann's tables.

COMPUTATION OF HEIGHTS FROM ANEROID-READINGS.

Date.	Aneroid-reading.		Temperature.		Assumed.		<i>h</i>		Eminence.
	Upper.	Lower.	Upper.	Lower.	<i>A-A'</i>	<i>A'</i>	By ane- roid.	By theo- dolite.	
	mm.	mm.	C.	C.	feet.	feet.	feet.	feet.	
1874, Mar. 12	736.00	763.57	-31½°	-31¼°	1128.1	15	1143	1494	C. Tegett., summit.
" " 13	736.00	770.50	-43¼°	-43¼°	971.1	15	986	1274	C. Littrow.
" May 2	717.65	765.20	-21¼°	-12.31°	1520.5	15	1535	1623	C. Brünn.

It will be noticed that the heights are in every case much less than those obtained with the theodolite. The difference is most likely owing to the effect of the intense cold on the delicate mechanism of the instrument employed, for it is least in the case of Cape Brünn, which was ascended under more favourable conditions than the other summits, as far as mere temperature was concerned, although the wind made the ascent the most trying that Payer ever made. In the absence of any information respecting the temperature-coefficient of the particular aneroid used, it is obviously impossible to place any confidence in the heights obtained with it. The readings on March 13 prove, however, that the aneroid barometer still works at a temperature when the freezing of the quicksilver stops the action of the ordinary barometer. Future experiment must determine whether the indications of the aneroid at these low temperatures can be treated in such a way as to give the true pressure of the atmosphere.

The heights obtained with the theodolite have alone been entered on the map, from which I have omitted the heights given in the original, as these seem to have been merely estimated. It is by no means unlikely, however, that Schönau island is not so lofty as the computation makes it, but it seemed best to retain all the computed heights, as the actually measured differences of altitude cannot be far from the truth.

The accuracy of the survey is very different in different parts. In the south all the more prominent points are so thoroughly connected with each other and with the base by well-conditioned triangles, that errors so large as 200 metres are scarcely to be apprehended in the whole stretch from Cape Oppolzer to the Wüllerstorf mountains, Orel island, and the position of the ship on October 18 and 19, 1873. Fully as accurate are the stations on the ice on March 31, April 1, and May 3, as well as the station at the foot of Cape Frankfurt occupied on April 21. In this section the agreement between the new map and the original chart published by Payer is almost perfect in all essential particulars. In Austria sound considerable discrepancies between the two maps make themselves evident, probably the reason being that the Austrian cartographer who constructed the chart relied to a considerable extent on the estimated distances covered by the explorers on their marches, whereas I mainly based the reconstruction on the observed latitudes, adjusting these by the smallest possible quantities that served to bring them into practical agreement with the recorded azimuths. In this way, after repeated trials, I succeeded in obtaining a network of triangles embracing the various

stations on the ice as far as and including Cape Brorok. To judge by the agreement of the bearings, it does not seem that these stations can be in error to the extent of much more than a nautical mile either in latitude or longitude. Probably the same degree of accuracy will be found in the positions of the Stoliczka islands, of Kane island, Coburg island, Hohenlohe island, the eastern shore of Rainer island, and the eastern summit as well as the general outline of Becker island. On the other hand, Cape Tirol, having been passed in cloudy weather on the northward journey, and having been observed from Cape Brünn under unfavourable conditions as to the stability of the theodolite, may be several kilometers wrong in latitude, although its longitude is well defined by azimuths from the neighbourhood of Cape Frankfurt.

The following table shows the various observed latitudes,* together with the observations on which they are based, as well as the final adjusted latitudes used for the map. The greatest differences, M—O, between the map and observations occur on March 31 and April 1, for which the positions on the map are derived solely from that of the ship by means of the triangulation.

The greatest error in the original map is in the north-eastern part, where Payer shows the large Dove glacier extending far to the north, in place of the open sea with a solitary group of islands which Nansen found in that region. There seems little doubt that Payer on his northward journey mistook fog-banks on the eastern horizon—possibly in combination with the ice-hummocks, which would naturally be formed on the margin of the fiord ice—for an extension of Wilczek Land towards the north beyond the latitude of $81^{\circ} 5'$. This mistake is the more pardonable from the fact that Payer seems certainly to have obtained a glimpse of one of the islands just mentioned on the afternoon of April 7, 1874, which he named *Freden island*, a name which has been very properly retained by Nansen. At 6.15 p.m., on the day in question, Payer made a halt on the ice, Cape Beuermann bearing west-south-west (true) at an estimated distance of half a nautical mile. At this point he noted that in exactly the opposite direction land was distinctly visible, which he described in these words: "The Ostland knoll 25–30 nautical miles distant—a cape, perhaps a north corner of an island jutting this way towards the west." † The atmospheric conditions were extremely favourable for seeing objects at a great distance. The day had been bright and clear, with a shade temperature of -16° R. at 8 a.m., rising to -13.1° R. at noon, as recorded on the survey sheet. The clearness of the air is attested by a black-bulb reading of $+3.5^{\circ}$ R. at 2.30 p.m. Under these circumstances, as the sunlight came more and more from the west the visibility of objects in the east would be increased and there would be every possibility of seeing land at the distance named.

The existence of Hoffmann island seems to be placed beyond doubt by two pairs of azimuths, observed at 8 a.m. and at noon, also on April 7, the island subtending angles of $23^{\circ} 13'$ and $26^{\circ} 2'$ respectively at the two stations. According to the sketches, it is completely covered with snow, and rises only slightly above the level of the sea. This may account for its not having been noticed by Nansen and Johannsen on their kayak voyage towards the west.

In the relative positions of the objects around Hohenlohe island, the new map differs considerably from its predecessor. In the original map the southern extremity of Crown Prince Rudolf Land is several minutes too far north. I have

* The latitudes are practically identical with the provisional results entered on one of the survey sheets.

† The words in the survey sheet are, "Die Kuppe des Ostlandes, 25–30 S. M. fern, ein Cap, vielleicht ein Nordeck einer Insel die nach W. hereintritt."

DETERMINATION OF LATITUDE FROM THE OBSERVED GREATEST ALTITUDE OF THE SUN'S UPPER LIMB.

Date, 1874 ...	March 31.	April 1.	April 3.	April 5.	April 7.	April 8.	April 9.	April 11.	April 12.	April 16.	April 17.
E. longitude ...	3h. 56m. 8s.	3h. 57m. 4s.	3h. 56m. 4s.	3h. 57m. 8s.	3h. 57m. 28s.	3h. 57m. 36s.	3h. 56m. 8s.	3h. 53m. 40s.	3h. 50m. 40s.	3h. 54m. 4s.	3h. 54m. 4s.
Thermometer R.	-20.7°	-16.4°	-13.2°	-2.6°	-13.1°	-12.2°	-8.2°	-12.5°	-11.0°	-14.0°	-12.0°
Barometer ...	766 mm.	765.8 mm.	755.6 mm.	752.8 mm.	759.9 mm.	755.8 mm.	754.5 mm.	760.2 mm.	761.1 mm.	747.5 mm.	746.9 mm.
Refraction ...	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "	0 ' "
Parallax ...	+0 4 21.4	+0 4 10.8	+0 3 58.0	+0 3 37.0	+0 3 41.7	+0 3 39.1	+0 3 30.8	+0 3 27.8	+0 3 25.3	+0 3 0.5	+0 2 53.3
Reduction to meridian ...	-8.6	-8.6	-8.5	-8.5	-8.5	-8.5	-8.5	-8.4	-8.4	-8.3	-8.3
Sun's declination ...	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.6	-0.6
Sun's semidistance ...	+4 8 23.6	+4 31 33.0	+5 17 39.4	+6 3 21.8	+6 48 39.9	+7 11 9.1	+7 33 32.3	+8 17 56.0	+8 39 57.1	+10 6 19.1	+10 27 37.8
(Observed Zen. distance ...)	+16 2.1	+16 1.3	+16 1.3	+16 0.8	+16 0.2	+15 59.9	+15 59.6	+15 59.1	+15 58.8	+15 57.8	+15 57.5
N. latitude by observation	75 47 30.0	75 31 0.0	75 11 8.0	74 37 45.0	74 14 45.0	74 0 30.0	73 44 15.0	73 3 0.0	72 58 15.0	70 47 15.0	70 14 0.0
Latitude used in map ...	80 16 8	80 22 36	80 48 38	81 0 35	81 23 1	81 31 9	81 37 8	81 40 14	81 57 27	81 12 24	81 0 13
Map - Observation ...	80 13.4	80 21.3	ditto	80 59.6	ditto	ditto	ditto	ditto	ditto	81 13.4	81 1.3
	-2.7	-1.3	-	-1.0	-	-	-	-	-	+1.0	+1.1

located Cape Brorok in accordance with the meridian observation taken there on April 11, together with various bearings of Hohenlohe island; that island in its turn being well determined by several bearings recorded on the 7th and 9th of that month, as well as the latitude of the latter date. Cape Rath, too, seems to be well defined, and there is just a possibility that Cape Buda Pest may also exist as a small island separated from the adjoining land by a narrow strait, somewhat uncertain indications of land in that position having been observed on two occasions.* André island does not seem to exist, except as the eastern end of Karl Alexander Land, there being no certain traces of a strait in the survey. Indeed, the data regarding the whole eastern and south-eastern shores of that land are very uncertain, as the Austrians passed it, for the greater part, in foggy weather. I have marked by red lines those bearings which seemed the most reliable. Deak island is fixed solely by a single, but perfectly reliable, azimuth from the noon station of April 16. Dr. Nansen has kindly shown me his sketches of the southern part of Crown Prince Rudolf Land, together with photographs of the coast near Cape Felder; they confirm Payer's survey sheets in the most satisfactory manner.

In Markham sound the coast-line necessarily remains very uncertain, only a few of the principal capes being laid down from cross-bearings. In the south-west I have restricted myself to indicating the few azimuths that seemed likely to be useful to any future surveyor.

In bringing to a conclusion this endeavour to utilize to the utmost the cartographic materials collected by Payer and Weyprecht, I cannot but express my admiration for the skill and energy displayed by those distinguished explorers. To Weyprecht, geography is indebted for the thorough manner in which he imparted to the fundamental points of the map all the accuracy with which he had determined the position of his astronomical observatory. To Payer's daring in extending his survey to so great a distance from the ship, no less than to his skill and indomitable energy, we owe our first map of Franz Josef Land, in which, in spite of imperfections, the region traversed by him is laid down in such a way that any explorer following in his track will be able to correct the few oversights inevitably incidental to a first exploration.

THE NEW RAPID ON THE YANG-TSE.

THE following extracts, giving some account of the new rapid on the Yang-tse, caused by a landslip, are from a letter from Mr. F. S. A. Bourne, H.B.M. Consul, who is in charge of the Blackburn Commercial Mission to China. It is dated—

On the Yang-tse off Feng-tu Hsien, December 18, 1896.

Messrs. Neville, Bell, and myself, accompanied by Mr. Cecil Hanbury, of Shanghai, whom I had invited to join us on the junk voyage from I-chang to Ch'ung-king, arrived at K'uei Fu in lat. 31° N. and long. 109° 30' E. on December 1. We heard in more precise terms here news, the rumour of which had rather disconcerted us at I-chang, "that a hill had fallen into the river and made a fearful rapid that we certainly could not pass." On December 6 we reached the small town of Yün-yang, and learnt that the magistrate had that morning left for the new rapid.

The next day we left Yün-yang at dawn, and, after passing through high mountains

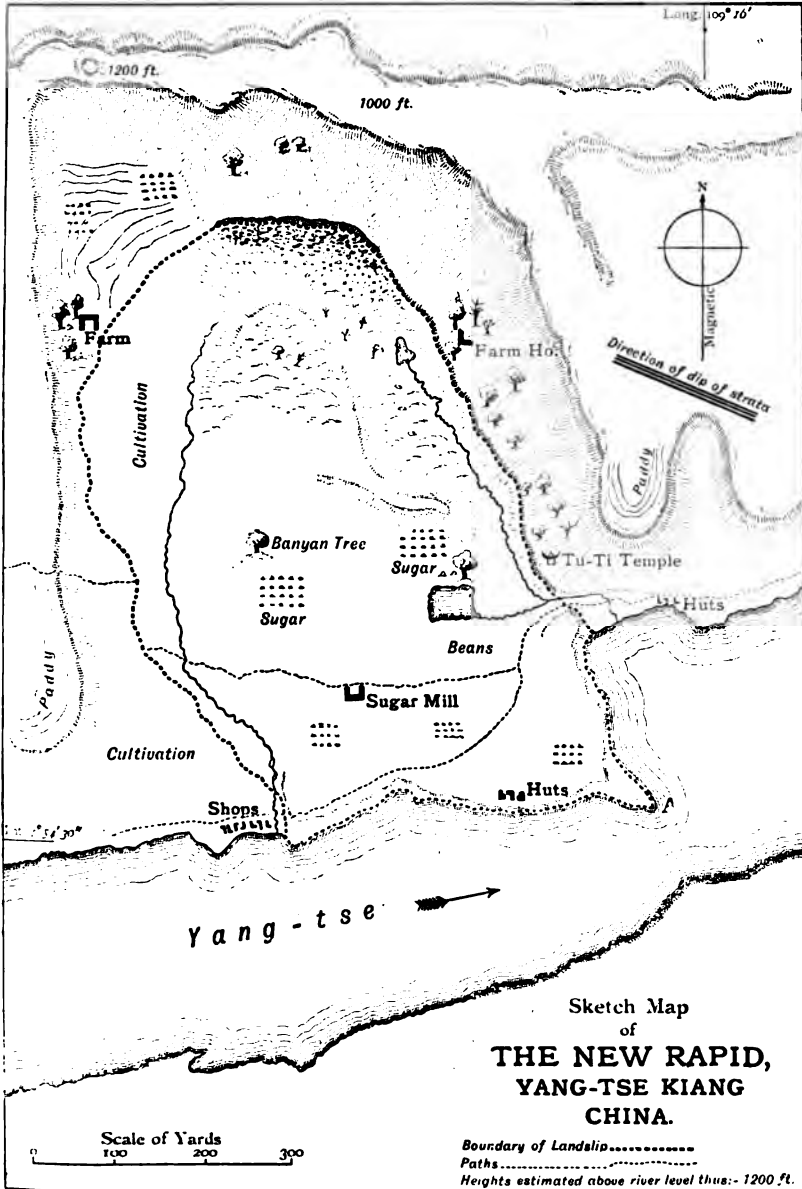
* The Norwegian explorers, however, who passed within about 15 miles of Cape Rath, saw no traces of any island in the position indicated.

flanked by slopes of red shale, now covered with the fresh green of beans and wheat, we came in sight of the rapid at noon. Mr. Hanbury and I had landed early in the morning, and had delayed at a very interesting *chai-tzu*, or village fort of refuge, on the north bank, where we noticed ancient *Man-tzu* bricks with very curious designs, an account of which I will give in a future letter.

Viewed from a distance, the new rapid somewhat belied our expectations. We had been told again and again on the way up that a mountain had fallen into the river, and we had expected to see a precipice overhanging the stream; but the height on either side looked at least half a mile from the bank. As we approached, however, an extraordinary scene presented itself; the river was suddenly contracted from 300 yards to a breadth of 80 yards only, and over this space rushed a mighty fall of water, far more than the most dreaded of the rapids we had passed. We all agreed that no steamer of whatever power could stem this torrent, and it appeared impossible a boat of any sort could be dragged up such water. The current in the middle is very fast, and on either bank huge waves are thrown up by the water dashing against the rocks below. As our eyes fell upon it for the first time, a large *Ssu-chuan* junk coming down stream struck a rock in the trough of the waves and was a wreck in three minutes.

Further examination showed that there had been an extensive landslip on the north bank, and that a block of ground, measuring about 700 by 300 yards, had fallen from the slope of the mountain, encroaching about 150 yards on the bed of the river. The sketch-map appended, which has been drawn by Mr. Hanbury, with the assistance of bearings taken by me with a prismatic compass and of a traverse, will give a better idea of what has happened than words. The space within the dotted line represents the area of the landslip, the northern edge of which fell vertically about 200 feet, bringing down huge blocks of hard sandstone, which had formed a deep bluff above the line of fissure. Below the hard sandstone bluff above mentioned the strata had split vertically, and the whole mountain-side had slid down horizontally a distance of 100 to 150 yards. Before the landslip, the surface going south appears to have been much as follows: The main ridge of the mountain about 1000 feet above the river; the hard sandstone bluff about 600 feet above the river, with a few pines growing above it; a slope at an angle of 30° to 45° , with boulders and t'ung oil trees; an undulating surface cultivated with paddy and sugar-cane, breaking down to a sand-slope; and then hard sandstone dipping to east-south-east at an angle of about 15° , which formed the bank of the river, where the towing-path was at low water. Now the same space is occupied as follows: Under the sandstone bluff, carrying down some 150 yards of it, is a vertical cliff where the mountain has been rived as if cut with a knife. At the bottom of this cliff, 200 feet high, huge blocks of sandstone from the bluff, broken by their fall, lie in a confused mass with fir trees prostrate, truncated, and at all angles. Below this come t'ung oil trees that have been carried down vertically 150 feet, but are yet fairly erect, with their roots in the ground. Then a curious narrow ridge of soft sandy earth, very steep, 50 feet above the level of the ground around it, appearing to have been forced up from below by the heavy fall of stone. Then a banyan tree, of a girth of 19 feet, which has been carried along bodily a distance of 100 yards, together with the rocks around which its roots are wound. To the west of the banyan tree is an old pathway which has been cut in two, the part upon the landslip being on about the same level, but 80 yards south of the part *in situ*, marking exactly the distance the slip has travelled on this side. South of the banyan tree is a sugar-mill, which shows curiously the form the slip has taken at this point; the bed of its crushing-wheels is thrown from the horizontal to an angle of 15° , dipping to the north, that is, away from the river. The mill is

said to have been on the top of a hillock, which appears to have been carried on and up, and may rest on the top of the old sandbank. Sugar-cane here has been carried



Sketch Map
of
THE NEW RAPID,
YANG-TSE KIANG
CHINA.

south about 80 yards, but is growing as if nothing had happened. The southern face of the slip presents to the river a bluff formed of a *débris* of loose mud and sand, with blocks of stone interspersed, 30 to 80 feet above the stream, and scarcely yet settled down. At the eastern extremity is a point (A on the map), the
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immediate cause of the rapid, running straight out into the river just where the stream is hemmed in on the south by a bluff 60 feet high, part of a reef of very hard sandstone that runs for miles. The point was, no doubt, at first of the same nature as the bank, but the river while in flood has washed out the loose mud and sand, and has left a most formidable heap of huge blocks of hard sandstone and jagged shale that have not been subjected to the rounding action of water; it bristles with sharp points, too cruel even for the cypress hull of a Yang-tse junk to touch.

The new rapid I found to be situated in lat. $30^{\circ} 54' 30''$ N.; its longitude may be estimated, from Blakiston's chart, at $109^{\circ} 16'$ E. It lies about half a mile above a small rapid called Ta-chang-tzu. There was no rapid here before the landslip, but a bay, it is said, and this is borne out by the name of the place, Lung-ching-wan, meaning Bay of the Dragon's Ford. The country on either side of the slip consists of slopes and hillocks of sand and clay coming down at an average angle of 30° towards the river from the main ridge, and divided by spurs of higher ground or secondary ridges at right angles to the main ridge, and to the river. The landslip consisted of the whole tongue of sloping hillside lying between two of these spurs, and it seems to have come down with a strong swing in the direction of the eastern spur, a point I shall notice later. On the east and west lines of fissure, blocks of stones have been thrown out resembling, near the river, the terminal moraine of a glacier, and along these lines small streams are working out a channel to the river.

The landslip occurred at 10 p.m. on September 30, 1896, after forty days of incessant rain. It seems that no one was killed, although we saw two houses that were wrecked and carried some 100 yards. The farmer who lives at the house on the west of the slip has been a heavy sufferer; his ancestral paddy land is gone under 40 feet of rock and *débris*, but he and his household of twenty mouths were lucky to escape with their lives: the slip passed within 20 yards of their door. The natives describe this landslip as a scooping movement, as if the earth had sunk in the middle of the slip and been piled up on the south, and there is evidence of something of the kind having happened, for there are two small lakes on the slip, and the surface rises towards the river. This is far from the only landslip caused in this neighbourhood by the excessive rains of last September. We noticed in our walks several smaller slips, and we heard of two very serious ones. The Sias Kiang, a tributary of the Yang-tse, on the north bank a few miles west of this, was said to be blocked to traffic by a slip of a similar nature; and a homestead embracing the whole family of a Master of Arts (*chü jên*), named Hwang, at a place called Chang-chia-wan, 20 miles from the north bank, was engulfed in a slip, which fell from the mountain-side into a deep valley, and buried in the bowels of the earth the houses and their sixty inhabitants.

In regard to the nature of the landslip, it should first be noted that the rocks which split vertically are, below, a very lightly compressed friable grey sandstone, and, above, a soft red sandstone. These probably rest on a very hard sandstone. These rocks all lie in stratification, and dip about east-south-east, a few degrees only removed from the direction of the slip. One may, perhaps, venture the following theory: the overlying soft rocks split under the weight of the mass above them saturated with rain, and slid along the dip of the hard sandstone beneath. This theory is borne out by the direction taken by the slip, which clung close to the ridge on the east, throwing up a big moraine of stone along the edge of fissure, besides pushing out point A; while on the west, at the side farthest removed from the direction of the dip, there was a smaller movement, and less disturbance.

Three months ago there was but one house here, now there is a busy town of

mat-shed shops—some four or five hundred. The place is full of trackers and the agents of merchants and junk-owners, and presents a most animated scene, suggesting a mining-camp. In the foreground pigs are being killed and food of all sorts prepared and offered for sale; trackers come labouring along, often fifty to one hawser; coolies pass and repass, carrying all manner of goods across the rapid; and the neighbouring slopes are adorned by square acres of Yorkshire lastings and long-ells, wrecked cargo spread out to dry—a field of gay colours; while in the distance on the flats beyond the river Indian cotton yarns form a white background, the whole set off by noble mountains, the lower slopes of which are green with young wheat and beans.

The effect of this rapid on the traffic is very serious indeed. For some time after the landslip the river remained very high, junks passed over the point, and the amount of damage to the river's channel was not known. In November all up-traffic was stopped. Not till the river had fallen much further, on December 4, were junks hauled up again. All junks, whether bound up or down stream, have to unlade, and then cargo has to be carried over land for half a mile. Downward-bound junks then shoot the rapids in the middle, and upward-bound ones are hauled over just under the point, by sheer weight of trackers, three to six bamboo hawsers and an equal number of stays being used to each junk. Both processes are very dangerous, and the merchant has not only to bear the extra expense, but to guarantee the junks against loss or damage. The junks hauled up seemed to us to be kept off the rocks beneath them by the tremendous force of the water under their hulls—of keel, of course, they have none, and they are, as I have said, empty. A hundred junks and a thousand lives have been already lost, we were told. The average cost of crossing the rapid may be put at one to two per cent. on the value of the cargo. About five hundred junks were lying at the rapid when we passed, the cargo on which may be roughly valued at £800,000. When the immense exchange of products between the lower Yang-tse provinces on the east, and Szu-chuan and North Yunnan on the west, is remembered, and that there is no other route practicable, the seriousness of this rapid can scarcely be exaggerated.

As there was no rapid here before the landslip, there can be no great difference in level* between the river above and below the obstruction, the removal of which would, one imagines, present no great difficulty to a foreign engineer; yet, far from taking any steps to get the obstruction removed, the local government, with the help of subscriptions from merchants in Wan Hsien and Ch'ung-king interested in the river traffic, is constructing roads on both banks for the portage of goods, as if the rapid were to remain a permanent bar to navigation.

I am afraid you will be weary of this letter, particularly of the details in regard to the landslips, but to us on the spot these details were intensely interesting; we could not but feel that we were face to face with one of those great forces that have laid down the surface of the Earth, and that such a chance of studying its action fell to the lot of few. And I must ask your indulgence for the deficiencies of this letter; it was written in a Chinese junk without the help of a library. I must ask the same indulgence for the map. The photographs, taken by Messrs. Neville, Bell, and Hanbury, who had to work under even greater disadvantages, have unfortunately not turned out well, for a worse place for photography and map-drawing could scarcely be found.

* This I believe to be the case at most, if not all, the rapids between I'ohang and Ch'ung-king. They only exist because the channel is contracted, usually by a boulder bed brought down by a torrent from the mountains, and not because of a great difference in level. They resemble mill-races rather than rapids.

THE POPULATION OF RUSSIA.

By P. KROPOTKIN.

THE figures relative to the population of Russia which were obtained at the recent census lead to several important geographical conclusions, some of which have been indicated by P. P. Semenoff in the report on the census which he read before the Russian Geographical Society on May 19,* while some others will be indicated in this paper.

From the items which were given in the June issue of the *Geographical Journal*, it was seen that the population of European Russia proper has attained this year 94,188,750 inhabitants, while the population of all the non-Russian provinces of the empire is 35,022,363, of which 2½ millions are in Finland, nearly 9½ millions in Poland, 9½ millions in Caucasia, nearly 3½ millions in the Kirghiz steppes, 4½ millions in Turkistan and the Transcaspian territory, and 5½ millions in Siberia.

At present the chief interest attaches to the distribution of the 94 millions of which the population of European Russia is composed, the last census giving most valuable data as regards its density in different parts of the territory, as well as the changes which took place in its geographical distribution within the last fifty years. In order to render these data more comprehensive, I have compiled the following table, in which the fifty provinces of European Russia are arranged into a number of natural groups, and the increase of population since the year 1851 is given for each group separately. I have also calculated the density of the population per square mile for each province separately, and I reproduce from the official census reports the relative proportions of males and females for each province of European Russia and for the other main divisions of the empire.

TABLE A.

Provinces.	Population.		Increase per cent. in 46 years.	Density in 1897. Inhab. per sq. mile.	Number of women per each 100 men. 1897.
	1897.	1851.			
Arkhangelsk	347,560	234,064	—	0·2	111·0
Olonets	366,647	263,409	—	1·2	110·9
Vologda	1,365,313	864,268	—	1·4	108·6
Northern provinces ...	2,079,520	1,361,741	53	—	—
Perm	3,002,655	1,741,746	—	3·7	107·0
Vyatka	3,082,615	1,818,752	—	8·2	109·2
Northern Urals	6,085,270	3,560,498	71	—	—
Novgorod	1,392,931	891,037	—	4·7	107·1
Pskov	1,136,580	657,283	—	10·9	106·0
St. Petersburg	2,104,511	566,409	—	19·5	87·4
Lake district	4,634,022	2,114,729	119	—	—
Livonia	1,300,401	821,457	—	11·8	106·3
Esthonia	413,724	289,800	—	8·7	103·3
Courland	672,539	539,270	—	10·2	105·8
Baltic provinces	2,386,664	1,650,527	54	—	—

* It was published in the Russian *Official Messenger*, Nos. 106, 107, and 108.

Provinces.	Population.		Increase per cent. in 46 years.	Density in 1897. Inhab. per sq. mille.	Number of women per each 100 men. 1897.
	1897.	1861.			
Vilna	1,591,912	787,609	—	15·7	100·4
Grodno	1,615,815	795,604	—	17·3	95·5
Kovno	1,549,972	875,196	—	16·0	103·5
Lithuanian provinces ...	4,757,699	2,458,509	94	—	—
Vitebak	1,502,895	742,811	—	14·2	100·6
Minsk	2,156,343	935,345	—	9·7	100·0
Mogbilev	1,707,613	837,537	—	14·6	101·7
White Russia	5,366,851	2,515,693	105	—	—
Smolenak	1,550,973	1,069,650	—	11·3	109·0
Kaluga	1,178,835	941,402	—	15·8	116·2
Western Central	2,729,808	2,011,052	35	—	—
Tver	1,812,559	1,359,920	—	11·6	119·4
Yaroslav	1,073,593	943,426	—	12·5	193·0
Kostroma	1,428,893	1,020,628	—	7·0	117·1
Moscow	2,433,356	1,348,041	—	30·1	83·2
Vladimir	1,570,730	1,168,303	—	13·4	114·2
Nijni-Novgorod	1,603,034	1,126,493	—	13·0	110·7
Moscow industrial region	10,922,165	6,966,811	57	—	—
Tula	1,431,322	1,092,473	—	19·0	111·4
Orel	2,054,609	1,406,571	—	18·1	105·1
Kursk	2,394,893	1,665,215	—	21·3	101·7
Ryazan	1,827,537	1,308,472	—	18·0	111·2
Tambov	2,715,265	1,666,505	—	16·9	104·4
Penza	1,483,948	1,058,444	—	15·8	105·8
Northern black-earth region	11,907,574	8,197,680	45	—	—
Kazan	2,190,075	1,347,352	—	14·2	103·1
Simbirsk	1,550,458	1,024,286	—	12·7	106·7
Saratov	2,419,756	1,444,496	—	11·8	103·5
Middle-Volga provinces	6,160,289	3,816,134	61	—	—
Podolia	3,031,040	1,577,966	—	30·0	82·1
Volhynia	2,999,346	1,469,442	—	17·3	98·2
Kieff	3,564,433	1,636,839	—	28·8	79·6
South-western provinces	3,594,819	4,684,247	105	—	—
Voronej	2,547,320	1,629,741	—	16·0	101·0
Poltava	2,794,756	1,668,694	—	24·1	101·4
Chernigov	2,322,007	1,374,746	—	18·2	103·6
Kharkov	2,510,378	1,366,188	—	18·9	98·1
Ekaterinoslav	2,112,651	788,179	—	13·8	94·1
Little Russia	12,287,112	6,827,548	80	—	—
Bessarabia	1,936,403	874,044	—	18·0	94·8
Kherson	2,728,508	889,205	—	16·0	95·3
Taurida	1,443,835	608,832	—	9·9	89·8
Don	2,575,818	907,948	—	6·5	98·1
Southern provinces ...	8,684,564	3,280,049	165	—	—

Provinces.	Population.		Increase per cent. in 46 years.	Density in 1897. Inhab. per sq. mile.	Number of women per each 100 men. 1897.
	1857.	1851.			
Astrakhan	1,002,316	386,763	—	1·7	95·5
Samara	2,761,851	1,820,108	—	7·2	102·4
Ufa	2,219,838	956,447	—	7·4	99·6
Orenburg	1,608,388	689,269	—	3·5	100·3
South-eastern provinces	7,592,393	3,352,587	126	—	—
Total, European Russia	94,188,750	52,797,685	78	8·0	102·8
Poland	9,442,590	4,852,055	95	30·6	98·6
Finland	2,527,801	1,636,915	55	3·2	102·2
Caucasia	9,723,553	4,436,152	—	9·3	89·5
Siberia and Sakhalin ...	5,731,732	2,497,184	135	1·8	93·7
Steppe region	3,415,174	1,220,654	180	0·6	89·4
Turkistan and Transcaspian	4,175,101	—	—	2·5	83·0
Russians in Bokhara and Khiva	6,412	—	—	—	99·9
Russian Empire	129,211,113	67,380,645	92	2·5	100·0

A few remarks must be made concerning the value of these figures. The earlier censuses of Russia were not censuses at all, in the sense that now attaches to the term. They were mere enumerations of the "tax-paying" peasant and small artisan population, which enumerations—as P. P. Semenov remarked in his report—"supplied almost no data for science, were of little value for the administration, and were hateful to the population." Still, the data which were collected in this way in 1851 were supplemented from various sources, and worked out in a more or less scientific way, by Koeppen; they may thus be taken as approximately reliable, in preference to the figures of a later enumeration which was made in 1858. They are given in the second column of the above table. As to the figures obtained during this year's census, they may be considered as quite reliable, within certain reasonable limits of possible error. To take that census, an army of 150,000 enumerators was set to work for three months—a great proportion of them being volunteers (more than a thousand students of the University and the High Schools took part in the census at St. Petersburg). The lists were made for each family separately, and they contain the name, the sex, the age, the mother-tongue, and the profession of each individual. Such lists will evidently make it possible to determine the number of persons of each age in the population, and to compile at last a reliable ethnographical map of the Russian Empire.

In the mean time, we can already see that considerable changes took place in the geographical distribution of the population of European Russia within the last forty-six years. From the third column of the above table A, it is evident that the increase of population has varied very much in different provinces. In some of them, possessed of a meagre clayey and sandy soil, the increase was as low as 35 per cent. in forty-six years, while in the provinces on the Black sea the average increase was 165 per cent., and even rose to 207 per cent. in Kherson.

True that the figures of the last census do not represent the *permanent*, but only the winter population. In Russia hundreds of thousands of peasants leave their abodes every winter, and wander south and north, towards the large towns, or to the fertile prairies, in search of work.* This sort of temporary migration is also very well illustrated by the extraordinarily high proportion of women in the population of certain provinces, which is seen in the census figures (table A). Thus, in Kaluga, which I know personally, the very high percentage of women (116 women for each 100 men) depends entirely upon the fact that a considerable proportion of the male population go in winter to South Russia in search of work as carpenters; they go chiefly to Kherson, where we find, indeed, the reverse proportion of only 95 women for each 100 men. In Tver, the similarly high proportion of women (117 women for each 100 men) is due to the men going in great numbers to St. Petersburg, to work in the textile factories during the winter months. In both these cases, and in fact in all others, the disproportion between the male and the female elements of the population would not have been so great if the census had been taken in summer, when the Kaluga and Tver people return home in order to work in their fields; but the same disproportion would then appear in other provinces, from which a considerable number of men migrate southwards, to work at haymaking in the southern prairies. However, even if these temporary causes were eliminated, very considerable differences in the rate of increase of the population would be none the less quite apparent.

The fact is—and this fact has an immense importance for the general development of Russia, its history, and its further progress—that the centre of gravity of the population of European Russia has been shifted within the last fifty years southwards, towards the shores of the Black sea. A hundred, and even fifty, years ago the chief bulk of the population of European Russia was in Central Russia, round Moscow; there being at the same time another centre of dense and numerous population round, or rather south-west of, Kieff. Now the main centre of dense population has been shifted southwards; and, while in Central Russia the population has been increasing more slowly than on the average in European Russia, in the southern parts of the territory the population was doubled and nearly trebled. Russia may be said to move southwards to the Black sea. In South Russia, especially since a prodigious development of agricultural home-made machinery took place,† and since culture on a large scale was introduced in the fertile “black earth” prairies, we find the densest agricultural population. There we find also the greatest number of populous towns, all of recent growth. If we take the towns having more than 75,000 inhabitants, we find that, with the exception of St. Petersburg and Riga, they are all situated to the south of Moscow, and that quite a number of large towns, which were quite insignificant spots fifty years ago, have grown up, either in the south of Kieff, nearer to the Black sea, or in the south-east on the lower Volga. Such are Kharkov (170,682 inhabitants), Saratov (133,116), Ekaterinoslav (121,216), Rostov-on-Don (nearly 150,000), Astrakhan (113,075), Baku in Caucasia (112,253), Kishineff (108,506), Nikolaeff (92,060), and Samara (91,659); to say nothing of a number of southern towns like Elisabethgrad, Kremenchug, Tsaritsyn, Berdicheff, Novocherkask, and Taganrog, which all have populations of more than 50,000. They have all grown up recently in

* The proportions of this migration may be judged from the figures which I gave in the descriptions of separate Russian provinces (K to Z) in the ‘Encyclopædia Britannica.’

† See the British Consular Reports in connection with the Nijni-Novgorod Exhibition.

South Russia, on or in the vicinity of the Black sea, and they are centres of either a considerable trade or of some important branch of industry. Besides, a very great number of populous villages in that region have rapidly become important small towns.

It may thus be said that the Baltic sea loses more and more of its importance for Russia, while the Black sea, and also the Caspian, acquire more and more importance in proportion. This is the fundamental fact which is brought into prominence by the last census.

Its geographical bearing is extremely interesting. The structure of the surface of European Russia may best be represented by stating that a broad plateau, deeply ravined by river valleys, crosses the territory from the south-west to the north-east; that is, from the Carpathians to the middle Urals. It slopes on the north-west towards the lake district and the double valley of the Sukhona and Vychegda (the two rivers which flow to meet each other and form, after their confluence, the Northern Dvina); and in the south it slopes towards the Black sea, the Sea of Azov, and the depression on the northern coast of the Caspian sea. Several separate depressions, which formerly were elongated gulfs of the Caspian sea and, later on, great lacustrine basins, are sunk into the plateau (the chief of them being that of Nijni Novgorod). This leading orographical feature of European Russia, which formerly was well understood by geographers, has unhappily been obliterated on recent hypsometrical maps, which, like all hypsometrical maps that are drawn with an insufficient number of contour-lines, have the drawback of obliterating the less pronounced yet important orographical features of a plateau-shaped territory. Nevertheless, all the physical and economical features of European Russia may be indicated on a map, in striking conformity with this leading feature of Russia's orography. The maps of distribution of various soils, of agriculture, of productivity of crops, of imported and exported corn, of agricultural well-being, of climate, and—we now see—of density and increase of population, can all be shown to be dependent upon the just-mentioned leading orographical feature. When we consider the figures of the last census from the geographer's point of view, we may interpret them as follows:—Formerly the Great Russians occupied the northern slope of the above-mentioned plateau, but gradually, since the seventeenth century, they began to spread along its northern edge. Next they spread on its surface; and since the end of the last century, when Turkish rule was abolished on the Black sea, they spread down the southern slope of the plateau, to the shores of the Black sea, the Sea of Azov, and the Caspian. At the present time as much as two-thirds of the whole population of European Russia is concentrated in the "black-earth" region, which covers less than two-fifths of the aggregate territory.

The table A fully illustrates this conclusion. We see, in fact, that the greatest increase of population took place in the southern "black-earth" and steppe-like parts of the plateau—the group of south-western provinces and Little Russia—and on its southern slope, in the provinces of Bessarabia, Kherson, Taurida, Don, and Astrakhan, where the increase of population was more than twice as high as the average increase for European Russia altogether.

Instituting a more detailed examination, and partly following P. P. Semenov's address, we find that (leaving aside the two capitals, Moscow and St. Petersburg) the densest population is in the south-western provinces of Podolia, Volhynia, and Kieff; in Little Russia (Voronej, Poltava, Chernigov, Kharkov); as well as in the group of the "northern black-earth region" (Kursk, Tula, Orel, Ryazan, and Tambov). In some parts of the last-named region, the agricultural population is altogether so dense that a considerable emigration to Siberia has taken place recently from the five last-named provinces. Consequently, the rate of increase of population was only 45 per cent. in forty-six years in these five governments.

In the Black sea provinces (Bessarabia, Kherson, Don, and Crimea) the increase ranges from 120 to 207 per cent., this last formidable increase having taken place in Kherson, where the population, attracted as it was by a very fertile, mostly unoccupied soil, by mining, and by the large city of Odessa, has more than trebled. The same is true of the south-eastern provinces on the lower Volga and in the Southern Urals, *i.e.* Samara, Ufa, Orenburg, and Astrakhan, where the increase was from 109 to 160 per cent., large towns also growing up in the mean time.

A strikingly small increase is found, on the other side, in the manufacturing region round Moscow, which contains nearly two-thirds of all the great industries of European Russia. In that region, notwithstanding the rapid growth of the capital itself, which now has nearly a million inhabitants, the increase was only 57 per cent., that is, much below the average increase for all European Russia.* As to the partly manufacturing provinces of Kaluga and Smolensk, which are possessed of but a very meagre soil, the increase of their population was still smaller (respectively 43 and 25 per cent.). Two other regions of very low rate of increase are found also in the lake district (Novgorod and Pskov) and in North-Eastern Russia, where the increase was only from 40 to 58 per cent. in forty-six years, notwithstanding the scarcity of population. As to the capital, St. Petersburg, its population has trebled within the same period, and now exceeds $1\frac{1}{2}$ million.

A notable feature is the rapid increase of population in the three Lithuanian provinces and the three provinces of White Russia. In only one of them, Kovno, the population has not doubled since 1851, while in the others the increase was from 100 to 137 per cent. The rapid multiplication of the Jews, and their better enumeration ("they have admirably well supplied all data for this census," M. Semennoff remarks), and especially the advantageous conditions under which the serfs were emancipated in the Lithuanian provinces (the Polish landlords were compelled, after the unsuccessful insurrection of 1863, to grant larger allotments and to receive smaller redemption for the liberation of their serfs than the Russian landlords in European Russia proper), fully explain, in Semennoff's opinion, that rapid increase.

As to Poland, which is the most densely peopled part of the empire, its population has nearly doubled since 1851 (increase 94 per cent.), and, what is still more remarkable, this high rate of increase was maintained within the last twelve years as well, while in several other parts of Russia the increase which took place in previous decades slackened recently. A good climate, a fertile soil, and an absence of droughts, which are so painfully felt in South-Eastern Russia, the specially favourable conditions under which the ex-serfs were liberated, the rational culture which spreads amongst the peasants as well, the rapid growth of industry, and partly also the German agricultural immigration, which was favoured by the German Government, explain this rapid increase.

As to Caucasia, its population has grown from 4,436,152 inhabitants in 1851 to 9,724,000; but this is not due to annexations—only 447,000 inhabitants having been annexed in 1878.† It is due partly to better methods of enumeration, but especially to the rapid colonization of Northern Caucasia by the Russians, as also, undoubtedly, to a local increase of population in Transcaucasia, where agriculture attains a high degree of perfection (in Tiflis and Kutais), while Baku has become a great industrial centre owing to its naphtha wells. The two

* The high percentage of women in that region shows that a considerable number of men must be absent in winter-time; but all allowance being made for that cause, the increase would still be very small.

† Against which might be set the loss by the depopulation of Abkhasia, now shown as uninhabited in the official maps.—Ed. G.J.

provinces of North Caucasia—Terek and Kuban—have now become, partly in consequence of immigration, and partly in consequence of natural increase (number of births as high as 55 in the thousand), important centres of Russian population—a very considerable number of small Cossack villages having lately become towns with 10,000 to 20,000 inhabitants.

As to Siberia and the Kirghiz steppes, they are being rapidly colonized by Russian emigrants. The province of Tobolsk is now thoroughly Russian, and it appears that even in the provinces of the Amur, Maritime, and Sakhalin there is already no less than 350,000 inhabitants, almost entirely Russians.

A question of great interest arises in connection with the last census, namely, what are the respective numbers of the different nationalities of which the Russian empire is composed? The lists of the census will undoubtedly give a complete answer to this important geographical question. It will take, however, much time to work out these data of the census, and in the mean time I have attempted to roughly compute what may be the number of Russians in that heterogeneous empire. For that purpose, I have availed myself of the percentages of different nationalities in Russia which were published some twenty years ago by Rittich.*

Taking Rittich's percentage figures and the data of the last census, the following table, which of course represents but a rough estimate, could be computed for European Russia:—

TABLE B.

Groups of provinces.	Population.	Great Russians.	Little Russians.
Northern and Baltic provinces	6,572,000	3,600,000	—
Lithuania, White Russia, and South-West Russia	19,719,000	200,000 (6,800,000 White Russians)	8,810,000
Little Russia and Don	12,750,000	4,000,000	8,400,000
Central Russia	28,082,000	26,100,000	1,000,000
Volga provinces	9,923,000	6,100,000	3,800,000
North-East Russia	9,913,000	7,400,000	100,000
Southern provinces	8,222,000	1,300,000	4,300,000
European Russia	94,081,000	49,700,000 (7,000,000 White Russians)	26,400,000

It may thus be said that there are in European Russia about 83,000,000 Russians out of 94,000,000 inhabitants, *i.e.* nearly 50,000,000 Great Russians, over 26,000,000 Little Russians, and about 7,000,000 White Russians (Byelorusses). There are, moreover, more than 3,000,000 Russians (Great and Little Russians) in Caucasia (chiefly in Cis-Caucasia), over 1,000,000 Russians in the Kirghiz steppes territory, and over 5,000,000 Russians in Siberia, as against less than 750,000 natives. The Russians thus make a little over two-thirds of the total population of the empire, and they are settled in three compact bodies—in Russia proper, in Northern Caucasia, and in Siberia.

* 'Plemennoi Sostav Kontingentov Russkoi Armii,' by A. E. F. Rittich. St. Petersburg. 1875.

A PORTABLE MERCURIAL BAROMETER.

By Captain H. H. P. DEASY.

THIS barometer, which was first used by Dr. J. Norman Collie, F.R.S., Professor of Chemistry, Pharmaceutical Society of Great Britain, consists of two glass ends of the same diameter, 0·4 of an inch, joined together by specially made rubber tubing of very small bore, capable of withstanding a long-maintained vacuum. The upper end is about 2·5 inches long, and contains an air-trap, into which all the air that may accidentally enter the barometer, either through the tap leaking, through the rubber tubing, or through either of the joints, must find its way. The lower or reservoir end is about 4·5 inches long, and has an air-tight tap about an inch below the broad part. These ends are forced into the rubber tubing, and, as an additional precaution against leakage, copper wire is bound round the joints. The scale is cut on an aluminium bar, along which two carriages, to which the barometer is attached, move up and down, and they can be clamped to the bar at any place (*vide* diagrams). By means of the verniers attached to the carriages, which are divided to 0·002 of an inch, it is very easy to estimate the height of the mercury to 0·001 of an inch.

To use the barometer, the carriages are put on the scale bar; the lower one is clamped at the bottom of the bar, and the upper one some inches higher up; the barometer is attached to the carriages by clamps which fit over the joints; the rubber cap is removed from the reservoir end, the tap opened, the verniers put in the middle of their runs, and the upper carriage moved up the bar until there is a vacuum. By means of the screws on the right of the mercury, the verniers are moved up or down until the top of the mercury at each end is in line with the edges of the rings attached to the verniers, and which fit round the glass ends. The rubber cap on the reservoir end is merely to prevent the small quantity of mercury, which should be left above the tap when it is closed, from being shaken out when travelling.

To pack up the barometer, lower the upper carriage *very slowly* until the mercury has touched the top of the glass; then detach the barometer from this carriage, and either let the upper end hang vertically below the reservoir, or detach the reservoir end from its carriage and raise it till the barometer hangs vertically. By this means the barometer is completely filled with mercury, and then the tap must be closed. The reason for doing this is to render it quite impossible for air to enter the barometer when it is not in use, as when thus filled and packed away the mercury is endeavouring to get out of the barometer. This is easily proved by carrying out the above directions, laying the barometer down on the ground or table, etc., raising the reservoir end, and opening the tap, when the mercury will at once rise in the reservoir. The barometer, with a thick soft cap at each end, is packed in a rectangular box about $11\frac{3}{4} \times 9\frac{1}{2} \times 3\frac{3}{4}$ inches, coiled round a partition containing the carriages, a small bottle of mercury, a small exhaust-pump, and a very small tin of composition to apply to the tap if required. A short length of tubing is put at the bottom of the box, and is required



THE BAROMETER IN ITS NORMAL WORKING POSITION.

to connect the pump to the barometer in case of air getting in, but the pump is seldom required. The total weight of this box and barometer, etc., is about $7\frac{1}{2}$ lbs. The scale-bar and travelling-case weigh about $6\frac{1}{2}$ lbs. Casella, who is the sole maker, is now making a lighter scale-bar and lighter carriages, so the total weight of the new instruments complete will be reduced.

If the instrument is packed as I described—in a well-padded box—it is quite unnecessary to take any further care with it when travelling. Should a traveller wish to carry a spare barometer, it can be carried in a well-padded box about $8\frac{1}{2}$ inches square by $4\frac{3}{8}$ inches deep, weighing, when full, about $3\frac{1}{2}$ lbs.

It was in a box of this description that I carried the barometer, which was exhibited before the Royal Society on May 19, 1897, on my recent journey into Western Tibet, of which country about 24,000 square miles were surveyed by me and the sub-surveyor, who was detailed by the Survey of India to accompany me. This particular instrument was used about two hundred and eighty times, and required to be pumped only twice. It was carried—chiefly on mule-back—over thirty-three passes, varying in height from 11,500 to over 19,200 feet, and was sent from Umballa to Bombay as an ordinary parcel, and thence shipped as ordinary cargo to London, where it arrived quite safely.

This instrument withstood a very severe test, to which it was accidentally submitted in India. It slipped off the seat of the carriage in which I was driving, and fell on to the metalled road. Although the best pace of hired animals in India is not very rapid, it was on this occasion quite sufficient to prove that this barometer, packed as described, can safely undergo a considerable amount of very rough usage. I would like to allude to the alleged drawbacks to this barometer, and to reply to them.

First, it takes a long time to set it up and take readings. I admit that the directions are somewhat lengthy, but it does not take long to carry them out—only about ten minutes to unpack, set up, read, and repack.

Second, it may require pumping often. I used one about 280 times, and it required pumping only twice, and the older the instrument the less likely is it to require pumping. Leakage would, of course, occur more easily when high pressures were being measured.

Third, it is hard to exhaust from it any air that may accidentally get in, and, besides, it takes a long time. This operation is not difficult, and, with a proper pump, should not take half an hour to perform.

Fourth, the presence of air in the instrument causes false readings. I compared the readings of my barometer, with air in the air-trap, with those of two standards, and all three readings were identical. As long as air does not go beyond the air-trap, the readings are not affected thereby.

Fifth, one critic—a very competent one—considered the handle of the tap, the neck joining it to the tap, very fragile. This is the strongest kind of handle, and the quality of glass used is exceedingly tough, so that there need not be any fear of the handle being wrenched off. Spare taps may be carried and easily fitted in place of a broken one.

Sixth, an error of reading would occur, owing to the meniscus of the mercury in the narrow top and bottom cisterns. This would not be the case, for the reading in the upper part of the barometer would be too high by exactly the same amount as that in the bottom part, and the two errors would counterbalance one another.

Seventh, there is no attached thermometer. Not required for all ordinary purposes, as, by exposing the instrument thoroughly for a few minutes, it will then have the same temperature as the surrounding air, which is easily ascertained

by suspending a thermometer from the clamp-screw of the upper carriage, or from any other place close to the instrument.

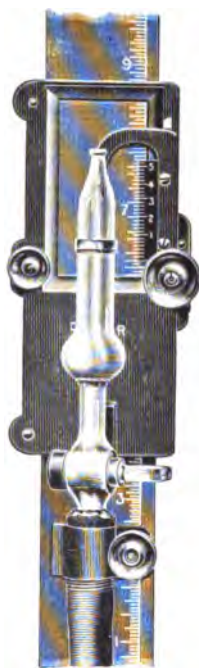
Eighth, the rubber tubing becomes stiff in cold weather, and will not last long. The tubing of the barometer which I used in Tibet was perfectly pliable at a temperature of $\pm 0^{\circ}$ Fahr., and did not show any tendency to becoming stiff. Time alone will prove for how long this tubing, which is made of the very best materials, will last; but I should think it will remain perfectly good for several years, and it can easily be replaced without returning it to the maker.

Ninth, the mercury soon becomes dirty and discolours the glass. Yes; but only in the reservoir end, which is open to the air, and it is easily cleaned with a piece of cotton-wool attached to a wire or stick.

Tenth, if, by any means, a large quantity of air got into the instrument, it might easily get above the air-trap and render the barometer useless until the



THE UPPER CARRIAGE AND VERNIER,
WITH BAROMETER ATTACHED.



THE LOWER CARRIAGE AND VERNIER, WITH
RESERVOIR END OF BAROMETER ATTACHED.

mercury was re-boiled. Quite recently, while testing a piece of new tubing which was thought to be defective, the barometer was set up and left open, with about half an inch of vacuum, during the night. On examining it next morning, the upper part was found full of mercury, the air-trap was full of air, and there was a considerable amount of air in the tubing as well.

Having referred to the alleged drawbacks, I think it will not be out of place for me to mention that this kind of barometer requires no special care when packed as described by me; is capable of withstanding a considerable amount of rough usage, exposure to great changes in temperature, without being opened; is very easily and rapidly set up and read; the error, if any, is constant, and it will last for several years without requiring new tubing. A spare barometer of this pattern, which

reached me when I was on my way to Tibet, having proved defective owing to a faulty tap, I filled it in a temperature of about $+25^{\circ}$ Fahr., at Rimdi, near Changchenmo, in Ladak, and sent it by coolie over two passes about 18,000 feet high to Leh, and thence by parcels post to London, over three passes varying in height from 11,500 to 13,600 feet, and through India in the month of June, when it is reasonable to suppose that it was subjected to a temperature of about 100° Fahr., probably higher. This instrument, which in all probability experienced a change of temperature of about 75° Fahr., reached Dr. Norman Collie in London quite safely.

NOTE BY DR. J. NORMAN COLLIE, F.R.S., ETC.

The barometer mentioned above by Captain H. H. P. Deasy ought to be of considerable use as a field instrument, chiefly on account of the ease with which it can be packed and carried about without fear of damage. The ordinary mercurial barometer is an unwieldy instrument to use, and must be constantly looked after during transport; in this new form of mercurial barometer, the stem being flexible obviates most of the objections which can be urged against the ordinary form of barometer.

During a mountaineering expedition to the Himalayas in the summer of 1895, I first used one of these flexible-stem barometers. The instrument was packed in a quarter-pound tobacco-tin, and usually carried in the pocket of my coat; for a scale a pocket steel measure was used, and my ice-axe, and two indiarubber rings to clamp the barometer on to the axe, served as a support for the instrument. Of course the readings were only approximately accurate to within, perhaps, a tenth of an inch, and do not for one moment compare with those obtained by the perfected instrument used by Captain Deasy. The instrument, however, has lasted well. Since 1895 it has been lying about in a cupboard, but it is still in a perfectly usable condition, and I shall take it with me on an expedition this summer to the Selkirks, in Western Canada.

Appended is a table of comparisons of two patent portable barometers with two standard barometers.

HEIGHT IN MILLIMETRES.

Barometers.	I.	II.	III.	IV.
June 11, 1897	767.6	767.4	767.3	767.4
June 12, 1897	767.5	767.4	767.2	767.4

I. Barometer at University College (chemical laboratory).

II. Barometer at Pharmaceutical Society (chemical laboratory).

III. Barometer used during trip to Tibet, 1896.

IV. Barometer used in Himalayas (Kashmir), 1895.

NOTE.—There was a minute bubble of air in Barometer III. Barometers II., III., and IV., were all read in the same room, which was about 30 feet higher than the room at University College in which Barometer I. was read.

THE SOCIETY'S ADDRESS TO THE QUEEN.

We give in this month's number of the *Journal* a reduced facsimile of the Address presented to the Queen, on the occasion of the completion of the sixtieth year of Her Majesty's reign. Necessarily the colour embellishments are omitted.



The Humble Address of the President and Council
of the Royal Geographical Society.

Most Gracious Sovereign,

WE, Your Majesty's dutiful and loyal subjects, the President and Council of the Royal Geographical Society, beg leave, most respectfully, to offer in the name of the Society, our sincere congratulations on the completion of the Sixtieth Year of Your Majesty's happy and glorious reign.

Sixty Years ago, on the occasion of Your Majesty's accession, our predecessors offered Your Majesty a humble address, thanking you for your gracious condescension and goodness in granting the Society the honour of Your Royal Patronage and in bestowing upon the Society a Royal Premium for the encouragement of geographical science and discovery.

Your Majesty has been graciously pleased to continue these marks of Your Royal favour throughout your long reign much to the advantage of the Society and to the advancement of the important subject with which it is its function to deal. The most distinguished explorers and geographers at home and abroad during that long period have been the recipients of the Medal which Your Majesty's liberality enables the Society to award each year.

In the humble address offered by the Society sixty years ago it was predicted that the reign of Your Majesty, like that of your great predecessor Queen Elizabeth would be famed for its glory and prosperity, and for the promotion of geographical knowledge. This prediction has been amply fulfilled, for during Your Majesty's reign, all the unknown lands of the earth have been opened up, the depths of the ocean have been explored, and both poles have been closely approached, and that to a large extent by British enterprise.

Through this means not only has knowledge been greatly advanced, but humanity has been materially benefited, civilisation spread over the globe, and the glory of the great Empire over which Your Majesty reigns, enhanced in a degree never before equalled.

That Your Majesty may still be long spared to reign over this Great Empire is the earnest wish and ardent prayer of Your Majesty's loyal and devoted servants and subjects, the President, Council and Fellows of the Royal Geographical Society.

Wm. Mitchellham, Printer.

T. MORING, LONDON. W.C.

REDUCED FACSIMILE OF THE ADDRESS PRESENTED TO THE QUEEN
BY THE ROYAL GEOGRAPHICAL SOCIETY.

THE MONTHLY RECORD.

EUROPE.

National Photographic Record Association.—Sir J. Benjamin Stone, M.P., who has greatly interested himself in the systematic collection of photographs illustrating the history of different parts of the country, convened a meeting on July 8 to consider the further development of the idea. To this meeting he invited, amongst others, representatives of the Royal Society, the Royal Geographical Society (Major Darwin and Dr. Mill), the Society of Antiquaries, the Royal Archaeological Institute, the Royal Institute of British Architects, the Royal Photographic Society, the British Museum, and the South Kensington Museum. Sir Benjamin Stone presided, and spoke of the important aid to historical description which the modern permanent photographic processes had rendered available. It was now possible to secure photographs which were as durable as the paper on which they were printed, and the British Museum authorities had undertaken to accommodate a collection forming a National Record as soon as it was brought together. The chairman had presented one hundred pictures of Westminster Abbey and the Houses of Parliament, which he had taken himself, to form a nucleus. During a short discussion, the importance of making the proposed record applicable to the whole United Kingdom, and of making it include illustrations of the common dwellings of the people as well as public buildings and objects of archaeological interest, was insisted on. A resolution was put and carried that an association should be founded for the purpose of carrying out the proposed plan under the name of the National Photographic Record Association, and a small committee was nominated to carry out the organization of the association. The names proposed were the Earl of Crawford, F.R.S., Sir E. Maunde Thompson, Sir Benjamin Stone, M.P., Prof. Meldola, F.R.S., Captain Abney, F.R.S., Dr. H. R. Mill, Mr. Alexander Graham, Mr. St. John Hope, Mr. Philip Norman, Mr. W. W. Watts, Mr. C. E. Fagan, Mr. Lawrence, and Mr. Robinson, while Mr. Scamell, Hon. Secretary of the Royal Photographic Society, agreed for the present to act as secretary. The exact scope of the work of the new association has not yet been defined; but there is no doubt that it will be to a very large extent geographical in its character, and will help towards the more complete description of the British Islands.

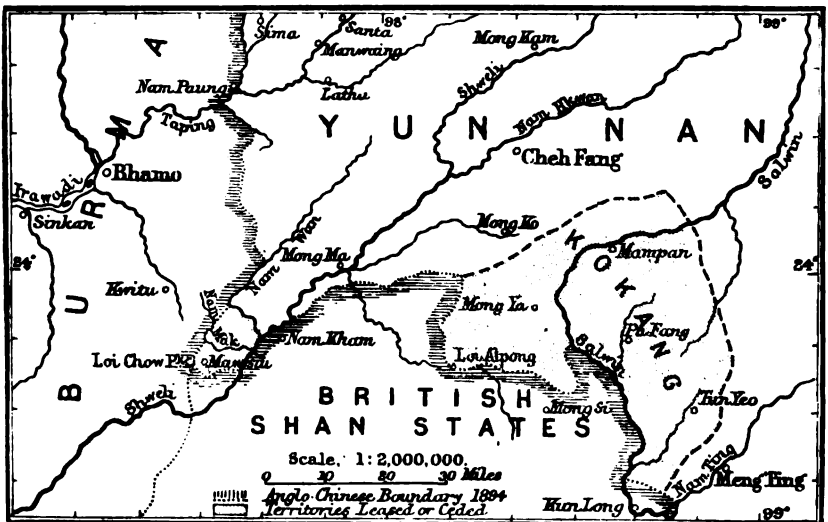
Regel's Geography of Thuringia.*—The region of the Thuringian states in Middle Germany, with which Prof. Regel's voluminous book deals, is very small, but it possesses a distinct individuality physically, ethnologically, and historically. It stretches from the southern slope of the Hartz plateau to the crest of the Thüringerwald on the north and south, and from the Eichsfeld on the west to the Saale plateau on the east. With the conclusions arrived at from the elaborate discussion it would be impracticable to deal here, but it is interesting to note what a German Professor of Geography considers to be the subject-matter for a geographical handbook, and the order in which he presents his selected facts. The whole is divided into three parts—the Land, Biogeography, and *Kulturgeographie*, which may be taken as equivalent to commercial geography. The first part deals with the historical and actual boundaries of the region, the general configuration and river-systems, at great length with the geological structure and history, and more briefly with the climate. The second part forms two great divisions—the first dealing very exhaustively with

* 'Thüringen: Ein geographisches Handbuch.' Von Dr. Fritz Regel. 3 vols. Jena: Gustav Fischer. 1892-96.

the distribution of plants and animals, including long lists of species; the second treating of the inhabitants. The portion dealing with the people occupies one quarter of the whole work, and includes a discussion of the prehistoric inhabitants, an account of the people inhabiting the country throughout historical time (practically an epitome of the history of Thuringia), an anthropological study of the existing inhabitants, and discussions on the local dialects, folk-lore, costume, and dwellings. The third great division treats of the utilization of the land in agriculture, cattle-rearing, forestry, fishing, and mining, the industries (treated in much detail), trade, the distribution of the people, and, more briefly, the religious, intellectual, and political conditions. The whole work is minutely classified, and the divisions numbered. A valuable subject-index, with about twenty thousand references, concludes the whole. Each section is headed with a list of the literature of the subject, and nothing more elaborate and exhaustive could well be imagined. We miss, however, a general summary, which might combine and generalize the bewildering profusion of facts and figures. The illustrations have suffered from the necessity of keeping down the cost of production, but, in spite of all economy, the work must have been an expensive one to produce, and the publishers, no less than the author, deserve praise for their enterprise in carrying it to a conclusion. A geological map, printed in black alone, but clearly indicating twenty-six different formations, is a marvel of skilful draughtsmanship.

ASIA.

The Anglo-Chinese Agreement of June 5, 1897.—The Anglo-Chinese Agreement, which was ratified at Peking on June 5 of the present year, very considerably modifies the stipulations of the Frontier and Trade Convention of March 1, 1894. These modifications had become necessary in consequence of China having



alienated, by her Convention of June 20, 1895, with France, certain territories which she had undertaken not to cede to a third power without having previously obtained the consent of Great Britain. China, notwithstanding this clear understanding, ceded the small state of Muang U, in the upper valley of the Nam U, and

the state of Kiang (Keng) Hung to the east of the upper Mekong. By the present agreement full reparation is made for this breach of the convention of 1894. Articles II. and III. deal with territorial changes. By Article II., China grants to Great Britain a perpetual lease of a small territory to the west of the Shweli river, which is bounded on the north by the Nam-Wan, and traversed by the Nam Mak. This territory possesses some importance, as it presents facilities for building a road from Bhamo by way of Kwitu to the Shweli. The administration and control of this district will be entirely conducted by the British Government, China undertaking not to exercise any jurisdiction or authority whatever. By Article III., China cedes the Shan state of Kokang, which lies for the greater part beyond the Salwin, its chief if not only access being along the railway now under construction between Mandalay and the Salwin ferry at Kun Long. Commercially, the concessions made are even more important. Trade between Burma and Yun-nan, which had been confined to the routes leading to the Chinese custom-houses at Sansi (25° 7' N.) and Manwaing (Manwyne, 24° 32' N.), is to be sanctioned by any other routes, the opening of which may be found to be in the interests of trade. The question of the construction of railways in Yun-nan is to be considered, and if decided in the affirmative these lines are to be connected with those of British Burma. By Article XIII., Great Britain may station consuls at Sumao, in Southern Yun-nan, and either at Momein (Tung-Yueh-ting, 25° N.), or Shun-ning-fu, on the upper Mekong (24° 25' N.), and British subjects may establish themselves and trade at these places under the same conditions as at the treaty ports. Lastly, China has consented to the opening of the West river or Si-kiang as far as Wu-chau-fu, about 180 miles above Canton, where the tide still rises from 12 to 20 feet. The town named Sam-shiu and Kong-kun are to be "open" ports, and steamers will also be allowed to call at Kong-mun, Kom-chuk, Shin-ning, and Tak-hing for goods and passengers. Our sketch-map is intended to illustrate the territorial changes effected by this agreement. As the country beyond the Salwin is still almost a *terra incognita*, the boundaries given to Kokang must be accepted as a rough approximation. Its survey will no doubt be undertaken shortly. As to the Si-kiang, it is interesting to note that H.M.S. *Tweed* has already left London for the purpose of making a survey as far as Wu-chau.

Dr. Sven Hedin's Travels.—Pending the presentation to the Society of the connected narrative of his travels, which Dr. Hedin has promised for one of the evening meetings next session, it may be of interest to recall in outline the chief explorations carried out by him during his long wanderings in the heart of Asia. After a preliminary journey to Persia and Kashgar in 1890, Dr. Hedin returned to Sweden and obtained the support of King Oscar and one or two private individuals for an exploring project, by which he proposed to visit some of the least-known districts of Central Asia. He set out in October, 1893, and spent the greater part of 1894 in investigations of the climate and glaciers of the Pamirs, paying particular attention to the relation of the snow to the quantity of water in the tributaries of the Amu-darya. He ascended the great peak of Mus-tag-ata (Tagarma) to a height of 20,000 feet, out of its total of 25,000. The succeeding winter was spent at Kashgar, and in February, 1895, Dr. Hedin started eastward, exploring the country between the Kashgar and Yarkand rivers, and proceeding in April to cross the dreaded Takla-Makan desert, between the latter river and that of Khotan. Its passage had never before been attempted, and though successful, Dr. Hedin barely escaped with his life, the caravan finding no water during a thirteen days' march across a desolate region of high sand-dunes. In addition to the leader, only two men and one camel reached the Khotan river. Whilst waiting to replenish his supplies, and to replace the instruments lost on this unfortunate expedition, Dr.

Hedin paid another visit to the Pamirs, and completed his topographical and geological survey of the difficult mountain ranges which bound them to the east. Leaving Kashgar again in December, 1895, he proceeded to Khotan, crossed the desert between the Khotan and Keria rivers, and traced the latter to its termination in the sands. He then crossed the desert northwards to the Tarim, discovering interesting remains of old buried cities, once possessed of a high degree of culture. Continuing down the Tarim, he carefully mapped its intricate river-system, and proceeded to Lob Nor, where he set himself to solve the problem of the discrepancy between Prjevalsky's account of the lake and its delineation on old Chinese maps. Dr. Hedin found the large northern lake of the latter represented by a series of small lakes in a part of the Gobi unvisited by travellers. In May, 1896, he was again in Khotan, and a month later set out for Tibet, crossing the Kwen-lun by a new pass south of the Kopa goldfields (about 82° E.). For two months he journeyed across the northern, highest plateau of Tibet, seeing not a single human being outside his own party, but finding great herds of wild horses and yaks. Four large and nineteen small salt lakes were discovered, the largest stretching alongside the route during four days' march. Having lost many of the baggage animals, the caravan made for Tsaidam, the first Mongols being met at Tsohan-gol. In Tsaidam the party had to stand on their guard against the attacks of Tangut robbers, but eventually avoided a fight. Passing through Sining and Liang-chau, Dr. Hedin crossed the Alashan desert by a new route, and made his way through the Ordos country to Peking, which was reached on March 2, 1897. He returned to Europe *via* Urga and the Siberian railway. As already mentioned, Dr. Hedin is now engaged in writing the narrative of his travels, and will for some time to come be occupied with the working-up of the scientific results.

Exploration of Bukhara.—An expedition, under Colonel Kouznetsoff, was sent out this spring from Russian Turkistan for the exploration of Bukhara. Part of this expedition has already returned home. From the railway station, Kermineh, they went southwards *via* Karshi, Guzar, and Shir-abad, to the ruins of Termez. They collected chiefly statistical information, and studied the economic conditions of the Khanate. From Termez they reached the banks of the Amu at Pata-ghissar, and followed them for 190 miles, through the desert region, crossing the Surkhan, Kafirnagan, and Vaksh rivers, and finding on this stretch only two inhabited spots, Aivaj and Sarai. From this first spot they explored the yet unknown region in the direction of Chubek and Sarigor, whence they returned to Aivaj, and from this spot proceeded down the Amu to Charjui in a boat. More than two hundred photographs were taken during the journey. It is to be hoped that through the expedition we shall at last learn something about the population and economic life of Bukhara, which hitherto remain less known than even far less accessible parts of Central Asia.

Attack on Lieut. Pottinger's Expedition to the Upper Irawadi.—We regret to learn that the expedition under Lieut. Eldred Pottinger to the upper Irawadi, which was supported by the Royal Geographical Society, met with a reverse at the end of May last. According to telegrams received in June, an attack was made by the "Black Mairus" on the night of May 22, and a native surveyor and one of the Gurkhas of the party were killed. The leader escaped, with his companion Mr. Laurence and the rest of his force, and after great difficulties reached Myitkyina, below the junction of the two branches of the Irawadi, on June 18. Lieut. Pottinger informs us by letter that he has been able to save his maps, which will throw light on the previously unknown country between 25° 20' and 26° 45' N., and between 98° 15' and 98° 45' E. He promises the full account of his travels shortly.

The Chin Hills.—We have received from the Chief Commissioner of Burma the first volume of a comprehensive account of the Chin hills, which is being brought out under Government auspices by R. S. Carey and H. N. Tuck. Besides giving a historical sketch of the British relations with the Chins, it contains a useful summary of the geography of the country and the manners and customs of the inhabitants. The abundant photographic illustrations are also a valuable feature. The country is described as consisting of a much broken and contorted mass of mountains intersected by deep valleys. It is utterly devoid of plains and tablelands. The main ranges run generally north and south, varying from 5000 to 9000 feet. Five distinct kinds of forest are mentioned, but the hills are often thickly clothed with grass. The illustration facing page 5 gives a typical view of the nature of the country. Of the Chin tribes, the Hakas of the south contrast strongly with the Siyins of the north by their manly carriage and frank manner. The latter are cruel and untrustworthy. Three types of village are described—those of the nomadic “jhoomers,” the professional raiders, and the stationary communities, powerful enough to resist attack. The raiders choose the most inaccessible sites, without thought of other advantages. Those of the third class are also carefully fortified, and the entrances are so small as to admit only one man at a time. They are nearly always placed on the side of the hills. Numerous illustrations of villages and houses are given, plate 17 (*a* and *b*) showing the great size to which the former sometimes attain. The system of bachelor quarters which prevails among many of the hill tribes between Burma and Assam, does not appear to be found amongst the Chins. Amongst the Hakas, whose houses are the finest in the hills, the back room is occupied by the whole household, the girls sleeping on one side, and their would-be sweethearts on the other. Marriage customs differ in the north and south, but in both the girls are practically sold by their parents.

The Amur Geographical Society.—The last issue of the ‘Memoirs’ (*Zapiski*) of this young Society (vol. ii. part i.) contains a very interesting work, by M. Shimkevich, on Shamanism amongst the Gols. It is a well-written account of the religion of this interesting tribe, its customs, beliefs, etc., in which some quite new folk-lore is given. Portraits of shamans, and photographs of many interesting objects of worship are given. The second part of the same volume is devoted to an inquiry, by N. A. Krukoff, into the forms of land-ownership, which have been worked out by different Russian settlers in the Amur and the Usuri regions, on the lands which were allotted to separate villages.

AFRICA.

British Expedition to the Jub.—Major J. R. L. Macdonald, well known for his work in British East Africa, left England in June last to take command of an expedition despatched by the British Government to explore the river Jub. One of the main objects of the expedition is to settle which is the main branch of the stream, this constituting the boundary of British East Africa according to the Anglo-Italian agreements of 1891 and 1894. On some maps, published both abroad and at home, the frontier is shown as following the course of the Daua, although this would seem rather to be a southern tributary of the main stream. King Menelik is said to be desirous of coming to an understanding with the British Government with regard to the mutual frontier. It will be remembered that Dr. Donaldson Smith holds to the belief in the identity of the Omo with the Jub, so that, in spite of the many Italian expeditions to this region, some important geographical work remains for Major Macdonald to perform. He will be accompanied by various officers, with a force of Indian troops, and it is hoped that a large increase to our knowledge of the country in various directions will result.

M. Foa's Explorations in the Zambezi-Nyasa Region.—M. Foa calls our attention to the scientific results of his travels, the narrative of which has lately been given to the public in the works noticed elsewhere in the *Journal*. M. Foa's journey was carried out under the instructions of the French *Ministre de l'Instruction Publique*, and the large zoological collections made by him have been sent to the Paris Museum. Throughout his journeys, largely over untraversed routes. M. Foa executed surveys checked by astronomical observations. He visited the old gold-workings north of Zambezi, and carried out a triangulation of them with the aid of the theodolite. He also investigated the hydrography of the country between the Zambezi and Lake Nyasa, and determined the watershed between the two systems. The results of these surveys are unfortunately not fully given in the published account of his travels, and M. Foa does not inform us in what form they are to be issued. In May last he was about to start from the Shire river on a new expedition to Lake Tanganyika, whence he hoped to proceed by new routes to Katanga, and possibly to make his way across to the French Congo territory.

Dr. Esser's Exploration of the Lower Kunene.—The second number of the *Verhandlungen* of the Berlin Geographical Society for the current year contains the account of a journey made by Dr. Max Esser to the district of the lower Kunene, principally with a view to testing the possibilities of the stream as a means of communication with the interior of German South-West Africa. Starting from Mossamedes, Dr. Esser proceeded southward to Port Alexander, an excellent harbour, which, in spite of the absence of good drinking-water, might acquire importance from the export of dried fish, used along the whole West African coast as the staple food of the negro labourers. Hence the route led over the Chella range and down the Caculovar to the Kunene, which was then followed to the sea. Great quantities of game, including elephants, giraffes, and ostriches, were met with throughout most of the journey. On the west of the Chella range, a nomadic people, the Muquichs, were encountered. They are served by the Ba Kubabe, one of the rudest and least civilized tribes to be found in Africa, whose whole nutriment consists of raw roots and leaves. Fires were never seen in their villages. East of the Chella, the Nyi Buba, a branch of the Vaherero of Damara-land, formed a complete contrast by their intelligence and noble bearing. Many Boers were met with, some being engaged in washing for gold, which has lately been discovered in rich deposits north-east of Humbe. The Kunene varies exceedingly in character, being sometimes broad and fordable, and sometimes confined to a rocky channel less than 10 yards wide. In the direction of the sea the country became more and more broken and rocky, the colouring of the rocks defying reproduction on paper. Below the St. Marien, a tributary on the south bank, the stream appeared to be navigable to within a little of its mouth, none of the obstructions marked on Portuguese maps being visible. Dr. Esser saw evidences of the former existence of a channel leading southwards to a small bay, which, he considers, may supply a means of approach to the coast for ships. The main mouth of the river being, as is known, blocked by drift-sand, this bay may, he thinks, become an important point of entry into the German territory, the Kunene route having the advantage of a constant water-supply. Tiger bay, north of the Kunene, is, however, considered by Dr. Esser as the best harbour on the whole coast, and the natural terminus of a railway which might connect the Atlantic and Indian oceans *viâ* British South Africa and the Transvaal.

Dr. Passarge's Expedition in South Africa.—Dr. S. Passarge, well known for his explorations in Adamawa, last year undertook an expedition to the region of Lake Ngami. A letter from him, written in December last on the banks of the Botletli river, and published in the *Verhandlungen* of the Berlin Geographical

Society, gives some details as to the complicated *régime* of the rivers in that region. At the point at which his camp was pitched, a stream entered the Botletli from the north-west, coming apparently from the Okavango. Between the point of junction and Lake Ngami there was no perceptible current, while the eastward flow of the Botletli, east of the junction, was unmistakable. Dr. Passarge therefore suggests that the stream from the north-west, which is not shown on our maps, may date from recent years only, and that this may explain the great decrease in the size of Lake Ngami. It may be noted, however, that, ever since Livingstone's time, a branch of the Okavango has been reported as entering the Botletli direct, but this may be farther west than the stream seen by Dr. Passarge.

French Explorers in Africa.—The July number of the *Revue Française* gives several items of news relating to French explorers in Africa. M. Foureau, who set out in April last on a new journey in the Sahara, has returned to Biskra, having been unable for want of camels to proceed southwards to Aïr. The Hoggar Tuareg were raiding towards the south, and it is possible that the reverse lately sustained by a French force north of Timbuktu may have been inflicted by them. Mgr. Toulotte, of the White Fathers, has made his way from Timbuktu to Konakri by way of the sources of the Niger, passing along the frontiers of Liberia and Sierra Leone. M. Gentil, engaged in the transport of a small steamer to the Shari, has been delayed in launching the same on the Nana through the discovery of an obstruction to navigation. A suitable spot for putting together the sections was, however, ultimately found, and it is probable that the steamer was ready for launching early in May. A letter from the explorer himself, published in the *Politique Coloniale* of July 17, states that the Nana is not identical with the Kuma, as thought by Maistre, but has a parallel course.

Capture of Rejaf by Congo State Troops.—News has been received in Brussels of the capture, after severe fighting, of the post of Rejaf, in the so-called "Lado Enclave" (leased to King Leopold by Great Britain), by the expedition despatched in December last under Captain Chaltin. After being driven from their position, the Dervishes fled towards the north, and the people of the district made their submission to the Congo State. The site of the old post of Lado is now covered with brushwood, and others of the old Egyptian stations have also ceased to exist.

AMERICA.

Cabot Celebrations.—A meeting of the Royal Society of Canada was held in June to commemorate the discovery of the continent of North America by John Cabot. Major-General D. R. Cameron was present as delegate of the Royal Geographical Society, and on behalf of that body delivered a message of sympathy with the objects of the gathering, and appreciation of the invitation given to the Society to send a representative to it. The reception accorded to Major-General Cameron was of the heartiest nature. Exhaustive papers, dealing with Cabot's discovery and elucidating difficult points connected with it, were read by competent authorities, those by Archbishop O'Brien (President of the Royal Society of Canada) and Dr. S. E. Dawson being especially mentioned by our delegate. The former explained certain difficulties by supposing that a part of the original map of Cabot's voyage was erroneously introduced into the later and more general map. The city of Bristol is commemorating the four hundredth anniversary of Cabot's voyage by the erection of a memorial tower, intended to be 100 feet high, the foundation stone of which was laid by Lord Dufferin on June 24. The tower will be squarely built, in two stages, with an octagonal spire surmounted by a globe and symbolical figure. Lord Dufferin delivered an address, in which he pointed out the importance of Cabot's

discovery to the development of the sea-power of Great Britain. At Halifax, Nova Scotia, a memorial tablet was on the same day unveiled by the Governor-General of Canada, whilst the occasion has been commemorated by the Newfoundland Government by a special issue of postage stamps.

Scientific Expeditions in North America.—The various scientific expeditions now in the field in one part or another of North America include two to Mount St. Elias—one Italian under Prince Luigi Amadio, and one American under Mr. Henry G. Bryant, well known as the leader of the Peary Auxiliary Expedition of 1894. Prof. W. Libbey, jun., also a member of the same expedition, has proceeded with a party of explorers to Albuquerque, New Mexico, with the intention of exploring a *mesa* or sandstone tableland in that neighbourhood, which has hitherto proved inaccessible, although it is thought to contain archæological remains. Its height is more than 7000 feet. It is also announced that a party from the London Alpine Club and the Boston Appalachian Mountain Club will carry out explorations in the Canadian Alps, whilst the islands in the Gulf of California are to be explored by an expedition sent out by Mr. Jesse D. Grant. The anthropological study of the North Pacific, set on foot by M. K. Jessop, has already been alluded to (*Journal*, vol. ix. p. 568).

Rainfall of the Northern Part of Central America.—By way of completing the work of Prof. M. W. Harrington on the Central American Rainfall (Washington, 1895), and correcting it on the basis of further data, Dr. Karl Sapper, of Coban, Guatemala, contributes to the June number of *Petermanns Mittheilungen* some notes on the rainfall of Guatemala, Salvador, British Honduras, and the southern parts of Mexico as far as the Isthmus of Tehuantepec, and annexes three rainfall maps. The data are, however, still very imperfect. The maps are based on observations at thirty-three stations, but only at six of these do the observations extend over more than four years. In the part of Mexico included, for the omission of which from Prof. Harrington's work Dr. Sapper expresses regret, there are only three stations, with observations for one year each, and those different years. Dr. Sapper has, thus far vainly, endeavoured to obtain the results of the meteorological observations at Campeche and Mérida—for a series of years presumably, for Mérida is one of the places for which in his table he gives data for one year. The two other Mexican stations are Ixtacomitan and San Juan Bautista. The inadequacy of the data thus afforded has compelled him to base his map, so far as Mexico is concerned, on the character of the vegetation.

The Chilean-Argentine Boundary Question.—The voluminous nature of the literature on the question of the boundary between Chili and Argentina, and the plausible advocacy by writers on the one or the other side of the particular view which favours their own nation, renders the clear and impartial review of the whole question by Dr. Steffen, in the *Zeitschrift* of the Berlin Geographical Society (1897, No. 1, with map), of special value to those who have not the time or opportunity to search through the mass of original documents which bear on the subject. Copious references to these are given in the course of the article, while Dr. Steffen's personal acquaintance with a portion of the region in dispute, from his well-known journeys between 1892 and 1896, makes him well qualified for the task he has undertaken. The first section of the paper takes us back to the days of the Spanish colonies in South America, and discusses the somewhat doubtful question of the limits between the captain-generalcies of Chili and La Plata. This, as Dr. Steffen points out, is now of merely historical interest, since the dispute was placed on an entirely new footing by the agreement of 1881, according to which Chili abandoned all claims arising from historical considerations in the southern extremity of the continent, and allowed the decision to depend on natural principles connected with

physical geography. Since that date the difficulties in the way of a settlement have arisen from the ambiguities in the terms of the agreement of 1881, which laid down, as the boundary between the extreme north and 52° S. lat., a line passing through "the highest summits of the Andes, which form the water-parting" (*cumbres mas elevadas que dividan las aguas*), whereas the line of highest summits by no means necessarily coincides with the water-parting. Other ambiguities appear in the clauses dealing with the boundary beyond 52° S. lat., but these have been partially removed by subsequent agreements. The main source of disagreement was rather emphasized than removed by the protocol of 1893, which, while adhering to the faulty formula as the absolute rule for the determination of disputed points, introduced the inconsistent, and in itself far from precise, expression *encadenamiento principal de los Andes* ("principal chain of the Andes") to describe the line chosen. This agreement of 1893 is, in fact, in many ways the least practical of all. That of 1896 is principally important for its definite adoption of the principle of arbitration (*Journal*, vol. viii. p. 640). The third part of the paper describes the progress which has been made with the actual demarcation of the boundary, which presents comparatively few difficulties as regards the northern and central portions.* In the last section of his paper, Dr. Steffen describes the principal passes and chains of the Andes in the region explored by him personally (between 40° and 44° S. lat.), pointing out the principal sections in which the main chain deviates from the water-parting, and the districts which are thus still in dispute between the two powers. The upper basin of the Puelo, known as "El Valle Nuevo," now occupied by Argentina, would, in case the line of the water-parting were upheld, fall to Chili, as would also the "Valle seis de Octubre," in about 43° S. lat., where an Argentine colony has been established by Colonel Fontana.

Proposed Survey of Chili.—We have received from the author a pamphlet by Dr. Paul Krüger, professor in the University of Valparaiso, setting forth a scheme for the trigonometrical survey of Chili. The difficulties presented by the country are in many ways unusually great, but we are glad to learn that there is some prospect of the work being undertaken on an adequate scale.

Dr. Herrmann Meyer's Journey to the Headwaters of the Xingu.—From the account of Dr. Meyer's journey, published by the Berlin Geographical Society (*Verhandlungen*, 1897, No. 3), we take the following details, which supplement those previously given in our pages (*Journal*, vol. ix. p. 449). It appears that the Ronuro, which Dr. Meyer considers the main headstream of the Xingu, was not followed throughout from its source, the guide insisting on taking the party by way of the Jatoba, a right-bank tributary of the former. Near its source this stream was hemmed in by steep clay banks, behind which stretched hills clothed with dense thorny bush. Numberless falls and rapids broke the course of the river, causing great difficulties in its navigation. No fewer than 105 were counted, apart from the smaller rapids. The loss of supplies caused by accidents to the canoes placed the travellers in a precarious position; but, fortunately, a fishing-place of Indians from the Batovy (the stream explored by Von den Steinen) was met with, and food obtained from them. The banks of the stream, after the hilly country had been passed, were covered with a thick matted forest, with no sign of permanent habitation. Eight days after meeting with the Indians, the Ronuro was reached, and the broad and deep stream offered no more hindrance to navigation, while the abundance of fish provided an ample food-supply. Animal

* The disputed point with reference to the Puna de Atacama (*Journal*, *loc. cit.*) is but lightly touched upon by Dr. Steffen, who avowedly devotes his chief attention to Patagonia.

life seems to have been generally more varied than before. An important stream, emptying itself into the Ronuro from the west, was discovered, and Dr. Meyer thinks that it may be derived from certain headstreams previously attributed to the Paranatinga (Tapajos basin). Traces of Indians were now met with, but none were seen until near the junction of the Ronuro with the Kuluene (the eastern headstream of the Xingu). Here a party of Kamayura were met with, being the first really wild Indians with whom the expedition had come in contact. Friendly relations were established with them, and also with the Trumai, who live on the Kuluene. This tribe appears to be rapidly diminishing in numbers, and to stand at a lower grade of civilization than the Kamayura. On the return journey, the Nabuqua, a previously unvisited tribe dwelling between the Kuluene and Kulisehu, were reached by a land excursion, the travellers then striking across to the upper Kuluene, a stream with a powerful current, but decidedly smaller than the Ronuro. It was descended to its junction with the Kulisehu, by which stream the return voyage was effected.

M. Coudreau's Expedition to the Xingu.—The *Revue Française* publishes news of M. Coudreau's expedition (*Journal*, vol. ix. p. 93), according to which the French traveller had succeeded in reaching the upper river, but had been twice attacked by native tribes, several members of his expedition being killed and wounded. Eighty-three rapids had been passed. Numerous colonists were met with on the lower river, and a number of Indian tribes were visited. Caoutchouc abounds in various parts of the Xingu basin.

AUSTRALASIA.

Journeys in Western Australia.—On March 1, 1896, a prospecting party composed of six persons with thirty horses started from Cue, the centre of the Murchison goldfield in Western Australia, in 27° 25' S., 117° 52' E., under the leadership of Mr. H. Fletcher. Proceeding in a north-north-easterly direction, the party reached the east end of the Ophthalmia range, in 23° 17' S., 119° 35' E., and then advancing north-eastwards across the Fortescue range, were three days without water. At last, about 60 miles east of the Oakover river (one of the headstreams of the De Grey), they discovered a hitherto unknown but not inconsiderable river with an east-north-easterly current. This they named the Bloomer, and followed for 100 miles. In many places it had a steady flow, but it appeared as if it would dry up within six months to a series of water-holes unless heavy rains occurred. With the exception of a few stretches of better land on its course, the region traversed consisted of nothing but desert, sandstone ridges, and spinifex. In the end the river expanded into a lagoon about 2 miles long, on which were numerous ducks and other waterfowl. Kangaroos and emus also abounded. Many natives were met, of powerful build, but so shy that it was impossible to enter into communication with them. On July 15 the party returned to Nannine, a mining station 59 miles north-east of Cue. In June, 1896, Mr. H. W. Harslett undertook an expedition from Port Augusta, in South Australia, to Norseman on the Dundas goldfield, in Western Australia, with the view of finding out a practicable route for the passage of cattle between the two colonies. The route followed was nearly that of the old telegraph line, but from Ponton's station the party diverged northwards to Buldara and Norseman, arriving at the latter place on November 16. A similar attempt, but much further north, was made in the same year by Mr. S. G. Hübbe on behalf of the Department of Crown Lands in Adelaide. Setting out from Oodnadatta, the present terminus of the transcontinental railway, it struck Mr. (now Sir) John Forrest's route of 1874, and kept to it with little deviation to 125° E. It then turned to the south-west, crossed Wells's route of 1892 at Lake Wells,

and arrived at its destination, Niagara, the easternmost telegraph station of Western Australia, $1\frac{1}{2}^{\circ}$ north of Coolgardie, after forming ninety-five camping-stations. The return journey was almost direct to Eyre's Sandpatch, and thence along the old telegraph line. The results of the topographical survey made on this journey are laid down on a map in three sheets on the scale of 1: 1,000,000, published at the Surveyor-General's Office, Adelaide, in 1896. The third sheet shows a new telegraphic connection of the mining district of Western Australia.—*Petermanns Mitteilungen*, June, 1897.

The Australian Bush and the Coasts of the Coral Sea.*—This book adds another to the rapidly increasing number of descriptive books of travel which we commonly designate as "narratives," indicating thereby that scientific or other special results are for the time left on one side, while the traveller tells the tale of his wanderings in the manner most likely to interest a popular audience. Prof. Semon says in his preface that his main object in undertaking this journey was to explore the ever-marvellous fauna of Australasia. A number of special reports on his collections have already appeared, and more are to follow, but in this volume zoology occupies only a secondary part, the narrative including many observations in the usual fields of botany, geology, ethnology, etc. The journey may be said to have begun at Maryborough in August, 1891, Gayndah being made a centre for a number of exploring excursions in the Burnett district. In the course of these Prof. Semon made extensive acquaintance with the manners and customs of the Australian bush, and received object-lessons in the art of colonization as practised by the British, which seem to have impressed him favourably in comparison with the more rigorously scientific methods adopted in most German colonies. Much of what is described in the first two hundred pages of the book is commonplace enough in this country, but it is always pleasant to see the merits and difficulties of our work appreciated. After a chapter on Australian aborigines, Prof. Semon proceeds to describe the north-east coast of Australia from Brisbane to Cape York, giving a good deal of geological information; then follows an account of Thursday Island and Torres straits, and two chapters on New Guinea. The last part of the book is devoted to the East Indies, Java, Celebes, the Northern Moluccas to Amboina, and Amboina to Banda. The homeward journey through India included an expedition to Darjiling. A vocabulary of native words from the Burnett region and four indifferent maps are appended, and there are many good illustrative photographs.

Renewed Boring Experiments at Funafuti.—An expedition has been set on foot, under the auspices of the Royal Geographical Society of Australasia, to endeavour to carry to a successful issue the coral-boring experiments which last year ended in failure owing to unforeseen difficulties, arising from the honeycombed nature of the coral rock and the interspersed beds of sand met with. Liberal pecuniary assistance from private individuals in New South Wales and from the Royal Society of London, together with offers of help in other ways from the Government of New South Wales and from the London Missionary Society, have enabled the promoters to provide an ample equipment for the expedition, which started early in June under the leadership of Prof. David, one of the local members of the Royal Society's reef-boring committee. Special appliances, including pipes of various sizes to line the bore-hole, are being taken to obviate the difficulties encountered last year, the weight of the whole plant amounting to twenty-five tons. The length of pipes taken will admit of the attainment of a depth of 1000 feet, but it is

* 'Im australischen Busch und an den Küsten des Korallenmeeres: Reiserlebnisse und Beobachtungen eines Naturforschers in Australien, New Guinea, und den Molluken.' Von Richard Semon, Professor in Jena. Leipzig: Wilhelm Engelmann.

expected that the foundation of the atoll will be reached at a much less depth. Prof. David hopes to return in September.

POLAR REGIONS.

Herr Andrée's Balloon Voyage.—Favoured at last by a southerly breeze, Herr Andrée made his long-expected balloon ascent from Danes island on Sunday, July 11. The morning of that day broke with a clear sky, and, the wind blowing freshly from the south, it was decided that preparations for a start should be made. Part of the balloon-house was taken down with the greatest speed possible, and by half-past two in the afternoon all was ready for the ascent. Standing in the car with his two companions, Fraenkel and Strindberg, Andrée gave the order for the ropes to be cut, when the balloon rapidly ascended to a height of 600 feet, and, after a temporary re-descent, floated away northwards over the flat peninsula of Hollaendernaes. It continued visible to those remaining behind for about an hour, after which it disappeared in the northern horizon. Its speed was reckoned at 22 miles to the hour. The Swedish gunboat *Svenskeund* returned to Tromsø on July 16 with news of the successful ascent, having encountered south-westerly winds during the passage, so that the balloon would probably take a direction towards Eastern Siberia, unless more southerly winds were encountered further north. Tidings of the adventurous travellers will be awaited with the deepest interest, but it is possible that, even if all has gone well, nothing may be heard of them for some time. Hazardous as the undertaking undoubtedly is, the excellence of the balloon, the absence of great temperature changes during the perpetual day of the arctic summer, and the great care with which every eventuality was provided for, justify some confidence in its success.

Lieut. Peary's Plans for an Expedition to the Pole.—In the February number of the *Journal* (vol. ix. p. 223) we gave the outline of Peary's proposed plan for reaching the north pole. Leave of absence for five years has now been granted to the explorer by the Navy Department at Washington, and he intends to devote the present summer to a preliminary expedition to Whale sound, on the north-west coast of Greenland, the main expedition being arranged for July of next year, before which he hopes to visit Europe. At Whale sound he hopes to make arrangements with the Eskimo, so that they may have furs and provisions in readiness on the arrival of his ship in 1898. The only civilized members of the main expedition will be Peary himself and a surgeon, the explorer believing that a greater number only diminishes the chances of success owing to difficulties of food-supply. Two scientific parties * accompany this year's expedition.

Danish Expedition to the East Coast of Greenland.—The administrators of the "Carlsberg Fund" † for scientific purposes has provided the means—150,000 crowns, or about £8300—for sending an expedition to explore a part of the east coast of Greenland, which has never before been visited, namely, the coast from Angmagsalik, about 66° lat. N., where the Danish Government a few years ago established a station, and northwards to Scoresby sound, about 72° lat. N. The leader of the expedition, Lieut. Amtrup, R.D.N., will next autumn (1898), with the steamer which the Danish Government every year sends to Angmagsalik, land here with two naturalists. The party will winter in order to reconnoitre the coast northwards and explore the tract in the vicinity of Angmagsalik, a tract of special

* A third, which was to have been headed by Prof. G. H. Barton, will, according to latest accounts, not proceed north this year.

† Carlsberg is the name of a brewery close to Copenhagen, whose proprietor, the late Mr. J. C. Jacobsen, has given a large fortune to scientific purposes.

botanical interest. The reconnoitring expedition returns to Copenhagen with the Danish steamer in the autumn of 1899, and in 1900 the real expedition, which probably will consist of two naval officers, two naturalists, and some few men to assist, will start and land somewhere at the entrance of Scoresby sound. After wintering here, the expedition will the following year (1901) proceed southwards to Angmagssalik to catch the yearly Danish Government steamer.

Sir Martin Conway in Spitsbergen.—Accompanied by Mr. E. J. Garwood, Sir Martin Conway left London on June 29 on a second expedition to Spitsbergen, with a view to continue the exploration of the interior begun last year. It is proposed to land at King's bay, on the west coast of the main island, in 79° N. lat., and to explore the inland ice-sheet thence by sledge-expeditions. Afterwards Sir M. Conway hopes to complete the exploration of the southern peninsula from Horn sound.

Hydrological Expedition to the North Siberian Sea.—An expedition which is sure to enrich our knowledge of the arctic seas, has just been sent out by the Russian government, under Rear-Admiral Makaroff, the well-known explorer of the Northern Pacific. The Russian admiral will take under his orders, at Vardö, seven steamers which have cargoes of coal and various goods for the mouths of the Siberian rivers, the Ob and the Yenisei, and he will proceed himself, on board one of these steamers, *via* the Kara sea, in order to ascertain how far his ideas as to the possibility of extending the period of navigation across that sea are correct. These steamers have their stems built of thick iron, and, without being ice-breakers in the true sense of the word, they can be used for breaking through the ice to some extent. The flotilla will return to Europe with various Siberian cargoes, while Admiral Makaroff intends to steam up the Yenisei and to return by the overland route. He takes with him all the hydrological and meteorological instruments with which measurements were made on board the *Vityaz* during her cruise in the Pacific. Captain Wiggins does not take part in this expedition, as he has sailed to South Africa.

GENERAL.

The Distribution of Marine Mammals.—An interesting paper on the above subject has recently been contributed to the Zoological Society by the secretary, Dr. P. L. Sclater. The groups of aquatic mammals that are represented on the Earth's surface at the present time are three in number, viz. (1) The suborder of the Carnivora, containing the seals and their allies (Pinnipedia), which are semi-aquatic; (2) the Sirenia, now represented by only two forms—the manatee and dugong—which are mainly aquatic; and (3) the Cetacea, which are wholly aquatic. After briefly considering the principal representatives of these three groups, the author proceeds to divide the oceanic portion of the globe into six sea-regions, subsequently treating of the characteristic mammals of each region. These sea-regions are given as follows: (1) The North Atlantic Sea-region, or Arctatlantis, consisting of the northern portion of the Atlantic down to about 40° N. lat. This region is characterized by its seals, by the absence of sirenians, and by the possession of three peculiar genera of cetaceans. (2) The Mid-Atlantic Sea-region, or Mesatlantis, consisting of the middle portion of the Atlantic down to about the Tropic of Capricorn. The genus *Monachus*, or monk-seal, and the Sirenian genus *Manatus*, being restricted to this region. (3) The Indian Sea-region, or Indopelagia, containing the Indian ocean down to about the same degree of south latitude, and extending from the coast of Africa on the west to Australia and the Malay archipelago on the east. This region is characterized by the presence of

the Sirenian *Halicore* (the dugong), and by the absence of pinnipeds. (4) The North Pacific Sea-region, or Arctirenia, containing the northern portion of the Pacific ocean to about the Tropic of Cancer. The true seals (*Phoca*) are found in this region, in common with the North Atlantic, and three of the species of this genus appear to be actually identical in these two sea-regions. This region is also characterized by the presence of certain species of the eared seals (*Otariidæ*), which are unknown in the Atlantic down at least to 30° S. lat.; as the home of the (now extinct) Sirenian *Rhytina* and of the endemic cetacean *Rhachianectes*. (5) The Mid-Pacific Sea-region, or Mesirenia, containing the inter-tropical portion of the Pacific ocean; without true seals (*Phocidæ*), but having the eared seals (*Otaria*) and the sea-elephant (*Macrorhinus*) from the south. (6) The Southern Sea-region, or Notopolagia, containing the whole of the South Polar ocean all round the globe south of the above-mentioned limits, characterized by four endemic genera of *Rhocidæ*, and by the presence of many *Otariidæ*; without Sirenians, but with two endemic forms of cetaceans (*Neobalæna* and *Berardius*). The author, in conclusion, calls attention to some of the more remarkable points in the general distribution of the marine mammals, adopting the hypothesis of a former barrier of land between Africa and America in explanation of certain facts in connection with the subject.

The Vasco da Gama Celebrations in Portugal.—The Geographical Society of Lisbon has celebrated the fourth centenary of Vasco da Gama's departure for India, by the erection of new buildings, which were opened by the King and Queen on July 8, the date (old style) of the sailing of the ships from Lisbon. Papers were read on the occasion, and Lisbon and some other towns were illuminated at night, but the grand national celebrations, the proposed outline of which has already been announced, will not take place till next spring.

Geography in Education.—Prof. Spencer, of the University College of North Wales, has edited a useful Teachers' Handbook,* to which a number of specialists contribute chapters on the teaching of their own subjects. The primary object of the work is for the guidance of teachers in Wales, but it will be found of quite general application. It does not give a syllabus of the various subjects, and is concerned rather with the manner of teaching than with the matter taught. The chapter on geography is contributed by Mr. H. Yule Oldham, Lecturer on Geography in the University of Cambridge, and expresses well the views which have been generally accepted by geographers as to the educational importance of their science. Mr. Yule Oldham points out that the recognition of geography as an element in education is much more general than the ability to handle it effectively—"although acknowledged to be a weapon indispensable to a well-equipped educational armoury, it is too often left to rust on the shelves, or placed in inexperienced hands." In the short space available it was impossible to enter into details, but many useful hints are given as to the manner of commencing the teaching of geography, and the relative places of map-drawing, blackboard work, and modelling, and the treatment of physical, political, economic, and historical geography as parts of the whole subject. In the general awakening which seems to have set in amongst teachers as to the necessity for improvement in educational geography, this practical chapter should be found stimulating and helpful.

Anniversary Meeting.—The name of the first scrutineer mentioned in p. 110 of the July number should have been Captain J. Henderson Smith, and not Captain Bedford.

* 'Chapters on the Aims and Practice of Teaching,' edited by Frederick Spencer, M.A., PH.D. Cambridge: University Press. 1897.

CORRESPONDENCE.

" *Kech-Makurán.*"

HAVING been closely associated with Makrán affairs for the better part of two years, during the period that I held administrative charge of that country, the letters that have recently appeared in the *Geographical Journal* on the subject of Makrán have been full of interest for me, especially that communication on the subject in which General Haig has published the result of his study of the itineraries of the well-known Eastern authors whom he quotes. As I actually resided in that country during the period to which I have alluded, I venture with all humility to put together a few items of information, in the hope that, as my information was collected directly from the inhabitants themselves, with whom I was brought into very close contact while engaged in making the Revenue Settlement, the notes may prove of interest.

The "Kes Macorán" of Marco Polo is a very close approximation to the name of this country which is in use at the present day. From careful inquiries made on the spot, it appears that Kech (or Kej) and Makurán are considered as two distinct countries, although they are adjacent to one another.

The country of Kech is bounded on the east by the Upper Kolwah district. The Kolwah district is itself divided into two parts by the stream known as Tirtej. South of this stream there is the district or subdivision of Lower Kolwah, which is included in Kech. The Tirtej stream is therefore the eastern boundary of Kech. On the west Kej includes the subdivision known as Tump. The Boleda valley, 30 miles north of Kech, is considered to belong to the latter, the actual boundary between it and Panjgur being a spot about 18 miles north-east of the fort of Chib, in the Boleda valley.*

The northern limits of Kech, and also of Makrán, are formed by the watershed which divides the waters flowing into the Mashkel and Rakshan rivers from those of the Sarbáz river, and the Nabing and Dasht rivers as well, Panjgur being considered by the inhabitants as belonging to "Khorassan."

Bámpur is not considered as belonging to or included in the country known as Makurán. Makurán is a collection of districts, of which the best known are Mand, Sarbaz, Kasrkand, Báhu, and Kir-Bir, and others as well. It is probably owing to this that it is written sometimes in the plural—"Makranát," the Makrans—in Persian books. The names of the subdivisions just mentioned do not represent towns; each of these districts may contain several villages, and none of these may necessarily bear the name of the district.

Kech also is composed of many subdivisions, Kech, Tump, Boleda, and Lower Kolwah being the best known. In the Kech subdivision there are five or six villages, none of which are known as Kech; the chief of these villages is Turbat.

Panjgur is said to extend from the hills known as Band-i-Panjgur, † 40 miles to the east of the village of Isai, and to include the Párom district, 40 miles west of the same village. The area under permanent cultivation which depends on Karez irrigation contains several villages, of which those worthy of mention are Isai, Taap, Khudabadan, and Garmkán, and not one of the villages is known as Panjgur.

Each village in these subdivisions is practically a distinct self-governing unit,

* The other forts are those of Bit, Koshk, and Suto.

† Or Panjgur Koh.

ruled by the "Rish safid," and the headman, who is called the "Ka-hudá" (a corruption of Kad Khuda). Under the orders of the latter are subordinate officials called "ghazirs," whose office is practically hereditary, and there may be one or more ghazirs in each village. The collection of villages situated in the part of the Panjgur valley which is permanently under cultivation has been called Panjgur by the British officials who are connected with the country and with the general supervision of its affairs, for the sake of convenience alone.

Wherever there are irrigation works of a permanent nature the date palm is extensively cultivated. It is grown on the borders of the fields, which are purposely made small, to afford a certain amount of protection from the direct rays of the sun, and prevent the rapid evaporation of moisture from the cultivated soil, and so prevent it becoming rapidly dry, and becoming hard and crusted. The fields are carefully tended, as if they were gardens. The rice, jowari, and other crops, such as tobacco, etc., are grown in nurseries, and when the young plants are an inch or two in height they are planted out in the fields, which have been carefully prepared to receive them. A group of date palms is called kallag, and the habitations, if any exist, are known variously as shahr, bázár, and res. The word "kalat" is also, of course, largely used.

The soil, which is a light clay, is very fruitful. On irrigated lands it is a common occurrence to obtain three or four harvests from one sowing of jowari; and even in ground dependent on the rainfall for irrigation, three crops have been obtained from a single sowing of jowari.

The letters *p* and *f* are frequently interchanged, as well in the colloquial as in the written language of Kech. Thus the well-known name *Pír Baksh* becomes corrupted very commonly into *Fír Baksh*. The name *Páhra* into *Fáhra*; *Panjgur* is also turned into *Fanjgur*; and *fakír* into *pakír*. The word *áp* ("water") is usually pronounced *áf*.

At the risk of appearing presumptuous, I venture to agree with the identification, by General Haig, of Pahra, near Bámpur (that is, the modern Persian fort of Nasrieh)*. The "Masakand of Istakhri" (I am quoting General Haig) is probably Naskand, a well-known locality in Makrán (properly Makurán) to the south-east of Bámpur. The city of the Khwarij I should be inclined (with all deference, be it said) to place south of the watershed of the Sarbáz stream. Rask may well have been a district or subdivision, such as have been just described, in which case the "village of Yáhyah-bin Amr" would have, in all probability, been the principal village, the residence of the chief, or the more influential man of the district of Rask.

To talk of ruined cities in this part of the world is apt to prove misleading. Ancient sites in Kech Makurán are recognizable by the mounds of white clay covered with fragments of pottery which are found in all parts of Baluchistan, and known as "damb." These mounds are the remains of forts and dwellings. The latter are constructed at the present day of either pure clay or of sun-dried bricks set in clay mortar. Trunks or beams of the date palm (being the most common timber) are set in the walls, especially near angles, to bind the earth or masonry together. This system of building is probably that which has always been employed in the country. A large town or village in Kej (that is, the country known as Kej) consists of a fort (varying, of course, in size), which is the residence of the chief. Adjoining the fort there may be a dozen or so of houses built in the manner just described; these are the dwellings of the principal inhabitants, and the shops of the local merchants or dealers, who require a secure place for the storage of their

* This name was obtained in 1889-90 from local information at Jálk.

ware. The remainder of the population, however numerous, dwell in huts, either thatched with mats and palm branches, or constructed entirely of those materials. Scattered among the date groves are to be found the huts of a considerable number of inhabitants whose lands lie at some distance from the village. It cannot be expected that "ruins" such as are generally understood could be found, except where the destruction has been recent. A village such as that just described, if destroyed, would, in the lapse of years, form a mound composed of the *débris* of the more permanent buildings, the clods of earth or unbaked bricks of which would dissolve under the action of the elements.

The only ruins worthy of the name are those of the domed buildings containing tombs, and which are evidently mausolea, which have been constructed of carefully baked bricks and tiles set in clay mortar. These have been found to exist from the Gand-i-Zirreh on the north all over Kharan, the Panjgur and Kech districts; those of Galugáh in the Máshkel have been already described by Colonel Holdich, C.B., etc., from information supplied by me. There are types of these buildings among the photographs I am sending to the Society; the general plan of the buildings does not vary, but the style of ornamentation does, and in many instances the representation of living objects is omitted.

The hills in the vicinity of such a village as that just described might be inhabited by a numerous and warlike tribe owing allegiance to the chief residing in the village, but these would dwell in tents, and the destruction of their habitations would result in a few handfuls of ashes.

The only instance of a carved stone is that contained in one of the photographs, in one of the panels of which there is a rude figure of a horseman armed with a bow.

At Jálwar, in the Kharan hills, I discovered inscriptions in what appeared to be Arabic characters cut with a blunt instrument into the face of a cliff, and I was informed that inscriptions exist in another locality in Makurán, which I have not had an opportunity, so far at least, of examining. It was a matter of deep regret that it was not possible to photograph the Jálwar inscriptions, or to devote time to copying them or to obtaining rubbings.

There are distinct traces of the occupation of Kech Makurán by the Moghals.* In the translation of the *Tabakat-i-Nasiri* by Major Raverty, treating of the subject, the name, given in a mutilated form, on the authority of the *Jami-ut-tawarikh*, of the locality in which the Moghal horde passed the summer (in a footnote) could be easily made to read Panj Gur. This name is still written in two distinct syllables, as well as in one word.

The Miri fort in the Kech subdivision, which is at present in a ruinous condition itself, stands on a very extensive "damb" or mound, which is evidently that of a more extensive fort or group of habitations than the Miri fort represents.

There are two localities in Kech (that is, the country known by that name) which are known as Nag, one 25 miles north-west of the fort of Chib, in the Boleda valley, and the other about 40 miles to the east of the village of Turbat, in the Kech subdivision. At each of these two localities known as Nág there is an abundant supply of spring water. To the east of the village of Isai (in the Panjgur district), and about 80 miles distant from it, is the fort known as Naghai Kalat (the fort of the Nágba). Here there is also a fine spring of water.

The names of Kej (or Kech) and Panjgur are place-names of very great antiquity. The latter was the headquarters of the Administration, and the quarters of the civil

* At Dizak, in the "Perso-Baluch" country; also seen in names such as "Moghal-páb" ("the Spring of the Moghals"), "Moghal Khariná," and "Turki Ambár," frequently met with in Kech and Panjgur.

officer and his establishment were at the small village of Chitkán, where lines had also been constructed to house the troops stationed in the country. The surrounding villages used to be constantly visited for purposes of administrative work, as well as the surrounding country, and there are certainly more than five tombs in Panjgur.

GEO. P. TATE,
Survey of India Department.

Quetta.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1896-1897.

Fourteenth Ordinary Meeting, June 28, 1897.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

ELECTIONS.—*Henry de Courcy Agnew; Mathew Arthur, D.L., J.P.; Frank Bateman; Edward Boyle, Barrister-at-Law; Captain Murray Cookesly (late 22nd Regiment); William Montgomery Crook, B.A.; William Fraser Hume, D.Sc.; M. H. Spencer Josephs; Claude G. Montefiore, M.A.; Thomas Dixon Rust; W. Gordon Sprigg; Edgar Salis-Schwabe; Alexander Tucker Wardrop (Customs and Harbour Officer); M. L. Wessels.*

The Paper read was:—

“Recent Journeys in Persia.” By Captain Molesworth Sykes.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. Bd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
J. = Journal.
M. = Mitteilungen.

Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

Austrian Alps.

Die Pinzgauer. Von Dr. Wilhelm Schjerning.—Forschungen zur deutschen Landes- und Volkakunde . . . herausgegeben von Dr. A. Kirchhoff. Zehnter Band. Heft 3. Stuttgart: J. Engelhorn, 1897. Size 9½ × 6½, pp. [104]. *Illustrations.*

Schjerning.

A note on this paper was given in the June number of the *Journal*, vol. ix. p. 660.

- Belgium—The Scheldt.** *Mouvement G.* 14 (1897): 178-179, 197-198, 210-211. Rutot.
Le cours de l'Escaut à travers les âges géologiques, d'après une communication faite par M. A. Rutot à la Société belge de Géologie. *With Maps.*
- France—Alps.** *C. Rd.* 124 (1897): 1170-1178. Martel.
Sur l'hydrographie souterraine et les chouruns du Dévoluy (Hautes-Alpes). Note de M. E.-A. Martel.
- France—Brittany.** *Ann. G.* 6 (1897): 23-44, 103-122. Barrois.
Des divisions géographiques de la Bretagne. Par M. Charles Barrois. *With Map.*
A regional study, the concluding section of which is devoted to the effects on the people of the natural conditions of the district. In considering the history of Brittany, the author allows himself to forecast the future of the country as foreshadowed by the principles of geography.
- France—Champagne.** *Ann. G.* 6 (1897): 230-238. Chantriot.
La falaise de Champagne et le vignoble champenois. Par M. E. Chantriot.
- France—Gascony.** *C. Rd.* 124 (1897): 1041-1043. Durègne.
Sur le mode de formation des dunes primaires de Gascogne. Note de M. E. Durègne.
- France—Seine.** Lemoine and Babinet.
Ponts et Chaussées. Service Hydrométrique du Bassin de la Seine. Observations sur les Cours d'Eau et la pluie centralisées pendant l'année, 1895. . . . Par M. G. Lemoine et M. Babinet. Versailles. Size 17 × 11. *Diagrams.*
Résumé des Observations centralisées par le Service Hydrométrique du Bassin de la Seine pendant l'Année, 1895. Par M. Babinet. Versailles, 1896. Size 10½ × 7, pp. 54.
- Germany—Hamburg.** *M.G. Ges. Hamburg* 13 (1897): 131-140. Gottsche.
Die tiefsten Glacialablagerungen der Gegend von Hamburg. Vorläufige Mittheilung von Dr. C. Gottsche. *With Map.*
The maximum depth at which glacial clays have been found by borings in the neighbourhood of Hamburg is about 550 feet below the surface. The map shows the end-moraines of Schleswig-Holstein, together with the distribution of alluvial and diluvial formations.
- Greece—Athens.** *J.R.I. British Architects* (3) 4 (1897): 345-358. Penrose.
The Parthenon, and the Earthquake of 1894. By F. C. Penrose, F.R.S. *With Illustrations.*
The paper gives incidentally a history of the Parthenon.
- Greece—Ionian Islands.** *Coemos* (2) 12 (1896): 97-108. Stefani.
Cenni geologici sull' Isola di Leucade. Per Carlo de Stefani. *With Maps.*
A description of the geology of the island known as Santo Mauro, or Leucada, in the Ionian group, with effective orographical and geological maps in colours.
- Iceland.** Thoroddsen.
Fra det nordlige Island. Rejseberetning fra Sommeren 1896. Af Dr. Phil. Th. Thoroddsen. (Særtryk af "Geografisk Tidsskrift," 14^{de} Bind, 1ste—2 det Hefte.) Copenhagen. Size 12 × 9½, pp. 22. *Map. Presented by the Author.*
- Mediterranean—Crete.** *Ann. G.* 6 (1897): 255-257. Ardaillon.
Répartition des chrétiens et des musulmans dans l'île Crète. Par M. E. Ardaillon. *With Map.*
The map shows the regions in which there is an important Mussulman element in the population, and those in which the proportion exceeds one-half. The name of each town or village is followed by a number giving the percentage of Mussulmans in the population.
- Norway.** Chapman.
Wild Norway: with chapters on Spitsbergen, Denmark, etc. By Abel Chapman. London: E. Arnold, 1897. Size 9 × 6, pp. xiv. and 358. *Illustrations. Price 16s.*
Chapters on various parts of Norway, some of them rarely visited by the tourist, on Denmark, and on Spitsbergen, the last containing a contribution by Mr. Arnold Pike on "A Winter in the Eightieth Degree." The key-note of the work is sport, but this involves much reference to natural history.
- Norway—Fauna.** Sars.
Fauna Norvegica. Vol. i. Descriptions of the Norwegian Species at present known belonging to the Sub-orders Phyllocarida and Phyllopoda. By G. O. Sars. No. II.—AUGUST, 1897.]

- Christiania: Printed by the Joint-Stock Printing Co., 1896. Size 13 × 10, pp. vi. and 144. *Plates*. [In Norwegian and English.] *Presented by the Royal University of Norway*.
- Norway—Meteorology.** Mohr.
 Jahrbuch des Norwegischen Meteorologischen Instituts für 1893 (pp. x. and 110); 1894 (pp. x. and 110); 1895 (pp. x. and 110). Herausgegeben von Dr. H. Mohr. Christiania, 1895-96. Size 13½ × 10. *Presented by the Norwegian Meteorological Institute*.
- Norway—Flora.** Norman.
 Norges Arktiske Flora. I. Special Plantetopografi. 1ste. Del J. M. Norman. Christiania: Oscar Andersens Bogtrykkeri, 1894. Size 10 × 6½, pp. 760. *Map. Presented by the Royal University of Norway*.
 On the arctic flora of Norway. The map is merely a topographical outline.
- Poland.** Arctowski.
 Henryk Arctowski. *Materyaty do Bibliografii prac naukowych Polakich. Zestawienie treści 14-tu tomów Pamiętnika Fizyograficznego 1881-1896*. Bruksella, 1897. Size 10 × 7½, pp. 16. *Presented by the Author*.
 Dr. Arctowski here gives an index arranged according to the authors' names of the 14 volumes of the publications of the Polish Physiographical Memoirs. The titles are given in Polish, with a French translation.
- Spain—Cantabrian Mountains.** *G.Z.* 3 (1897): 278-281. Penck.
 Die Picos de Europa und das kantabrische Gebirge. Von Albrecht Penck
 A contribution to the morphology of the Iberian peninsula.
- Spain—Galicia.** *Blackwood's Mag.* 163 (1897): 109-119. Lynch.
 An Unnoted Corner of Spain. By Hannah Lynch.
 A gracefully written record of travel in the province of Galicia and along the north coast of Spain.
- Sweden—Norbotten.** Schoener.
 Schwedens Högfällgebiet. Von J. G. Schoener. (Separat-Abdruck aus Nr. 475 und 476 vom 1. und 15. April 1897 der "Oesterr. Alpen-Zeitung.") Wien. Size 11 × 8, pp. 12. *Presented by the Author*.
- Switzerland—Jungfrau Railway.** Guyer-Zeller.
 The Proposed Jungfrau Railway rising to an altitude of 13,670 feet. Considered from its scientific, technical, and financial aspects. Zürich: Printed by F. Schulthess, 1897. Size 11½ × 8½, pp. 86. *Map and Plates accompanying. Presented by the Jungfrau Railway Syndicate*.
 Full plans are given for the most remarkable mountain railway ever projected, and the accompanying pamphlet considers the practicability of the scheme in all aspects, scientific, engineering, hygienic, and financial.
- Switzerland—Jungfrau.** *Deutsche Rundschau G.* 19 (1897): 241-249, 299-311. Wottitz.
 Die Jungfraubahn. Von J. Wottitz. *With Map and Illustrations*.
 An account of the projected railway up the Jungfrau.
- Switzerland—Lake of Geneva.** Halbfass.
 Morphometrie des Genfersees. Von Dr. Wilhelm Halbfass. Size 8½ × 5½, pp. [28]. *Plate. Presented by the Author*.
 A discussion based on the map of the official Swiss bathymetrical map of the lake.
- Switzerland—Map.** Früh.
 Ein Relief der Schweiz. Von Dr. J. Früh in Zürich. Separatdruck aus der Schweizerischen Pädagogischen Zeitschrift. VII. Jahrgang 1897, Heft iii. Zürich, 1897. Size 9½ × 6½, pp. 12. *Presented by the Author*.
 On the educational utility of the proposed relief-map of Switzerland on the natural scale (for height and horizontal distance) of 1:100,000. The author points out the faintness of the relief on this scale, and suggests the production of a larger-scale relief map.
- Switzerland—Saas.** Balch.
 Ascents near Saas. By Edwin Swift Balch. Reprinted from *Appalachia*, vol. viii., No. 2. [Boston, 1896.] Size 10 × 6, pp. [8]. *Plates. Presented by the Author*.
- Switzerland—Saas Valley.** Coolidge.
 Quelques nous de lieux dans la vallée de Saas. (Separat-Abdruck aus dem "Anzeiger für Schweiz. Geschichte," Nr. 6, 1896 und Nr. 1, 1897.) Par W. A. B. Coolidge. Size 10 × 7, pp. 12. *Presented by the Author*.

- Turkey.** G.Z. 3 (1897): 249-256. **Vambéry.**
 Die Stellung der Türken in Europa. Von H. Vambéry.
 Prof. Vambéry discusses the composition of the population in European Turkey, and incidentally the position of Turkey with regard to the great Powers.
- United Kingdom—England.** *J. Manchester G.S.* 13, 1896 (1897): 157-167. **Wells.**
 The Canals and Navigable Rivers of England. By Lionel E. Wells.
- United Kingdom—England—Herefordshire.** **Bevan, Davies, and Haverfield.**
 An Archaeological Survey of Herefordshire. By the Rev. J. O. Bevan, M.A.; James Davies; and F. Haverfield, M.A. Westminster: Printed by Nichols & Sons, 1896. Size 12 x 10, pp. 16. *Map.*
 The pre-Conquest antiquities of Herefordshire have been catalogued, and their positions recorded by appropriate signs on a map on the scale of 4 miles to 1 inch.
- United Kingdom—England—Lancashire.** **Harrison.**
 An Archaeological Survey of Lancashire. By William Harrison. Westminster: Printed by Nichols & Sons, 1896. Size 12 x 10, pp. 26. *Map.*
 The district covered by this survey, and incorporated in the accompanying map, extends beyond the borders of Lancashire, and, including the greater part of the Lake District and some of Western Yorkshire, affords an excellent opportunity for cataloguing the antiquities and showing the mutual relations of ancient sites in the north-west of England.
- United Kingdom—England—Lancashire.** **Bolton.**
J. Manchester G.S. 13, 1896 (1897): 188-197.
 The Physical Geography of North-East Lancashire. By Herbert Bolton. *With Map and Illustrations.*
 A good piece of local geography.
- United Kingdom—England—Southport.** **Baxendell.**
 Borough of Southport, Meteorological Department. The Fernley Observatory, Southport. Report, and Results of Observations, for the year 1896. By Joseph Baxendell. Southport, 1897. Size 10 x 7½, pp. 30.
- United Kingdom—Scotland.** **Blaikie.**
 Itinerary of Prince Charles Edward Stuart, from his landing in Scotland, July, 1745, to his departure in September, 1746. Compiled from *The Lyon in Mourning*, supplemented and corrected from other contemporary sources by Walter Biggar Blaikie. With a Map. Edinburgh: Printed . . . by T. & A. Constable for the Scottish History Society, 1897. Size 9 x 6, pp. xvi. and 136. *Illustrations. Presented by the Author.*
 This singularly interesting work will receive a special notice.

ASIA.

- Afghanistan.** **McMahon.**
 The Southern Borderlands of Afghanistan. By Captain A. H. McMahon. From the *Geographical Journal* for April, 1897. Size 10 x 6½, pp. 24. *Map and Illustrations.*
- Ceylon.** *M.G. Ges. Hamburg* 13 (1897): 70-91. **Geiger.**
 Ceylon und seine Bewohner. Von Prof. Dr. Wilhelm Geiger.
 A general account of a visit to Ceylon in 1895-96, undertaken on behalf of the Bavarian Academy of Sciences in order to pursue linguistic and historical studies.
- China—Lighthouses, etc.**
 China. Imperial Maritime Customs. III.—Miscellaneous series: No. 6, List of the Chinese Lighthouses, Light-Vessels, Buoya, and Beacons for 1897. (Corrected to December 1, 1896.) Twenty-fifth Issue. Shanghai: Statistical Department of the Inspectorate General of Customs, 1897. Size 11 x 9, pp. 52. *Charts.*
 The position of all the Chinese coast and river lights is shown in three charts.
- Dutch East Indies.** **Van der Chijs.**
 Nederlandsch-Indisch Plakaatboek, 1602-1811. Door J. A. Van der Chijs. Vijftiende Deel, 1808-1809. Batavia, 1896. Size 8½ x 5½, pp. 1164.
- India.** *J.S. Arts* 45 (1897): 561-571. **Black.**
 The Railway to India. By C. E. D. Black. *With Map.*
 The proposed railway route to India is from Alexandria to the head of the Gulf of

Akaba, thence across Northern Arabia to the Euphrates, and on by Basra, the eastern side of the Persian gulf, and along the south of Baluchistan to Kurrachee.

India—Assam.

Report on the River-borne Trade of Assam for the Quarter ending September 30, 1896. [Shillong, 1897.] Size 13½ × 8½, pp. 42.

India—Burma. *Fortnightly Rev.* 62 (1897): 86-104. **Parker.**

The Burmo-Chinese Frontier and the Kakhyen Tribes. By E. H. Parker.

An account of a journey from Bhamo in 1893 through the territory of the Kakhyen tribes.

India—Kulu. *Globus* 71 (1897): 1-8, 23-29. **Oppert.**

Reise nach Kulu im Himälaya. Von Prof. Gustav Oppert. *With Illustrations.*

India—Rainfall. *Nature* 56 (1897): 110-115.

Periodic Variations of Rainfall in India. By J. E.

An elaborate study of the variations of Indian rainfall which appears not to be associated with similar variations of the same or opposite phase in other parts of the world.

Malay Archipelago—Celebes. *Rev. Maritime* 133 (1897): 5-17.

Benseignements recueillis à Macassar par le "Duguay-Trouin."

Palestine. **Whitty.**

Palestine Exploration: Further Revelations! chiefly concerning the Discovery of "Whitty's Wall" at Jerusalem (King Solomon's Rampart). By the Rev. John Irwine Whitty, LL.D., etc. London: Simpkin & Co., 1897. Size 8½ × 5½, pp. 50. *Map. Presented by the Author.*

Siberia—Gold. *Rev. Scientifique* (4) 7 (1897): 513-528. **Sabachnikoff and Levat.**

Les placers aurifères de la Sibirie orientale. Par T. Sabachnikoff et E. D. Levat. *With Map and Illustration.*

Gives an account of the method of prospecting for gold used in Eastern Siberia, and of the working of the placers, with special reference to the economic conditions of Russian gold-mining.

Tibet—Sanpo. *Globus* 71 (1897): 334-339. **Reichelt.**

Der Tsangpo-Brahmaputrafluss von der Quelle bis Sadiya. Von G. Th. Reichelt. *With Maps.*

Western Asia. **Bigham.**

A Ride through Western Asia. By Clive Bigham. London: Macmillan & Co., 1897. Size 9½ × 6, pp. xii. and 284. *Maps and Illustrations. Price 8s. 6d. Presented by the Publishers.*

Mr. Bigham, in the course of thirteen months, travelled through Asia-Minor, visiting Angora, Sivas, Erzinjan, Erzerum, Bayazid, and then entered Persia, through which he made a number of routes, some leading him into regions very rarely visited. He also made a rapid visit to Mesopotamia, and concluded his already extensive travels by a run to Samarkand on the Trans-Caspian railway, a journey to Kashgar, and a crossing of the Tian Shan to the Siberian railway line, by which he returned to Europe. The narrative is lively and concise, the illustrative photographs well selected, and the maps show the numerous routes clearly.

AFRICA.

Africa—People. *Cosmos* (2) 12 (1895-96): 82-89, 145-153. **Lenz.**

Sui cosiddetti "popoli nani" dell' Africa, pel dott. Oscarre Lenz.

On the dwarf-peoples of Africa.

Africa. **Peters.**

Lecture delivered by Dr. Carl Peters on the Future of Africa, at the Society of Arts, on March 5, 1897. London, 1897. Size 9 × 6, pp. 16.

Algerian Sahara. *Ann. G.* 6 (1897): 147-168. **Hess.**

L'Extrême-Sud algérien et le Touat. Par M. Jean Hess. *With Map and Photographs.*

British East Africa—Uganda. **Vandeleur.**

Two Years' Travel in Uganda, Unyoro, and on the Upper Nile. By C. F. S. Vandeleur, D.S.O. From the *Geographical Journal* for April, 1897. Size 10 × 6½, pp. 26. *With Map and Illustrations.*

- East Africa—Somaliland.** *B.S.G. Bombay* 17 (1896): 5-30. **Ghica-Comănesci.**
O călătorie prin țara Somalilor. Conferință . . . de Dim. Ghica-Comănesci.
With Map and Illustrations.
- East Africa—Victoria Nyansa.** *Petermanns M.* 43 (1897): 77-80. **Brard.**
Der Victoria-Nyansa. Von Pater Brard. *With Map.*
On the southern part of the Victoria Nyansa.
- Eastern Africa.** *Export* 19 (1897): 131-133, 143-145. **Reinisch.**
Ein Blick auf Aegypten und Abessinien. Von Leo Reinisch.
- German East Africa.** *Koloniales Jahrb.* 10 (1897): 1-17. **Bernhard.**
Ueber Eisenbahnprojekte in Deutsch-Ost-Afrika. Von L. Bernhard.
- German East Africa.** *Koloniales Jahrb.* 10 (1897): 40-62. **Maercker.**
Landesaufnahme von Deutsch-Ostafrika. Von Maercker.
- German South-West Africa.** *M.G. Ges. Hamburg* 13 (1897): 58-69. **Dove.**
Wissenschaftliche Aufgaben in Südwestafrika. Von Dr. K. Dove.
- German South-West Africa.** *M.G. Ges. Hamburg* 13 (1897): 141-142. **Hartmann.**
Bemerkungen zur vorläufigen Karte des Koncessions-Gebietes des South-West Africa Co., Lim. Von Premier-lieutenant à la suite Dr. ph. Hartmann. *With Map.*
The map is on the scale of 1 : 500,000.
- Italian East Africa—Erythraea.** **De la Jonquière.**
C. De la Jonquière. Les Italiens en Érythrée. Quinze ans de Politique coloniale.
Paris: H. Charles-Lavauzelle [not dated, 1897?]. Size 9 × 6, pp. 352. *Maps.*
Price 5s.
The subordinate place given to dates throughout this work reduces its value as a book of reference. It gives a continuous history of Italian enterprise in East Africa, and details of the recent disastrous war. There are numerous sketch-maps.
- Portuguese West Africa.** *Mouvement G.* 14 (1897): 175-178. _____
Le Chemin de Fer d'Ambaka. *With Map.*
On the railway from Loanda to Ambaka, and its projected extension.
- South Africa.** **Schulz and Hammar.**
The New Africa. A Journey up the Chobe and down the Okovanga Rivers. A record of Exploration and Sport. By Aurel Schulz, M.D., and August Hammar, C.E. With a newly drawn Map of hitherto unexplored parts of the Country, and Seventy Illustrations from Original Drawings by the Authors, and Photographs. London: W. Heinemann, 1897. Size 9½ × 6, pp. xii. and 406. Price 28s. Presented by the Publisher.
- South Africa—Zambesi.** *Rev. Scientifique* (4) 7 (1897): 561-564. **Foa.**
Un voyage sur les bords du Zambèze, d'après M. E. Foa. *With Illustrations.*
- Tunis.** *Ann. G.* 6 (1897): 239-254. **Blanchet.**
Le Djebel Demmer. Par M. P. Blanchet. *With Map.*
The author resuscitates the old Arab name, Jebel Demmer, for the whole mountain backbone of Southern Tunis, at present known under different names in its different natural divisions.
- West Africa.** *Ann. G.* 6 (1897): 133-146. **Toutée.**
Principaux résultats géographiques de la mission Toutée. *With Map.*
- West Africa.** **Harford-Battersby.**
Niger and Yoruba Notes. A Record of Work in Western Equatorial Africa. Vols. i. and ii. Edited by C. F. Harford-Battersby, M.D. London: Marshall Bros., 1895 and 1896. Size 10 × 7½, pp. (vol. i.) iv., 48, and 48; (vol. ii.) iv. and 96. *Maps. Presented by the Editor.*

NORTH AMERICA.

- Canada.** **Dawson, Tyrrell, Low.**
Recent Explorations in Canada, 1897-98. I. Introductory Sketch. By G. M. Dawson, C.M.G., etc. 2. The Barren Lands of Canada. By J. Burr Tyrrell, M.A., etc. 3. The Labrador Area. By A. P. Low, B.A.Sc., etc. Reprinted from the *Ottawa Naturalist*, vol. x. No. 11. Ottawa, March, 1897. Size 9 × 6, pp. [16].

- Canada—Bell River.** *B. Geolog. S. America* 8 (1897): 241-250. **Bell.**
Evidences of North-easterly differential rising of the land along Bell River. By Robert Bell. *With Maps. Presented by the Author.*
- Canada—Gulf of St. Lawrence.** *Ann. Hydrographie* 25 (1897): 116-122. **Schott.**
Weitere Beiträge zur Hydrographie des St. Lorenz-Golfes. Nach den Kanadischen Berichten bearbeitet von Dr. Gerhard Schott. *With Plate.*
- Canada—Mineral Industry.** **Ingall.**
Geological Survey of Canada, G. M. Dawson, c.m.s., etc., Director. Part 5. Annual Report, vol. viii. Section of Mineral Statistics and Mines, Annual Report for 1895. Elfric Drew Ingall. Ottawa, 1897. Size 10 x 7, pp. 104.
- Historical.** **Winship.**
The Coronado Expedition, 1540-1542. By George Parker Winship. Extract from the Fourteenth Annual Report of the Bureau of Ethnology. Washington, 1896. Size 11½ x 8, pp. 327-638. *Illustrations and Facsimile Maps. Presented by the U.S. Bureau of Ethnology.*
This will be specially noticed.
- United States.**
Annual Report of the Chief of Engineers, United States Army, to the Secretary of War, for the year 1896. Six Parts. Washington, 1896. Size 9½ x 6, pp. 4196. *Maps and Diagrams. Presented by the Engineer Department, U.S. Army.*
This voluminous report gives particulars of the public works carried out on the navigable rivers of the United States in 1896.
- United States—Alaska.** **Schott.**
Standard Geodetic Positions in South-Eastern Alaska, depending on astronomic observations made during 1892-93-94. Reports of December 27, 1893; March 28 and August 7, 1894. By C. A. Schott.—Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894. Part ii. Pp. 71-85. Washington, 1895. Size 12 x 9.
- United States—Alaska.** **Schott.**
Distribution of the magnetic declination in Alaska and adjacent waters for the year 1895. Report by C. A. Schott.—Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894. Part ii. Pp. 87-100. Washington, 1895. Size 12 x 9. *Charts.*
- United States—Massachusetts.**
Geographic positions in the State of Massachusetts, 1832-1890 (second enlarged and revised edition).—Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894. Part ii. Pp. 349-615. Washington, 1895. Size 12 x 9. *Charts.*

CENTRAL AND SOUTH AMERICA.

- Bolivia—Rio Beni.** **Heath and Ballivian.**
Ministerio de Instruccion Publica y Fomento. La exploracion del Rio Beni. Revista historica, por el Dr. Edwin R. Heath. Traducida y anotada por Manuel V. Ballivian. La Paz, 1896. Size 8½ x 6, pp. iii, 89, and xx.
- British Honduras.**
[British Honduras: Addresses of Welcome to Sir A. Moloney, 1896.] Size 13¼ x 8¼, pp. 12.
- Central America.** **Sapper.**
Das Nördliche Mittel-Amerika nebst einem Ausflug nach dem Hochland von Anahuac. Reisen und Studien aus den Jahren 1888-1895. Von Dr. Carl Sapper. Braunschweig: F. Vieweg und Sohn, 1897. Size 9½ x 6, pp. xii. and 436. *With Portrait, Maps, and Plans. Price 9s.*
This book brings together the important information which Dr. Carl Sapper has been accumulating on Central America during the last seven years. It deals with all the conditions of geography, and is illustrated by a series of very useful general physical maps.
- Equador—Rio Napo.** **Dolby-Tyler and Giglioli.**
Gli ultimi giorni dell' Età della Pietra (America meridionale). Di alcuni strumenti litici tuttora in uso presso certe tribù del Rio Napo. Nota di Carlo H. Dolby-Tyler ed Enrico H. Giglioli. (Estratto dall' *Archivio per l'Antropologia e l'Etnologia*, vol. xxv. Fascicolo 3°, 1895.) Size 10 x 6½, pp. 14. *Presented by Prof. cav. Enrico H. Giglioli.*
On stone implements in use on the Rio Napo.

WEST INDIES.

- West Indies.** **Newton.**
Glimpses of Life in Bermuda and the Tropics. By Margaret Newton. London: Digby, Long & Co. [1897.] Size 8 x 5½, pp. xii. and 256. *Illustrations.*
Price 6s. Presented by the Publishers.

The authoress gives a pleasant account of an agreeable holiday spent in sketching in Bermuda and the West Indies, most of the islands of which, lying on the mail-route, were visited. A selection of clever pen-and-ink sketches illustrates the book.

- West Indies—Virgin Islands.** *G.Z.* 3 (1897): 121-137. **Deckert.**
Politisch-geographische Betrachtungen über Westindien. Von Dr. Emil Deckert.
 IV. Die Jungferinseln.

AUSTRALASIA AND OCEANIC ISLANDS.

- Australia.** *J. Manchester G.S.* 12 (1896) (1897): 109-127. **Harper.**
The Growth and Progress of the Australian Colonies. By W. Harper. *With Map.*
- Australia—Alps.** *J.R.G.S. Australasia* 6 (1896): 75-96. **Helms.**
The Australian Alps, or Snowy Mountains. By Richard Helms.

New South Wales—Historical.

The Brabourne Papers. (Relating to the Settlement and Early History of the Colony; purchased from Lord Brabourne by Sir Saul Samuel, Agent-General.) A Pamphlet containing a Summary of the Contents of these important Papers. Reprint of a pamphlet published in 1886 by Charles Potter, Government Printer, Sydney. Size 9½ x 6, pp. 48.

The "Brabourne Papers" are really the letters preserved by Sir Joseph Banks, which were addressed to him by correspondents, mainly in the recently founded colony of New South Wales, on the early history of which they throw much new light. This pamphlet is a summary and table of contents of the whole collection, which will ultimately be published in its entirety.

- Queensland—Anthills.** *P.R.S. Queensland* 12 (1897): 99-100. **Jack.**

Note on the "Meridional Anthills" of the Cape York Peninsula. By R. L. Jack.

A note describing the remarkable anthills of northern Queensland, built by termites, and possessing the curious characteristic of being placed due north and south. The reason for this is stated by Mr. Jack to be that in that position they secure the maximum of desiccation.

- Queensland—Meteorology.** *J. Manchester G.S.* 12, 1896 (1897): 128-136. **Wragge.**
Meteorology of Queensland. By Clement L. Wragge.

- Solomon Islands—New Georgia.** *J. Anthropol.* 1. 26 (1897): 357-412. **Somerville.**
Ethnographical Notes in New Georgia, Solomon Islands. By Lieut. Boyle T. Somerville. *With Illustrations.*

- Victoria—Geology.** **Stirling.**

The Geological Society of Australasia. Session, 1896. Inaugural Address by the President, James Stirling, September 25, 1896. Size 8½ x 5½, pp. 16.

A summary of the geology of Victoria, with special reference to the minerals of economic value.

POLAR REGIONS.

- Antarctic.** **Arctowski.**

Quelques remarques sur l'intérêt qu'offre pour la géologie l'exploration des régions antarctiques. Par H. Arctowski. (Extrait du Bulletin de la Société Belge de Géologie, etc. Tome X. Année 1896.) Size 10 x 6½, pp. 4. *Presented by the Author.*

Dr. Arctowski of the Belgian Antarctic Expedition suggests that the tertiary rocks of the Andes reappear in Grahamsland, which he believes to be a prolongation of the American continental axis.

- Antarctic.** *Globus* 71 (1897): 320-325. **Lindeman.**

Die neueren Reisen zur geographischen Erforschung der Südpolarregion und der deutsche Plan. Von M. Lindeman. III (Schluss.) *With Illustrations.*

This concludes Herr Lindemann's excellent *résumé* of the history of antarctic exploration.

- Arctic.** Simon.
Henry Simon's occasional Letter. Special Nansen Number. April, 1897. Manchester. Size 14 × 8½, pp. 8. *Portrait and Illustrations.*
- Arctic and Antarctic.** *J.S. Arts* 45 (1897): 632-636. Trevor-Battye.
Arctic and Antarctic. By Aubyn Trevor-Battye.
- Arctic—Nansen's Voyage.** *Ann. G.* 6 (1897): 71-78, 169-180. Zimmermann.
Le voyage de Nansen et les Théories sur les courants du pôle boréal. Par M. M. Zimmermann.
- Greenland.** *Petermanns M.* 43 (1897): 86-95. Hartz.
Die dänische Expedition nach Ostgrönland 1891-92. Von N. Hartz. *With Map.*
Describes and gives a geological sketch-map of Scoresby Sound.
- Spitsbergen.** Conway.
The First Crossing of Spitsbergen. By Sir W. Martin Conway. From the *Geographical Journal* for April, 1897. Size 10 × 6½. *Maps and Illustrations.*

MATHEMATICAL GEOGRAPHY.

- Astronomical.** _____
Tables used in the Nautical Almanac Office for the calculation of the Occultations of Stars by the Moon generally, together with special tables adapted for the Royal Observatories at Greenwich and the Cape of Good Hope. London: Printed . . . by Darling & Son, 1896. Size 13½ × 8½, pp. 48.
- Geodesy.** *Knowledge* 20 (1897): 148-150. Fowler.
Measurement of the Earth. By A. Fowler. (*Illustrated.*)
An account of some historical geodetic surveys, with a photograph of the monument at Hammerfest commemorating the end of the triangulated meridional arc from the mouth of the Danube.
- Geodesy.** _____
Formulæ and tables of factors for the computation of geodetic positions (fourth revised and enlarged edition).—Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894. Part ii. Pp. 277-348. Washington, 1895. Size 12 × 9.
- Photographic Surveying.** *Ann. G.* 6 (1897): 97-102. De la Noë.
Les méthodes photographiques en topographie. Par M. le général de la Noë.
An epitome of the results obtained in Switzerland by Herr Rosenmund, who decided, after experiments, that photographic methods were of unique value only in reducing the time necessary to be spent in the field, and that they should only be employed in cases where the number of days in the year available for field-work was very small.
- Position—Determination.** *Ann. Hydrographie* 25 (1897): 122-127. Tetens.
Ueber geographische Ortsbestimmung an Lande ohne astronomische Instrumente. Von Otto Tetens.
A statement of Dr. Paul Herzer's method of observing for position without instruments.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

- Air and Life.** Russell.
Smithsonian Miscellaneous Collections. 1072. Hodgkins Fund. The Atmosphere in relation to Human Life and Health. By Francis Albert Bollo Russell. Washington: The Smithsonian Institution, 1896. Size 10 × 6, pp. 148.
- Air and Life.** Varigny.
Smithsonian Miscellaneous Collections. 1071. Hodgkins Fund. Air and Life. By Henry de Varigny, M.D., etc. Washington, 1896. Size 10 × 6½, pp. 70.
Dr. Varigny's essay was awarded the third prize of £250 in the competition for the Hodgkins Prize recently held in Washington. It deals comprehensively with the composition of the atmosphere, and with the relations of air to life.
- Air in Towns.** Cohen.
Smithsonian Miscellaneous Collections. 1073. Hodgkins Fund. The Air of Towns. By Dr. J. B. Cohen. Washington, 1896. Size 10 × 6½, pp. 42. *Plates.*
- Atmospheric Sounds.** *Globus* 71 (1897): 333-334. Sieger.
Seechiessen, Wasserschüsse, Nebelrülpe, Luftpuffe. Von Dr. R. Sieger.

Geodesy.

Hirsch.

Comptes-Rendus des Séances de la Commission Permanente de l'Association Géodésique Internationale réunie à Lausanne du 15 au 21 octobre 1896 rédigés par le Secrétaire perpétuel A. Hirsch, suivis des Rapports sur les travaux géodésiques accomplis dans les différents pays pendant la dernière année. Berlin: D. Reimer, 1897. Size 11½ × 9, pp. 318. *Maps and Plates.*

Amongst the more important reports and maps in this volume are those dealing with the triangulation of Italy and of Japan.

Gravity.

Preston.

Telegraphic determination of the force of gravity at Baltimore, Md., from simultaneous observations at Washington and Baltimore. By E. D. Preston.—Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894, Part ii. Pp. 57-70. Washington, 1895. Size 12 × 9.

Gravity Measure.

Putnam and Gilbert.

Relative determination of gravity with half-second pendulums, and other pendulum investigations. By G. R. Putnam; and a report on a geological examination of some Coast and Geodetic Survey gravity stations. By G. K. Gilbert.—Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894. Part ii. Pp. 7-55. Washington, 1895. Size 12 × 9.

Meteorology.

Duclaux.

Smithsonian Contributions to Knowledge. 1084. Hodgkins Fund. Atmospheric Actinometry and the Actinic Constitution of the Atmosphere. By E. Duclaux. Washington: the Smithsonian Institution, 1896. Size 18½ × 10, pp. 48. *Presented by the Smithsonian Institution.*

Meteorology.

Gebelin.

Les limites géographiques du Climat Tempéré. Communication faite au Congrès national des Sociétés françaises de Géographie le 6 Août 1895 (16^e Session: Bordeaux). Par Jacques Gebelin. Bordeaux: Feret et Fils, 1896. Size 10 × 6½, pp. 10. *Map.*

The author's definition of "temperate" climate includes on his map Spitsbergen and the Punjab.

Meteorology.

McAdie.

Smithsonian Miscellaneous Collections. 1077. Hodgkins Fund. Equipment and Work of an Aero-physical Observatory. By Alexander McAdie. Washington: the Smithsonian Institution, 1897. Size 10 × 6½, pp. 30. *Presented by the Smithsonian Institution.*

This essay discusses the equipment and sphere of work of a laboratory devoted to the study of the physical conditions of the atmosphere, such as has been proposed for one of the American universities.

Ocean Depths.

List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1896, from H.M. Surveying Ships, Indian Marine Survey and British Submarine Telegraph Companies. Hydrographic Department, Admiralty, London, February, 1897. Size 13½ × 8½, pp. 20. *Presented by the Hydrographic Department, Admiralty.*

Oceanography—Tides.

Harris.

Manual of Tides, Part iii. Some connections between harmonic and non-harmonic quantities, including applications to the reduction and prediction of tides. By Rollin A. Harris. Report of the Superintendent of the U.S. Coast and Geodetic Survey . . . 1894. Part ii. Pp. 125-262. Washington, 1895. Size 12 × 9. *Tables.*

Plant-Geography.

Abh. k. A. Wiss. Berlin (1896): 1-28, 1-36.

Engler.

Ueber die geographische Verbreitung der Rutaceen im Verhältnis zu ihrer systematischen Gliederung. Von H^m. Adolf Engler. *With Maps.*

Ueber die geographische Verbreitung der Zygophyllaceen im Verhältnis zu ihrer systematischen Gliederung. Von H^m. Adolf Engler. *With Maps.*

Numerous clear maps are given, showing the distribution of a large number of separate species.

Seismology.

Rev. Scientifique 7 (1897): 360-362.

Lapparent.

Les mouvements de l'écorce terrestre. Par M. A. de Lapparent.

It is gratifying to observe that M. de Lapparent acknowledges the assistance given him by the notices of geographical literature in this *Journal*.

Terrestrial Magnetism.

Bauer.

On the distribution and the secular variation of Terrestrial Magnetism. No. iv. On the component fields of the Earth's permanent Magnetism. [Abstract.] By L. A. Bauer. (Reprinted from *Terrestrial Magnetism*.) Size $9\frac{1}{4} \times 7$, pp. [7]. *Chart. Presented by the Author.*

Terrestrial Magnetism. *Terrestrial Magnetism* 2 (1897): 27-31.

Schmidt.

On the Distribution of Magnetic Observatories over the Globe. By Adolf Schmidt.

Terrestrial Magnetism.

Comparison and Reduction of Magnetic Observations.—Report of the Committee, consisting of Prof. W. G. Adams, Dr. C. Chree, Lord Kelvin, Prof. G. H. Darwin, Prof. G. Chrystal, Prof. A. Schuster, Captain E. W. Oreck, the Astronomer Royal, Mr. William Ellis, and Prof. A. W. Bæcker. (Section A. British Association Meeting, Liverpool, 1896.) Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 12.

Tidal Phenomena. *American J. Science* (4) 3 (1897): 406-412.

Duff.

Seiches on the Bay of Fundy. By A. Wilmer Duff.

The author traces the secondary undulations of a recording tide-gauge on the Bay of Fundy to seiches concerning which he confirms Forel's theory that they are due to the free vibration of the whole water in a basin.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.**Ancient Geography.**

Tozer.

A History of Ancient Geography. By H. F. Tozer, M.A. Cambridge: The University Press, 1897. Size $8 \times 5\frac{1}{2}$, pp. xviii. and 388. *Maps. Price 10s. 6d. Presented by the Cambridge University Press.*

A special notice of this book will be given.

Anthropogeography. *Rev. Scientifique* (4) 7 (1897): 353-360.

De la Blache.

L'Éducation des indigènes. Par M. P. Vidal de la Blache.

Discusses the problem of education for the natives in French colonies, which is recognized as difficult and delicate, but not impossible of solution.

Anthropogeography. *B. American G.S.* 29 (1897): 1-12.

Mindeleff.

The Influence of Geographic Environment. By Cosmos Mindeleff.

This theme is treated with reference to the Pueblo Indians of the south-west of the United States, who have for many centuries inhabited a country of pronounced and exceptional natural features.

Anthropogeography. *G.Z.* 3 (1897): 268-278.

Ratzel.

Die geographische Methode in der Ethnographie. Von Friedrich Ratzel.

In the form of a criticism of Achelis' "Moderne Völkerkunde," Prof. Ratzel gives an interesting exposition of the application of geographical method to ethnography.

Anthropology. *M. Deutsch. Schutzgeb.* 10 (1897): 1-25.

Seidel.

Instruktion für ethnographische Beobachtungen und Sammlungen in Togo. . . . Bearbeitet von H. Seidel.

A series of questions for the special guidance of German officials in Togo, with the object of fully studying the anthropological conditions.

Arab Geography. *G.Z.* 3 (1897): 137-146.

Schwarz.

Die ältere geographische Litteratur der Araber. Von P. Schwarz.

Notes on some of the older Arab geographers, especially Ibn Khordadbe (ca. 850), and Mukadasi (ca. 1070).

Cabot's Voyage. *Blackwood's Mag.* 161 (1897): 838-851.

John Cabot: an Anniversary Story.

Civilisation. *J. R. Statistical S.* 60 (1897): 148-161.

Rubin.

A Measure of Civilisation. By Marcus Rubin. Translated by A. W. Flux, M.A.

Historical—Albuquerque.

Rebello.

J. J. de Brito Rebello. Ementas historicas. I. A edade de Affonso de Albuquerque. Coimbra, 1896. Size 10×7 , pp. 26. *Presented by the Author.*

Historical—Asiatic Trade. *M.G. Ges. Hamburg* 13 (1897): 92-130.

Baasch.

Die Anfänge des modernen Verkehrs Hamburgs mit Vorderindien u. Ostasien. Von Dr. Ernst Baasch.

On the early trade between India and Hamburg by sea; but this trade only began in 1791, and for the next ten years the annual number of vessels from India and China to Hamburg varied from two to seven.

NEW MAPS.

By J. COLES, *Map Curator, R.G.S.*

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AFRICA.

Africa.

Herfst.

Reference Map of the Orange Free State, reduced from the Ordnance Map as compiled by order of the Government of the O.F.S., with all the recent improvements and additions, by J. J. Herfst. Scale 1:380,160 or 6 stat. miles to an inch. Presented by the Orange Free State Government, through Sir W. Dunn, Bart., M.P.

This map has been produced by photography, and is a reduction of the large map of the Orange Free State which has been compiled by the order of the Government. It contains a larger amount of detail than has previously been given on any map of this State, but in its present form—a blue print—the hills are but faintly indicated.

AMERICA.

Canada.

Geological Survey of Canada.

Geological and Topographical Map of the Northern Part of the Lake of the Woods and Adjacent Country. Scale 1:126,720 or 2 stat. miles to an inch. Geologically surveyed by A. C. Lawson, M.A. Compiled and drawn by A. E. Barlow, B.A. Additions by W. J. Wilson. 1897. Geological Survey of Canada. Presented by the Geological Survey of Canada.

GENERAL.

General Atlas.

W. & A. K. Johnston.

Our Empire Atlas, showing British Possessions at Home and Abroad. Fifty-nine plates and complete Index, with introduction by C. P. Lucas, B.A. 1897. Messrs. W. & A. K. Johnston, Edinburgh and London. Presented by the Publishers.

Historical Geography.

Poole.

Historical Atlas of Modern Europe from the Decline of the Roman Empire, comprising also maps of parts of Asia and of the New World, connected with European History. Edited by Reginald Lane Poole, M.A., Ph.D. Lecturer in Diplomatic History in the University of Oxford. Part ix. Oxford: The Clarendon Press; London,

Edinburgh, Glasgow, and New York: Henry Frowde, M.A.; Edinburgh: W. & A. K. Johnston. 1897. Price 3s. 6d. each part. Presented by the Clarendon Press.

Part ix. contains the following maps: No. 4, Europe in the time of Charles Great, by Reginald Lane Poole, M.A., F.R.S.; No. 46, Hungary, 1526-1699, by R. N. Bain; No. 53, France, Lotharingia, and Burgundy in the Eleventh and Twelfth Centuries, by Walter E. Rhodes, M.A. Each map is accompanied by letterpress.

World.

Bergl

Chart of the World. XII. Edition. Dr. Herm. Berghaus. Gotha: Justus Perth 1897. Price 14 marks.

This is an entirely new edition of Berghaus's well-known Chart of the World. It shows all tracks followed by all the principal steamship lines and sailing vessels, the outward and homeward tracks being distinguished by the colour of the arc indicating the direction. Currents are shown and their velocities given; railways and submarine telegraph lines are laid down, and the positions of coaling-stations, &c. etc., are shown. In addition to the vast amount of information given on the principal map, there are insets showing the principal telegraph lines of the World, co-tidal lines of the World in hemispheres, on Lambert's polar projection, showing steam navigation and railroads round the World, and a general wind chart. At the foot of the map, copious notes are given explaining the symbols employed, and general information with regard to steamship lines. The map is beautifully drawn, and is equally well suited for general reference in the library, merchant's office, or schoolroom.

PHOTOGRAPHS.

Baluchistan.

Y

Eleven Photographs of Baluchistan, taken by Major A. C. Yate. Presented by Major A. C. Yate.

This is an exceedingly interesting set of photographs, consisting of the following: (1) Distorted rails due to earthquake, December 20, 1892, at Old Chaman; (2) Railway terminus at Chaman; (3) Railway plant for line to Kandahar; (4) Telegraph plant for line to Kandahar; (5) Kojhak tunnel; (6) Sanzal; (7) Black hair tent nomads; (8) Interior ground-plan of black hair tent; (9) Locusts at work; (10) Showing effect of earthquake near Old Chaman.

Central Asia.

Thirteen Photographs of Sikkim and Tibet. Presented by Miss S. M. Taylor.

This interesting series contains the following photographs taken in Sikkim and Tibet: (1) Gnatong, altitude 12,350 feet; (2) Lake Bedentzo, between the Tukola and Jelapa; (3) Tent hill; (4) The main street of the Trade Mart of Yatung, Tibet; (5) View from the Commissioner's balcony, Trade Mart, Yatung; (6) Sida Dhurki, chief Tibetan at the Trade Mart; (7) View from Yatung Trade Mart of the wall, quarter of a mile off; (8) Small fortifications to the right of the temple; (9) View taken from the further side of the wall and looking towards Sikkim; (10) The temple of Rinchingong in the valley below; (11) View from the temple of Rinchingong in the valley below; (12) Further temple considerably above the altitude of the first.

New South Wales.

Twelve Photographs, showing water issuing from various artesian bores in New South Wales. Presented by Joseph Brooks, Esq.

These photographs illustrate the progress that has been made in New South Wales with artesian wells. The particulars of depths, amount of flow, temperature, &c., are given on each photograph. They consist of the following: Burrenbella bore; Lissington bore; Cutta Cutta bore; Lissington bore; Bore No. 3; Charlotte Plains bore, No. 1; Charlotte Plains bore, No. 2; Camden Park bore; Noorama, No. 1 bore; Noorama, No. 2 bore; Thurlagoona bore, No. 11; Cunnamulla bore; Claverton Downs bore, No. 2.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, will be useful for reference if the name of the photographer and his address are given.



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AN EXPEDITION TO THE SOURCE OF THE NIGER.*

By Colonel J. K. TROTTER, R.A.

FROM a boundary commission, equipped with every requisite for making a high-class survey, very important results in the way of elucidating the geography and topography of the country visited are naturally expected. And yet, with regard to the collection of general information on these subjects, a boundary commission has many difficulties to contend with. It is closely tied to one particular line of country, and cannot deviate from it to examine places of special interest which may lie near the route; and the work of delimitation takes up so much of the time available that it is impossible for those engaged in it to give their attention to other matters. Such at least was my experience, and on my return from West Africa, I could not but contrast with regret the smallness of the results we had obtained with the many openings which had been offered to us for adding to our knowledge of the country in every branch of science.

This boundary commission was, it may be hoped, the final step to a series of negotiations which have been going on for many years past. The task assigned to it was to mark out on the ground the boundary, according to the agreement signed at Paris on January 21, 1895, between France and England, which extends from Kiragba on the Atlantic coast to the 10th parallel of north latitude, along this parallel, and up the watershed between the Niger and the waters flowing westwards to the Atlantic, as far as the Niger sources at Tembi Kunda. The chief point of interest in connection with this boundary delimitation was that practically nothing was known about the Niger sources, though they had been visited on one or two occasions, and that their

* Paper read at the Royal Geographical Society, December 7, 1896. Map, p. 348.
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position with reference to that part of the Sierra Leone hinterland which had been explored in recent years was quite unknown. The entire region covered by the boundary from Tembi Kunda to the Great Skarcies at Wellia was also unknown to the British authorities, though a part of it had been explored by the French.

On December 16, 1895, the joint commission, consisting on the British side of myself and Lieut. Tyler, R.E., as commissioners, with Captain McKay of the Sierra Leone Frontier Police, Dr. Paris of the Colonial Service, four men of the Royal Engineers, and 448 natives (escort, clerk, interpreters, servants, hammock-boys, and carriers), and on the French side of Captain Passaga and Captain Cayrade, commissioners, with one under officer and 102 natives, and four mules, left Freetown in the colonial steamer, *Countess of Derby*, for Moferri, on the Port Lokko creek, where we transhipped to boats and rowed to Port Lokko. From this place we were to proceed by march to Tembi Kunda *via* Bumban and Kruto, and to commence at the Niger sources the frontier delimitation, which was to end at the Great Skarcies, near Wellia. A third French commissioner, Captain Millot, was to meet an officer delegated by the Governor of Sierra Leone at Kiragba, and to delimit the Samu frontier from the Atlantic coast to the little Mola river. This arrangement, however, broke down, and Captain Millot joined the other commissioners at Tembi Kunda, and remained with them till March 9.

Of the French commissioners, the senior, Captain Passaga, is an accomplished topographer, and has served in the topographical department of the French War Office, and on the Algerian 1 : 200,000 survey; Captain Cayrade is an astronomical observer of high qualifications. Both he and Captain Millot have served for some years in the French Sudan, and Captain Millot has been engaged in more than one campaign against the Sofas. The instruments used by the French commission were a large theodolite reading to five seconds, and a powerful telescope for astronomical work, and for surveying a theodolite compass (*boussole Brossé*). The English commission had a 6-inch theodolite reading to ten seconds, a 7-inch and a 5-inch sextant for astronomical work; and for survey work they had, in addition, a large and some pocket prismatic compasses, plane-tables, a perambulator, and a pedometer. They were also supplied with a special camera for taking photographs of the moon and stars for determining longitudes (Captain Hill's method), which was worked by Mr. Tyler, who took the photographs and developed them.

Before leaving Freetown we rated our watches, and read our aneroid at sea-level. I may mention here that the French officers who had served in the Sudan told us, as we marched up country, that we should find the movement of the barometer due to atmospheric disturbances to be very small in the interior. Our subsequent experience

confirmed this statement; even a tornado hardly caused a movement, and when we remained several days in the same place, the barometer readings varied very little beyond the slight daily rise and fall. The heights obtained from barometer readings are, therefore, much more trustworthy than in countries where the barometer has a greater daily variation.

The road from Port Lokko to Bumban being well known, we did not sketch it, but we checked the distances with the perambulator, and observed the latitude every day, using frequently both theodolite and sextant, and taking meridians of the sun and one or more stars. We



ENTRANCE TO TOWN OF ROTATA.

had some little trouble at first with the perambulator. The native boy who had charge of it could not be persuaded that there was any legitimate method of transport except by resting his burden on his head, and when out of sight he adopted this method. When cured of it, he resorted to the device of reversing the instrument occasionally, reeling off a mile or so, and then making it work backwards for a bit, so as to defy all attempt to get at the distance covered. But we very soon overcame these difficulties, and our operator learned to take a pride in his instrument, and became inflated with conceit at his own intelligence in wheeling it.

The distance from Port Lokko to Bumban by perambulator is $77\frac{1}{2}$ miles, and it took us seven days to cover it. At Rotata we crossed the

Belia, an affluent of the Mabile, which is fordable in the dry season; and near Madina, one march from Bumban, we crossed the Mabile, which is about 90 yards wide, with a swift current and low banks. It is not fordable, and it took us some three hours to get our loads across in the only two dug-out canoes available.

As far as Bumban the country is quite flat, though, after crossing the Mabile, the ground becomes a little more diversified, and large granite boulders are strewn about. The road is a narrow winding track, crossing many streams and swamps, and leading through a region everywhere covered with bush. One has constantly the impression



CROSSING TRESTLE BRIDGE.

that a few hundred yards further on it will be possible to get a view of the surrounding country, but nowhere is it possible to see anything at a greater distance than a hundred yards or so, and the road itself cannot be seen ahead at anything like this distance. Although the trees are not large, nor the bush very dense, one marches altogether in ignorance of what is on either hand, and the villages cannot be seen till they are within a stone's throw.

As one approaches Bumban, hills are visible on the east, north, and south, with curiously shaped summits, some dome-like, some conical, and some columnar, formed of masses of granite. The town, which is the capital of the Biriwa Limba, is large, and lies at the foot of hills which shut it in on the east, north, and south. It has an elevation

above sea-level of 327 feet. The chief is remarkable for the number of wives he possesses—a number which is only exceeded by that of his tame pigeons, which he feeds daily himself. He is held in great dread by his subjects, whom he rules without the assistance of any executive, and even the natives of our establishment had a most extraordinary belief in his power of injuring them as long as they were in Limba country.

Kru, or Kruto, as it is more correctly named, the next point of importance in our route to Tembi Kunda, lies almost due east of Bumban. But the country on the direct line between the two places is quite unexplored, and no roads exist, so we were obliged to follow the Falaba road till we could find a route to lead us eastward. After leaving Bumban, where we had halted for Christmas Day, we commenced almost immediately to ascend the hills, and were soon in an entirely different region, both as regards climate and surroundings, to that of the coast, which may be said to end at Bumban. It is a hilly country of small features and constant ascents and descents. The road is fairly open, but it is difficult even for single men, owing to the steepness of the gradients. It is a strange thing in this country that the roads, which are like a serpent's track on the level, even when there are no obstacles to avoid, generally go straight up and down the steepest hills. Our first halting-place after leaving Bumban brought us to a height of 825 feet above sea-level, and three marches further, at Lengekoro, we had reached an altitude of 1500 feet. At this place we succeeded in finding a man who offered to show us a direct road to Kruto. With this man as our guide we quitted the Limba country, and passed through a hitherto unexplored part of Kuranko country. The first march was difficult, and led through much swamp. It brought us to the new, well-built town of Kundembaia. Here, and at all places till we reached the Bagwe river, the natives were terrified of us. Few of them had seen Europeans before, though some we met remembered the late Captain Lendy, and all of them believed us to be of the nature of Sofas. The chiefs and the menkind generally invariably ran away on our approach, and left the women and the decrepit to receive us; but as soon as they learned that our intentions were not hostile, and that we had trade goods with us, they came out of their hiding-places and were very friendly. The towns in this part of Kuranko country, as throughout the country generally, were entirely destroyed during the Sofa war, and the people are only now coming out of their hiding-places, rebuilding their huts and reoccupying the land.

After leaving Kundembaia we crossed the Seli river, which is about 60 yards wide, with a swift current and stony bottom, by a very ingenious hammock-bridge made entirely of creepers. Three stout creepers act as roadway and handrails, and are fastened to the trunks of trees

on either bank. The roadway creeper is covered with battens of brushwood, and the space between roadway and handrails is enclosed by a network of creepers. The bridge is supported by long creepers fastened to the tops of trees and to the handrails. It bore four carriers with loads at a time.

Between Lengekoro and the Bagwe river the dewfall in the early morning was very great. On account of the vapour, it was impossible to see beyond a few yards till the sun was high, and the bush was so saturated that before we had marched five minutes we were as wet as if we had been exposed to heavy rain. Throughout the dry season



HAMMOCK BRIDGE OVER SELI RIVER.

the dewfall was heavy, but it was only in this particular section of the march up that we found it so intense. The country in this region is still hilly. From Lengekoro one descends to the valley of the Seli, and then rises to the watershed between the Seli and Bagwe, Yerembo, the highest point, being 1615 feet above sea-level. From this place the road falls to the Bagwe river. It was in very bad condition when we passed it, and led us through much swamp of a most offensive kind. We found many traces of wild buffalo in this country. The Bagwe, where we crossed it, is about 70 yards wide, and has a rocky bottom and rapid current. It is fordable with difficulty at certain points in the dry season. There is a canoe-crossing opposite Kilela. This town has been recently built by a brother of the chief of Kruto. It is about

a mile east of the Bagwe, and a mile or two west of the Falaba-Kruto road. I should mention here that the Bagwe river is called the Sewa when it reaches Mendi country.

We reached Kruto on January 4, 1896. The distance from Bumban by the route we followed, as measured by perambulator, is $93\frac{1}{2}$ miles, which it took us ten days to cover, the roads being bad and the country difficult. From Bumban we commenced to sketch the route, using prismatic compass, plane-table, and perambulator, and checking each day's work by latitudes. Kruto is a large town, with police barracks, in a low position, 1160 feet above sea-level. It has recently been moved to its present position from the top of the Kintiballia hill, where the



CROSSING BAGWE RIVER.

chief formerly lived, by order of the governor. The chief is a man of considerable importance. He collected all his people and organized a dance in our honour, which he led himself, brandishing an elephant's tail. We intended to halt here one day, but the effect of our march through the swamps made itself felt, and four out of the seven Europeans were down with fever, so that we had to remain two days in the place. The French officers told us that as long as we kept marching we should be free from fever, but as soon as we halted it would make its appearance; and this was confirmed by our experience. It was during the day's halt at Kruto that the malarial poison made itself felt.

We left Kruto on January 7 for Kurubundo. The country, after crossing the Bagwe river, from being hilly, becomes more distinctly mountainous; the features are larger and bolder, and their direction is

easier to define. East of Kruto the road skirts a high range, which terminates in the Kintiballia hill. On January 9 we reached Kurubundo, 1710 feet above sea-level, situated in a picturesque and interesting position on the upper slope of a steep hill, and surrounded on all sides by impenetrable bush. The town was guarded by a war fence with massive double gates, and the huts were built in the intervals of huge granite boulders. The chief and people appeared to be much more warlike than the Kuranko generally, and they are able to boast that their town was the only one which the Sofas failed to take.

On arrival at Kurubundo, our first business was to find out some route to bring us to Tembi Kunda. No communication existed from the British sphere to the Niger sources, and the distance and direction of the place we sought was a matter of the widest conjecture. We succeeded in getting the chief to interest himself in our journey, and he informed us that there was no road to Tembi Kunda, but he set his people to work the whole night to cut a road through to Porpor, a village which we reached the next day. From thence we marched to Buria, descending to the valley of the Bafin, which we passed east of Buria, and which is here merely a mountain stream. From this point we began a steep ascent, which brought us on January 13 to the western watershed of the Niger, from whence, from an elevation of 3280 feet, we looked down upon the Tembiko valley. We now had reached the eastern limit of the British sphere, and, descending to the Tembiko, we entered French territory. Our guides here considered that their task was ended. They declined to point out the source of the Tembiko to us, assuring us that it was the seat of the devil, whom they had no anxiety to meet, though they are devil-worshippers. They believe that any one who looks on the Niger source incurs the wrath of the devil, and will die within the year, and they regard the water as poisonous. Our own experience rather confirmed the native views of the water, but we were not able to trace any direct connection between its unpleasant effect and the devil. In spite of the failure of the guides, we had not much difficulty in finding the source. On reaching the valley of the stream, we turned along it in a southerly direction, till we had got round the head, and then descended the ravine. The difference between the ground which forms the river valley itself and the country outside the valley, which includes the Niger basin, is very marked here, as always in this West African country. The part outside of the actual valley is covered with cane brake, 10 feet high, yellow, and burnt up. The moment the valley is reached, the bush is green, the foliage abundant, and the trees are covered with creepers and trailers, which make formidable obstacles. The slopes of the Tembiko ravine are steep and slippery, and, as in most valleys of the district, the bush is so dense that sun, air, and light are excluded. It is easy to imagine that the immense quantity of decaying vegetation will not, under these

circumstances, contribute to the healthiness of the country. We descended the side of the ravine, accompanied by Captain Cayrade, cutting our way through bush and creepers, and, reaching the bottom, found a tiny stream issuing from a moss-covered rock. On the rock were cut the initials ("G. B.") of Captain Brouet, a French officer who had visited the place in 1895, and in a small pool was a bottle, with a note giving the date of his placing it there. The spot is certainly a pretty one. Unfortunately, we failed to reproduce it. Mr. Tyler took a photograph, but it failed owing to the want of light. The distance of Tembi



FIRST CAIRN PLACED BY THE TWO COMMISSIONS AT THE NIGER SOURCE.
(From a photograph by Captain Passaga, President of the French Commission.)

Kunda from Kruto, as measured by perambulator, is $65\frac{1}{4}$ miles, which it took us seven marches to cover.

Our camp was fixed on the ground bordering the ravine, and nearly due west of the source. The French occupied ground a little south of us. We found the height of our camp to be 2800 feet above sea-level; the French, who made measurements independently with their own aneroid, made the ground near their camp about the same level as ours, 2820 feet high. We were disappointed not to find the elevation of the Niger sources to be greater. We had expected, judging from the reports of countries near this region, to find ourselves not less than 5000 or 6000 feet above the sea; but there can be no doubt that our measured altitude was not far from the truth. But, in spite of the elevations not being very great, the country about the Niger sources is

distinctly mountainous. Viewing it from any of the elevations about Tembi Kunda, one sees mountains in every direction. Towards the south, at distances of from 4 to 12 miles, are a number of peaks, one of which is Mount Daro; on the north the high columnar-shaped Kula peak (Mount Kolate) is very conspicuous; whilst in the immediate neighbourhood are Mount Konkonante (literally the four heads), the Sulu mountains, two conical and very conspicuous peaks, and Mount Kenna. The highest elevation we recorded, which was on the watershed near Tembi Kunda, was 3379 feet, and I should judge that none of the summits exceeded 5000 feet above the sea. As regards the distance of the mountains not visited, it is very difficult to speak with certainty, but we fixed one peak on the south by triangulation. Distances in this country are most deceiving. We frequently found mountains which we had imagined to be 40 or 50 miles away, to be a quarter of this distance. The haze in the daytime makes it very difficult to see far, and the mist at sunrise is still worse. We found, on many occasions, that with all our telescopes and field-glasses we could not pick up a flag at a range of 4 or 5 miles, or even less, and trigonometrical points could never be fixed at a greater distance than 7 or 8 miles under the most favourable circumstances.

Some difficulty is occasioned to geographers from the confusion of names in this region. A guide from the eastern side of the Tembiko gives quite a different name to places from that used by the Kuranko, and this has been the cause of several mistakes in cartography.

The mountains of this country are composed of masses of red granite. Occasionally their summits and part of their slopes are uncovered, but generally they are clothed with the high cane brake, which makes them very difficult to ascend, and shuts out the view. To climb these hills, forcing one's way through the cane brake, is very slow and laborious work. The natives make bush fires yearly, but when we arrived they had not begun to burn the bush, and afterwards the fires so interrupted our view that we had to stop them. Occasionally the cane brake is varied by a coarse herbage 3 or 4 feet high, which covers loose rocks, and always indicates broken and bad walking.

The valleys are deeply eroded, and have steep sides. They are covered with dense bush. The rubber-vine is found in many parts, creeping on the large trees.

Tembi Kunda is the birthplace of three great rivers. Within a very few yards of the Niger source, the Mantile, which runs southwards, the course of which has not yet been explored, rises; and about half a mile to the west is the source of the Bagwe, which runs through British territory.

The position of our camp, which was about opposite the Niger source, we found, from four meridian observations of stars, to lie in $9^{\circ} 5' 20''$ N. lat. The French, by circummeridian observations of a star, fixed their

camp in $9^{\circ} 4' 55''$ N. lat., their position being about a quarter of a mile south of ours. Their observations for longitude gave as result $10^{\circ} 47' 0''$ W. Major Grant, who fixed Kruto by lunar distances, and then carried the time to Tembi Kunda and back, found the longitude to be $10^{\circ} 46' 32''$; whilst our meridian distance from Kruto, assuming Major Grant's position for that place, gave $10^{\circ} 46' 40''$.

As soon as we arrived at Tembi Kunda, we set about arranging for a trigonometrical survey of the watershed boundary. The country is very unfavourable for this class of work, especially on account of the difficulty of working through the bush, of finding places from which the surrounding country can be seen, and of picking up with the



NEAR THE SOURCE OF THE NIGER.

(From a photograph by Captain Passaga, President of the French Commission.)

theodolite trigonometrical points which have previously been observed from. Fortunately, our engineers were of great assistance to us. One of them was a very good observer, and all were expert chainers, so that, though we had most difficult ground on which to measure a base, the measurements were made with great accuracy. We carried this trigonometrical survey from Tembi Kunda to the 10th parallel, commencing on January 14, and ending on March 4. Several times we broke down owing to the denseness of the bush, and had to measure a fresh base and connect with the work already done. We had much difficulty, too, in judging the direction to be followed, for we had neither the time nor the men available to make a previous reconnaissance of the ground.

The watershed, we found, was continually eluding us, and instead of following the lofty peaks and chains, it more generally passed from one ridge to another by low cols, and it doubled back and twisted in the most unexpected way. We thus sometimes found points which had been observed ahead of us, which we supposed to be on or near the watershed, to lie many miles away from it. Whilst making the triangulation, we at the same time filled in the topography, using plane-tables. Owing to the difficulty of seeing far, we were not able to connect our work with other parts of the interior of Sierra Leone which had been previously explored, except by our route traverse to Tembi Kunda, and by our closing at Kalieri.

Our usual method of procedure was to start as soon as it was light in the morning, after some refreshment, with the intention of getting in to breakfast at about 11 a.m., but we found that in practice we rarely returned before midday, and on several occasions did not breakfast till after 4 p.m. We almost always under-estimated the time required to climb the mountains, the cane brake making our rate of progress terribly slow, and when we had a high mountain like the Kula peak to ascend, it took us the best part of the day. But the most serious difficulty we had to contend with was the management of the carriers. Day after after, as we moved camp, and had ourselves to climb to some elevated spot for surveying purposes, we despatched the carriers with their headmen, giving them the most explicit instructions where to halt; but, in spite of every precaution, I do not think it happened on more than one or two occasions, during the time the delimitation lasted, that we found our loads when we reached the place where we intended to camp. Experience on the West Coast has taught me two things—(1) that if, in the course of their movement across country, carriers, without a European at their head, strike a track, no power on earth will prevent them following it, whatever its direction; and (2) that if there is a town anywhere about, the carriers will inevitably settle there. The French, more experienced than ourselves, and with a smaller and more manageable following, made their carriers follow them wherever they went.

On arrival in camp, as soon as we had breakfasted, we worked out the triangles which had been observed, plotted them, and made a copy of the triangulation chart for the French officers, with description of the trigonometrical points. This chart gave the French a groundwork for their topography, which was placed at our disposal; and indirectly it helped us in another way, for Captain Passaga, in checking the triangles on the ground, more than once discovered an error, due to some small oversight, which, if it had not been corrected, would have permanently distorted the survey.

When we got back to camp in good time, we went out again in the afternoon and surveyed till sunset. After dinner we again worked out

the triangles and plotted the results. Each moment we could spare was given up to this work, and it took us all that we could do to get the results out in sufficient time to be available for the next day's work.

Besides the actual survey of the boundary, much time had to be devoted to delimitation. Each road and track was marked with a beacon at the point where it crossed the frontier. The beacons were made of stones piled in the shape of a sugar-loaf, when stones were available; in other cases ant-earth was used. Sixty-six beacons were built along the watershed on the first section of the boundary, the work being done by a number of carriers.

We left Tembi Kunda on January 19, after a stay of five days. We



McKAY'S GRAVE AT BOGORIA (BORIA).

were led to believe that we should find the whole watershed region to be barren and uninhabited, but this was not the case. About Tembi Kunda itself there are few villages, and these are small; but on reaching Bali on the 26th, we found ourselves in a region as well peopled as any we had passed through, with fair-sized towns at Bali, Yenankolia, Sansanbalia, Kulakoia, and Samaindu. From this point onwards to the 10th parallel the country is well peopled, and though we had occasional difficulties, we were able to subsist our little army of followers on the country.

On January 31, our police-officer, Captain McKay, who had suffered much from fever, was attacked with heat apoplexy near the village of Boria, and, in spite of the unremitting attention of Dr. Paris, he never

recovered consciousness, and died within half an hour of the seizure. The town is in French territory, and we buried him on the outskirts, enclosing the grave and improvising a cross, which we placed at the head. The French officers requested the commandant of the circle to see that the chief of the place kept the grave in good order.

We had now passed the high Kolate mountains, and the country very gradually became less mountainous, though still rugged and difficult. Near Boria are many good-sized towns, the principal British places being Dandafarra, Birimba, Mussadugu, Kirimandugu, Konkekoro, and Kiridugu. Kiridugu is a large and important place, the largest we saw in the interior. It is probable that an exploration of the country lying west of the longitude of Kiridugu, as far as the known part of Sierra Leone, would reveal the existence of many other towns which at present are unknown.

We reached Kiridugu on February 8, and, proceeding northwards, could trace a still more marked change in the nature of the country. It is broken, and very densely covered with vegetation, but the hills are isolated and further apart. It was, however, very difficult for triangulating work, and we had much cutting and clearing to do. On February 12 we arrived at Farama, close to Mount Keme, a large isolated hill which runs east and west directly across the frontier. Passing round this hill, we worked northward, till on February 19 we passed through a defile in another range close to Bonbonkoro. From this place the country becomes much less hilly, the watershed following a series of undulations which are covered with very thick vegetation. West of the watershed the country is a little more hilly, but on the east the hills disappear almost entirely as the valley of the Tintarba is reached. Songoia Tintarba, which is 1550 feet above sea-level, lies in a very flat position. We had great trouble here, not only in surveying, but in tracing the watershed. From the height of the cane brake and bush, we could not see the surrounding country, and it was not possible to say whether the ground a few yards away from us was rising or falling. We had to resort to burning the bush, and to feeling our way through it. On February 25 we reached Kambaia, and found ourselves at last out of Kuranko country. The principal towns after Mount Keme are Morifinia, Kenawa, Dakalofe, Salamaia, and Kombili.

The Kuranko country has no paramount chief. It is broken up into districts, of which the principal along the watershed are *Daldu*, the main towns being Samaindu (where the chief lives), Kulakoia, Birimba, Mussadugu, and Dandafarra; *Mangalia*, principal town—Kiridugu (where the chief lives), Konkekoro, Fangaia, Kirimandugu, Kamoror, Sokorola; *Mongo*, principal towns—Kombili (chief's town), Dakolofe, Salamaia, Boala Karafaia, and Kenawa. These towns are all English; some towns belonging to these districts have been cut into French territory, and are now separated from their chiefs.

The Kuranko as a people are not very high in the scale of civilization. They are timid, and the importance they attach to accuracy is limited. There is much to be said in their defence, however. They have had a very hard time, and have suffered greatly from the Sofas and the Konno people on the east. There is hardly one town now standing which has not been recently rebuilt on or near the ruins of one destroyed by the Sofas, and there are still many ruins of large towns which have never been reoccupied. The entire adult population now existing only escaped extermination by hiding in the bush, and many of them bear traces of the wounds they received in the war-time. The bones of those killed are still visible in places. Considering what they have undergone, one can hardly be surprised that they regard strangers with a certain amount of reserve, and that they cannot credit them with any motive except to kill and plunder. But when once convinced that their throats are not to be cut, the Kuranko are very friendly, and the intense delight with which they regarded the cottons, beads, caps, looking-glasses, salt, and tobacco with which we paid for the rice we got from them, shows that there is in this country an opening for traders, when once the inhabitants have learned to produce what the markets require. At present they produce nothing beyond what they actually use themselves, and as traders have been very little into this country, there is no inducement to grow what they cannot consume. They grow rice, cassava, a little guinea corn, cotton, kola nuts, and an inferior species of tobacco. Rice is everywhere the staple food. The cotton is carded, spun, and made into garments, which are generally dyed with indigo. Kola is the only produce with which any trade is done. It is exported to the French Sudan, where there is a great demand for it. The rubber-vine is found in most of the valleys, but the natives do not understand how to treat it, and make no use of it. Tobacco is carried by every native in small boxes; it is pounded up and used as snuff. The trade tobacco is much preferred to the native product, and a few tobacco leaves given as a present were always looked upon as a great treat.

The Kuranko possess a few sheep, but of horses and cattle there are practically none. The Sofas have, no doubt, accounted for all this form of property. The largest towns have perhaps two or three cows, and occasionally one or two animals which they distinguish by the name of horse, though it is difficult to say on what grounds. The chief of Kombili, who is exceptionally wealthy in this line, and advertises his interest in horseflesh by wearing very tight trousers, brought three animals of this description to greet us, and gave a performance in our honour by galloping them round the hut where we were working till they were hardly able to stand, and he seemed so pleased with the effect produced that he continued the performance on foot, and danced to an admiring circle of his wives.

The great majority of the Kuranko are pagans. Occasionally we

passed a Mussulman town, and it is very remarkable here, as in every part of the Sierra Leone interior, how far the Mohammedans are in advance of the pagans in wealth, in comparative civilization, and in intelligence. No doubt the Mohammedans are ignorant and superstitious, but they have a form of education, there is a school in each village, and what trade there is is entirely in their hands.

The Kuranko are very fond of music. The instrument universally used is made of flat pieces of wood of graduated length fastened to gourds. It is played with sticks, and the performer has iron bracelets attached to his wrists, which add to the volume of sound. A skilled performer can produce a very fair amount of noise with these materials,



MAKING NATIVE CLOTH AT BEREA.

and when half a dozen of them accompany the village tenor, all being congregated inside a small shelter or hut, the effect is very striking. The music consists of a sort of chant composed of two or three notes, which is repeated till the performers are satisfied that the audience has had enough.

On February 22 we invalided the senior of the sapper party, and sent him to Freetown.

At Kambaia we passed from Kuranko to Sulima country. The principal towns between Kambaia and the 10th parallel are Kambaia, Berea Timbako, Berea Futambu, Falaba, Heremakono, and Kalieri. Berea Futambu is the principal British town near the frontier; Kalieri

is a fair-sized town with a police barrack, but with a very bad water-supply. There is a great deal of cultivation in these parts, principally of rice. We reached Kalieri on February 27, and spent four days in the place, surveying the roads, erecting beacons, and taking observations. On March 3 we moved on to a camp which we had selected as being as near as we could estimate to the point where the watershed strikes the 10th parallel. We spent several nights observing here, taking meridians and circummeridians of stars and circummeridians of the sun. At first we could not agree with the French commissioners as to the terminal point of this first section of the frontier; but we got them to bring their big theodolite to our camp, and to observe two



VIEW FROM HEREMAKONO.

(From a photograph by Captain Passaga, President of the French Commission.)

stars, both commissioners taking the times with their own watches and working out the results independently. From these results an agreement was quickly arrived at, and we beacons the place from whence we were to commence the second section, which follows the 10th parallel as far as the Kaba river. Observations for azimuth were made, and on March 12, turning our faces in a due westerly direction, we commenced to delimit the second section of the frontier. The triangulation was discontinued at the 10th parallel, because the theodolite was required for running the line, and because it was necessary to follow the line so closely that work involving a frequent departure from the parallel was impossible. Our azimuth line, checked by occasional observations for latitude, gave us at all times one

co-ordinate, and for our east and west co-ordinate we relied on the distances given by the perambulator, checked by occasional time observations.

The country, which south of Kalieri becomes less and less hilly as one travels north, the watershed passing over slight undulations in a fairly level country, and the only hills visible being one or two ranges of no great elevation with a generally north and south direction, west of Berea Futambu, in the direction of Falaba, changes once more as one approaches the 10th parallel. From the top of the highest ground north of Kalieri, looking anywhere north of a due east and west line as far as the eye can reach, nothing can be seen but rounded and saddle-backed spurs, knolls, and ridges, all of apparently much the same elevation, and none of them exceeding from 500 to 800 feet above the general level of the country. The features are small, and the hills very close to each other, so that in whatever direction one goes in a straight line, one's progress is a constant passing from hill to valley and from valley to hill. This is more markedly the case in travelling along an east and west line, for the water along this region runs generally from north to south, and the hills, following the same direction, are crossed at their narrowest parts. No rock is exposed on the sides of these hills. They are all covered with a friable loam, and clothed with vegetation. This had been burned in the inhabited districts, and we were able from the high ground to obtain a good view of the surrounding country. The sides of the hills are steep, and the valleys are covered with thick bush.

The camp from which we began the delimitation of this section, on the top of a knoll, was 1750 feet above sea-level. Our first day's work brought us near to Simitia, which lies south of the 10th parallel. It is a clean, well-built town. The villages we passed west of Simitia are under either the chief of that place or of Tagania, a town in French territory. Near Simitia the main French road from Konakri on the Atlantic, *viâ* Ula and Tagania, passes to Sandenia, and then to Sankaran, and the country of the upper and middle Niger.

After passing, a few miles west of Simitia, the villages under the chief of that place, we came upon a tract of country entirely uninhabited and given up to big game, which extends as far as Yomaia. Throughout this region we daily crossed many elephant and buffalo roads, running north and south along the river-banks, well tracked and very difficult to distinguish from the ordinary country roads. Our guides all deserted us, possibly from conscientious motives, for when with us we found that their knowledge of the country was not of sufficient value to pay for their keep, and I think it very probable that we beacons more than one elephant road under the impression that we had to do with routes of trade. Game is very plentiful in this country. The number of elephants which pass through must be great,

but they were all north of us when we were in it. They pass into British territory in the wet season, and leave again at the beginning of the dry months. Buffalo were frequently visible, as well as large and small antelope, and bush-hog. If we had been able to give ourselves up to shooting, we should no doubt have had plenty of sport, but our work kept us so closely engaged that we could only fire an occasional shot, when we put up anything on the road. In a country so closely covered as this is with bush, it is necessary to make special arrangements to get at the game. It is certainly a country in which game is not only very abundant, but as yet untouched by sportsmen.

In passing through this district we were dependent for food on what we carried. Our reserve supplies were consumed during several days' halt near Simitia, where we had some difficulty about fixing the latitude of Bibia, a village close to the azimuth line, and the arrangements we had made for drawing supplies to meet us failed, as the native in charge feared to trust himself in an unknown region. We were soon, therefore, reduced to serious straits to find rice to feed the natives, and for some days the carriers had barely a handful of rice each. Fortunately, when at the very worst, we found locust beans, which kept them alive. But although in such serious difficulties for the want of the necessaries of life, the knowing ones were not altogether deprived of luxuries, and they were generally able to add to their menu either snakes, rats, or squirrels. A beautifully marked specimen of the boa constrictor was killed one day, but before we could take any steps to have its skin preserved, we found that it had been eaten, and that not a vestige remained. Wild honey also was fairly plentiful, and the natives ate it freely, although their indulgence generally resulted in toothache and other aches, which necessitated the use of castor oil, to which they have a singular dislike.

During this part of the delimitation we accomplished from 3 to 4 miles daily. This took us from early morning to sunset, allowing for a halt in the middle of the day for breakfast. We had to cut our way through cane brake and bush, and our progress was very slow. The sun was at this time (March) more powerful than it had been, and the climbing was very exhausting. We began to run the line with the theodolite, but found afterwards the French *boussole Brossé*, a theodolite with a large compass and a case which could be turned by a key so as to set off the magnetic variation, more suitable for the purpose. From many observations which we made, using the largest compass we had, we found the variation throughout the boundary region to be from $18^{\circ} 12'$ to $18^{\circ} 20' W$. The French results were the same as ours.

Of the rivers passed in this section, the Koka is a small stream; the Mongo a water about 30 yards broad, deep but fordable, with rocky bed; the Kaba, as the Little Skarcies is universally called in this

country, a fine river about 100 yards wide in the dry season, fordable in places, with very little current, and running in a rocky bed. In the rains it must be a very large water. Its valley is about a mile broad, and is shut in by very steep banks from 900 to 1000 feet high as measured by aneroid, the height of our camp on the top of the left bank being 1620 feet. We reached the Kaba on March 29, having passed south of Yomaia, a fair-sized town made up of three separate villages, and we spent two days in correcting the latitude and taking observations for longitude and time. We erected twenty-one beacons on this section of the frontier.

Our next task was to find a point on the right bank of the Kaba



COUNTRY NEAR THE FALL OF THE KITA.

(From a photograph by Captain Passaga, President of the French Commission.)

river 4 miles south of the 10th parallel. We did this by measuring a base and running two or three triangles down the river, and on April 2 we fixed the place from which the boundary was to be drawn direct to the Kita-Lolo junction. We encamped on the right bank. Hippopotami were fairly plentiful here; we got one, and our carriers made up for their former fasts by finishing the animal, which was an enormous one, in a couple of days.

Our next task was to delimit a straight line from the point we had fixed on the right bank of the Kaba to the junction of the Kita and Lolo rivers, a distance of about 18 miles. We had thought that this could be done by aligning one or two flags with the terminal points,

but when we saw the country we at once recognized the impossibility of proceeding in this way. The ground was so broken and so thickly covered with bush, that it was not possible to get any positions which could be seen from a distance of more than a mile or two. We therefore sent the sapper party to put up a large flag at the Kita-Lolo junction, and Captain Cayrade and Lieut. Tyler followed the azimuth given on the last Intelligence Division map to see where it would strike the Lolo, and to readjust the direction accordingly. They started on April 4, and, finding the country very difficult, reached the Lolo on the 8th, about $1\frac{1}{2}$ mile south of the Kita. A new azimuth was worked out, and on April 10 Captain Passaga and I followed this direction and delimited the line, reaching the Kita-Lolo junction on the 13th. The country is decidedly difficult. In character it is very similar to that we had just been through between Kalieri and Yomaia, but it is a little more broken, and the red laterite, so common about Freetown, is exposed in many places, and loose pieces are common. As one nears the Kita-Lolo junction the ground falls, till on the river-bank it is not more than 600 feet above the sea-level. A little east of the Lolo we crossed the Numelo, a river about 50 yards broad and rather difficult to ford. The Lolo is about 75 yards broad, with rocky bottom, and fordable at places in the dry season. The Kita is a small stream 25 to 30 feet wide. All these waters run in open valleys, and have low banks.

From this point we marched, on the 15th, up the right bank of the Kita to Lakhata, a small village in a flat country. The road from the Kita-Lolo junction is quite flat, and Lakhata itself is only 675 feet above the sea. The boundary leaves the Kita 1500 metres (1640 yards) above Lakhata, and this distance was chained, and we encamped near the spot fixed on April 16. The character of the country here changes again entirely. On the north is a very hilly country, Wossu being about the highest point, the hills about which are visible from the banks of the Kaba. These hills push out high bold spurs to the southward, which terminate very abruptly and tower over the flat country about Lakhata. Going northward from Lakhata, we found ourselves 600 feet higher in a distance of less than a mile, and the Kita falls at least 600 feet in half a mile, by a series of rapids and cascades.

Our next point was a gap in some hills about 8 miles away, to which the boundary was to be drawn by a straight line from the position last fixed. We had some difficulty over this, as we found that the gap referred to in the Agreement does not exist, and we had to agree on a point to fulfil the conditions of the Treaty. The delimiting of this line led us over some very difficult country, as it crosses directly several spurs of considerable height with rugged, precipitous sides. On the 22nd we found ourselves at Kungsi, on a broad, flat spur 2800 feet above sea-level. On the top of these spurs the country is more open than in any other part we passed through, and there are many thousand acres

of a perfectly flat, hard surface covered with short herbage, and capable of carrying a very large number of cattle. Numerous herds were being grazed here. The water is good, and the air very much fresher than in the low ground below. These hills are composed of a hard, brittle shale. On the 23rd we reached Kankuia, on a similar but lower spur 2400 feet above sea-level, and the next day we descended by a very steep track to the country west of these spurs, and found ourselves 580 feet above the sea. From the point we had selected to act as the gap the boundary runs in a direct line to a point above a bend on the Kora river, till it meets the great French road from Wellia to Ula. We had no



YUMBOYA.

(From a photograph by Captain Passaga, President of the French Commission.)

difficulty in fixing the direction of this line, and on the 25th we reached the Great Skarcies, or Kolinte as it is called here, passing through a perfectly flat country. The British towns of Dumbaia and Saionia lie some miles south of the frontier, but the French town of Ula is close to it. It is a large, very well-built town, with customs-post and white official, barracks, and a store. We put up twenty-three beacons in this section.

The Kora is a large river about 65 yards wide, with low banks near its confluence with the Kolinte, which is a fine water 100 yards wide, and deep, unfordable at any season, running in a perfectly flat plain, with low banks. Our camp on the east bank was 380 feet above sea-level. Wellia is a very small village about a mile west of the river.

There is a canoe-crossing at the place where the road reaches the river.

Game is plentiful in this country. Antelope small and large were seen, and a troop of five elephants passed the night of the 26th close to our camp, and were watched by our followers for a long time the next morning. Mr. Tyler set out after breakfast with his camera, hoping to get them to pose for him; but they had no sympathy with the modern craze for photography, and passed on southwards along the river-bank.

Whilst we had been delimiting the latter part of the frontier, Captain Sharpe of the Frontier Police had been nominated by the governor to meet Captain Millot, the third French commissioner, at Kiragba, on the Atlantic coast, and with him to mark out the frontier from that place to the source of the little Mola river. They commenced work on April 3, and it was anticipated that they would have no difficulty in tracing the boundary, which, after the first few miles, follows the watershed between the Mellakori and Great Skarcies rivers. But it was found that to do this accurately was a very arduous task, as the elevations are very slight and the country thickly covered with bush, and the watershed had to be felt for step by step. They completed the work on April 24, having set up eighty-eight beacons, and joined the other commissioners at Wellia on April 28. Several days were spent there in completing the *procès verbal* of the Commission, and on May 1 the Commission parted from their French comrades, and marched *via* Saionia, Berekuri, and Kukuna to Kambia, embarking on May 5, and reaching Freetown that night. The country passed through from Wellia is perfectly flat but for one rise of about 100 feet, the ground hard and free from swamp, and the road good. South of Kukuna the country is very populous, and there is much cultivation.

(To be continued.)

SUB-OCEANIC CHANGES.*

By JOHN MILNE, F.R.S., F.G.S.

SECTION III.

Cable Fracture.

Rudyard Kipling, who, with his powers of description and imagination, carries us from the barrack-room to the home of the deep-sea cables, tells us that in the abysmal depths of the ocean—

“There is no sound, no echo of sound, in the deserts of the deep,
Or the great grey level plains of ooze where the shell-burred cables creep.”

This description of oceanic plains commands all admiration.

* Paper read at the Royal Geographical Society, June 18, 1897. Continued from p. 146.

The fact that, in the regions here described, cables lie for years and years without disturbance is another testimony to the facts brought together by geologists to show that the flat plains of ocean beds are regions where there is but little change. Directly, however, we

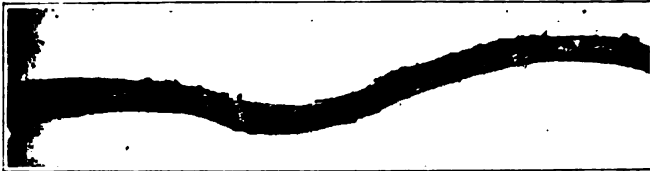


FIG. 3.—OUTSIDE COVER DAMAGED OFF SENEGAL, MAY 7, 1895.

approach sub-oceanic banks or the margins of continental slopes, although the depths may be abysmal, the fact that cables after interruption have to be broken away from beneath materials which hold

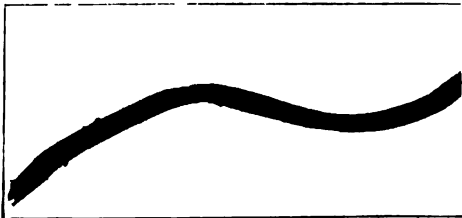


FIG. 4.—BURIED IN MUD, WEST COAST OF AFRICA. ST. LOUIS SIDE BROKEN, MARCH 12, 1895.

them fast, indicates that regions of dislocation have been reached, and what is true for these great depths is also true for localities nearer land. Sometimes cables are bent and twisted, sometimes they are crushed.

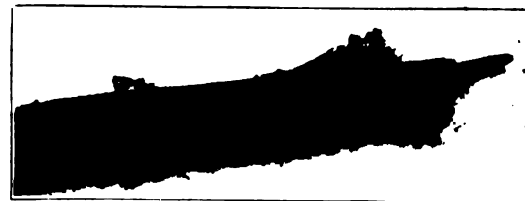


FIG. 5.—WEST COAST OF SOUTH AMERICA. 1891.

Now and again sections are recovered which, from the growth of shells and coral on all sides, show that they have been suspended. Others show that fracture has apparently been the result of abrasions, whilst the ends of wires, one of which is concave and the other convex, slightly drawn out, indicate that yielding has been the result of tension. Needle-pointed ends suggest electrolytic action ;* but, although cable-interruption may occur in these and other ways, the explanations which best accord with the observations made during cable-recovery generally are those which attribute their dislocation to sudden displacement of the bed in which they are laid, or to their burial by the sliding down of materials from some neighbouring slope.

* This may be due to electrolytic action between the zinc and the iron of the sheathing wires, or to the cable having rested on a mineral deposit.

Sometimes it will be seen that earthquake movement and cable fracture have been simultaneous, whilst many instances will be given where an interruption has occurred at about the same time that an unfelt movement has been recorded on land. These latter records, which in the lists are marked with an asterisk, are unfortunately not numerous, and only refer to days between the following dates.

1. Observations at Potsdam, Wilhelmshaven, Strassburg, Nicolaiew, Teneriffe, and in Japan. These, which include many of the writer's observations, are published in 'Beiträge zur Geophysik,' Band II., by Dr. E. von Rebeur-Paschwitz, March 27 to October 5, 1889; January 4 to April 27, 1891; February 23, 1892, to August 31, 1893.
2. Observations at Charkow by Prof. G. Lewitzky, August 4, 1893, to October 9, 1894.
3. Observations by Prof. G. Vicentini at Padua, February 1 to August 29, 1895.
4. Catalogues of Prof. P. Tacchini, January, 1895, to October 16, 1896.
5. Observations at Shide, Isle of Wight, by John Milne, August 19, 1895, to May, 1897.

A.—Fracture of Cables in Deep Oceans.

(The Times of Earthquakes are given in G.M.T. astronomical. Noon = 24 or 0 hrs.)

North Atlantic.—Through the kindness of an engineer, whose experience in the laying and repairing of cables has extended over many years, I am enabled to give the dates at which various cables have become ruptured, or been restored to working order. The only case of alteration in depth which he noticed was during the repairs of November, 1884, but this was not great. It seemed as if the picked-up cable had to be pulled from under a bank of earth which had slipped down from the eastern slope of the Newfoundland bank.

The following is a table of North Atlantic cable-interruptions.

North-eastern Slope of Flemish Cap.—(37° W. to 44° W. long.) July, 1894 (about); June, 1888 (about); September, 1889; September, 1881; June 10, 1894 *; July 28, 4.40 a.m., 1885; April 18, 8 p.m., 1885; July 25, 8 a.m., 1887; June, 1895.

Near South-eastern Slope of the Newfoundland Bank.—(46° W. and 50° W. long.) September, 1887 (about); October 3, 9.15 p.m., 1884; October 4, 4.8 a.m., 1884; October 4, 4 and 8 a.m., 1884; September, 1889.

An unfelt earthquake was recorded, June 11, 7^h 22^m, 1894, very strong at Charkow.

A striking feature connected with these Atlantic troubles is that nearly all have occurred in deep water near to the base of the eastern slope of the Flemish Cap, 330 miles from St. John's, Newfoundland, or the south-eastern slope of the Newfoundland bank. Off the Flemish Cap in lat. 49° N. and long. 43° E. there is a slope, in a distance of 60 miles, from a depth of 708 fathoms to 2400 fathoms, or 1 in 35. Another slope, over a distance of 30 miles, is from 275 to 1946 fathoms, or 1 in 17. Off the eastern side of the Newfoundland bank, in a distance

of 25 miles, the depth changes from 27 to 1300 fathoms, indicating a slope of 1 in 19.

These slopes are all well within the limits at which from time to time yielding due to bradyseismical thrust, secular crush, and facial sliding by overloading, should be expected, and the further a cable can be kept away from the scene of such action, if we may judge from experience, the longer will be its life.

In one case only has the cause of failure been attributed to a landslide, which it is just possible was caused by, or accompanied with, seismic phenomena. A very significant fact is the case when three cables running in parallel lines about 10 miles apart, broke at points nearly opposite to each other, on the same straight line. This was on October 4, 1884. At first the accidents were attributed to the grapnel of a cable vessel, but as no grappling was done then, this hypothesis had to be abandoned. Because three cables broke apparently at the same time in the same locality, one inference is, that the cause resulting in rupture was common to all, and this may have been a sudden change in the configuration of the ocean bed. Such a change does not necessitate any alteration in depth, such as could be detected by sounding, but either a landslip along a line of considerable length or simply a line of fracture like that which was suddenly formed along the Neo valley in Japan, in 1891.

When, on the American and English coasts, types of seismometers which will record the unfelt movements of the Earth's crust have been established, it seems likely that the cause of cable interruptions may be better understood. Because the fifteen repairs indicated in the previous table possibly cost half a million sterling, the localization of areas that should be avoided and the attribution of effects to their real cause are evidently *desiderata* of great importance.

St. Louis—Fernando Noronha.—From a paper read at the Institution of Electrical Engineers by Mr. H. Benest, A.M.INST.C.E., "On some repairs to the South American Company's cables off Cape Verde in 1893 and 1895," it seems that the St. Louis—Fernando Noronha cable has been twice broken. The first break occurred on December 26, 1892, about 130 miles from St. Louis du Sénégal, in a depth of 1220 fathoms, at the time of a heavy gale. The tape covering for 140 fathoms was rubbed bare to the sheathing wires, but on one side only. The sheathing wires at the break were drawn out as if they had been broken in a testing-machine. The Fernando side of the break also showed the effects of rubbing, and the character of the fracture was similar to the other end. In picking up these two ends there was at first a strain in one case not exceeding 2.6 tons, and the other of 4 tons, but as the ends were approached this rose to about 6 tons, when the cable evidently cleared itself from some obstruction, and came easily on board.

Although we have here evidence of what may possibly have been a

submarine landslip, I am not aware that at that time any disturbance was noted in Europe.

The second date is March 10, 1895 *. Here again great difficulty was experienced in breaking out the cable from beneath the mud, detritus, or whatever the materials were that had covered it. The position of this break was about 20 miles south-west from that of 1893.

On March 5, at 22 hours G.M.T., a very large unfelt disturbance was recorded in Europe, and one of moderate intensity at several places in Italy on March 10, at 10.4 p.m.

Mr. Benest holds the opinion that these fractures are connected with submarine river outlets and gully formations in the ocean beds. The gradients in the vicinity of the fractures vary from 1 in 34 ($1^{\circ} 30'$) to 1 in 7 (8°).

Fernambuco—Cape Verde.—To the north-west of St. Paul's (lat. $2^{\circ} 41' 45''$ N., and long. $30^{\circ} 29' 15''$ W.), which is a volcanic centre, two cables broke simultaneously in a depth of 1675 fathoms, indicating that the rupture was due to a widespread cause. This was on September 21, 1893. Here, in the deep ocean, this was the only failure in nineteen years.

Madras—Penang, and Aden—Bombay.—These interruptions are referred to on pp. 275-76.

B.—Interruptions to Cables on or near to Sub-oceanic Continental Slopes.

West Coast of Central and South America.—As illustrative of conditions which may exist round many parts of the west coast of South America, where there have been sudden and gradual upliftings of the land within historical time, a portion of a chart showing contours near to the mouth of the river Esmeralda is reproduced (Fig. 6). The soundings are in fathoms. Those in ordinary figures are from information received prior to June, 1895, whilst those in larger type are from soundings taken in March, 1896. Changes from 13 or 20 fathoms to upwards of 200 fathoms in this short interval of time are certainly remarkable, and as the position of the cable-repairing vessel *Relay*, belonging to the Central and South American Telegraph Company, which made the observations, was ensured by cross-bearings on the land, their general accuracy cannot be doubted.

The figures surrounded by a circle were taken many years ago, and are probably no longer correct. Off the shore, in a distance of 3 miles, there is a depth of 200 fathoms indicating a slope of 1 in 15, whilst at distances of 10 miles from shore, over a length of 1 mile, slopes of 1 in 3 may be found.

We have evidently here many instances of recent change in sub-oceanic form, and at the same time illustrations of conditions where considerable instability might be expected, and cable-interruptions might therefore frequently occur. It will be noted, by reference to the map, that the position of fractures which have taken place are grouped

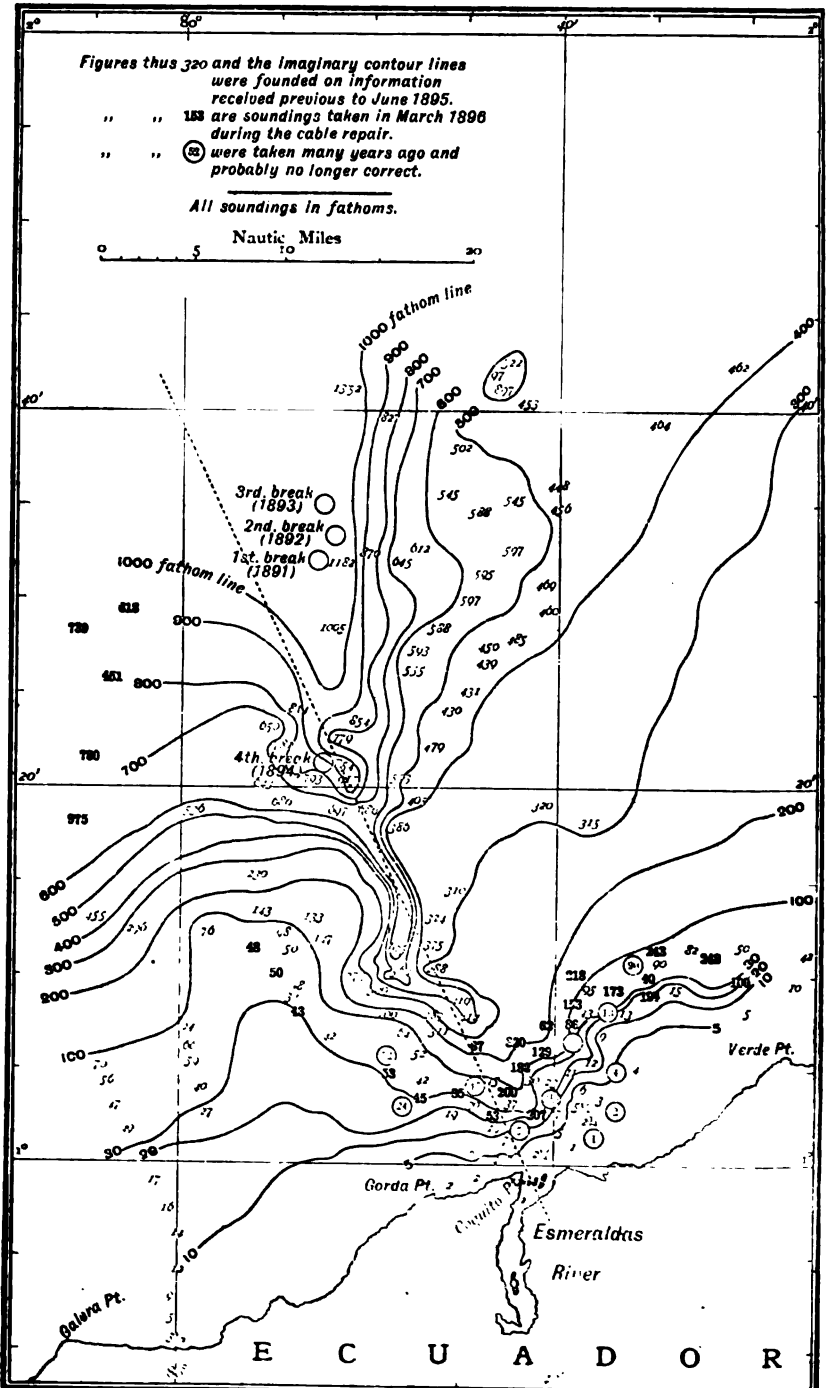


FIG. 6.—OCEAN BED OPPOSITE ECUADOR.

Walker & Bouall, Jr.

near to the base of steep slopes, and in this respect follow the rule of similar occurrences in the North Atlantic.

The following is a list of certain interruptions which have taken place off the coasts under consideration :—

La Libertad—Salina Cruz.—November 25, 1890.

Panama—San Juan del Sur.—June 4, 1889*; July 31, 1889*.

Sta Elena—Buenaventura.—This section is laid off the mouth of the river Esmeralda, at which point many breaks have occurred (Lat. $0^{\circ} 58' 20''$ N., long. $79^{\circ} 41' 25''$ W.). August 30, 1890; January 25, 1891*; February 13, 1892; December 5, 1893*; December 6, 1893*; December 14, 1893*; December 20, 1893*.

Paita (Peru)—Sta Elena (Ecuador).—This section passes Talara point, where many breaks have occurred. Lat. $4^{\circ} 29'$ S., long. $81^{\circ} 17'$ W. September, 1892; May 19, 1883; September 3, 1886; May 15, 1889*; March 31, 1891*; April 9, 1891*; May 14, 1892*.

Mollendo—Ghorillos (Peru).—This section crosses the gully off Pescadores point, lat. $16^{\circ} 24'$ S., long. $73^{\circ} 18'$ W. February 23, 1884; March 24, 1884; April 5, 1884; June 13, 1884; January 30, 1886; August 13, 1886; August 16, 1887; March 25, 1887; December 10, 1887, supposed to have been broken by an earthquake; December 11, 1888; February 21, 1890; March 15, 1890; March 30, 1891*; October 16, 1892*, supposed to have been broken by an earthquake; June 4, 1895*.

Arica—Mollendo.—May 9, 1877, by an earthquake; July 15, 1887; before June 24, 1891; August 13, 1891; June 6, 1895*, shore end broken by waves.

Iquique—Arica.—May 9, 1877, by earthquake; May 7, 1878, by an earthquake; June 12, 1895*, shore end broken by waves.

Caldera—Antofagasta.—July 7, 1886.

Valparaiso—Serena.—July 26, 1877; August 15, 1880, by earthquake; July 8, 1885; before August 19, 1891; July 4, 1895*, by landslide or earthquake.

The *unfelt* earthquakes which were noted in or near Europe were as follows :—

January 25, 1891, $5^{\circ} 01^h$. A small disturbance was recorded at Teneriffe.

March 26, 1891, $13^{\circ} 6^h$ to $14^{\circ} 8^h$. There was an earthquake of moderate intensity noted in Teneriffe.

May 15, 1892, $2^{\circ} 9^h$ at Strassburg, and at $3^{\circ} 7^h$ Nicolaiew, there was a feeble shock. Origin probably in Norway.

October 13, 1892. At $17^{\circ} 07^h$, and October 17, at $11^{\circ} 88^h$ at Strassburg.

December 16, 1893. At Charkow at $13^h 13^m$ there was a strong disturbance.

June 4, 1895. At Padua at $18^h 23^m$, large disturbance.

July 5, 1895, $5^h 32^m$. At Padua, origin evidently at a great distance.

Whether these seven unfelt movements recorded on the eastern side of the Atlantic were connected with seismic disturbances on the western side of South America leading to cable interruptions, it is impossible to speak with confidence until we know the *hours* at which these interruptions took place. In the meanwhile, all that we can say is, that it is worthy of note that out of fifteen cable-interruptions, nine of them took place about the times when delicately suspended instruments in or

near Europe were set in motion. Six interruptions, in some instances cables being broken at more than one point, took place when earthquakes were felt, whilst others were caused by landslips, which in turn may have been the result of mechanical shaking. On certain sections, as, for example, that connecting Arica and Mollendo, fractures have only taken place in certain months, which in this instance are June, July, and August. Restrictions like this suggest that the cause of fracture has been due to landslips brought about by the escape of fresh water beneath sea-level, the action of currents, and other sub-oceanic phenomena having seasonal maxima.

As regards the interruptions off Pescadores point (16° S. lat.), although, when recovering cables, branches of almost petrified trees have been brought to the surface, Mr. R. Kaye Gray attributes them to the great unevenness of the bottom, there being in that neighbourhood submarine hills 3000 and 4000 feet in height.

The following notes bearing upon the above sections were kindly drawn up by Mr. W. E. Parsoné, who has been engaged in cable work on the west coast of South America:—

Arica—Mollendo Section.—This section was laid in 1875. On the night of May 9, 1877, while the cables between Arica and Lima were being used for direct working, a very distinct shock of earthquake was felt by the operator in the Lima office at about 10.30 p.m., during receipt of a message from Arica, and communication ceased a few seconds later. The intermediate station of Mollendo afterwards reported that the shock was also felt there, and at about the same time, and that they were unable to communicate with Arica. Mr. Parsoné located the rupture of the Arica—Mollendo section as close to the shore at Arica, and proceeded by first opportunity to that place, where it was found that a violent earthquake shock on May 9, 1877, had been accompanied by a tidal wave of unusual severity, which had completely wrecked the greater portion of the town. The sea-front and harbour had suffered enormous damage, the iron pier having been washed away, and practically all the craft in the port having parted their moorings or foundered. In undertaking the repair, tons of anchor-moorings and material were picked up with the cable, which had been considerably dragged out of position and twisted for a considerable distance from the shore. Communication on this section was restored on May 24, 1877, and worked without interruption until it was permanently repaired by renewing a portion of the shore-end and intermediate cable on November 17, 1878.

Iquique—Arica Section.—This section was laid in 1875. On May 7, 1878, a severe shock of earthquake was experienced in the neighbourhood of Iquique, after which the cable connecting that place with Arica was found to be interrupted. Mr. Parsoné located the rupture at 6 knots from Iquique on the intermediate cable in 60 fathoms of water, and, after considerable difficulties working with barges, there being no repairing-ship obtainable, succeeded in lifting the cable on the spot. Both ends were recovered, and it was found that the cable (intermediate) had snapped clean through, the compound on either side of the break being undisturbed, except at, say, a distance of 18 inches in either direction, where the sheathing wires had made one complete turn. There the compound had sprung, and some of the strands parted, and the sheathing wires were compressed out of position. But for these comparatively slight indications of the enormous force which must have been exerted to make so

clean a break in heavy intermediate type, the cable was in no way damaged, the rest of the cable being in as good condition as the day it left the factory. The earthquake, which was undoubtedly the direct cause of the rupture, was said to have a direction from south-west to north-east, and it was noticed with much surprise that the base of the high cliffs on the fore-shore bore marks of recent disturbance at a spot bearing due north-east from the position of the break. The disturbance referred to had the appearance of a recently formed cavern or tunnel—a few feet above the beach where the base of the hard rock was met—as if some enormous piece of artillery had been fired point-blank into the rock, and this had also caused a falling away of the surface rock above the opening, which peels off in layers like decomposed slate. We could not land at the place to examine it more closely on account of the surf and rocks, but attempted to do so by clambering and crawling over the headland of rock, but large thin sections of decomposed surface slipped away with us continually, and we had to give up the attempt. Communication was restored with a piece of deep-sea cable and a permanent repair effected by the *U.S. Retriever* on November 21, 1878.

La Serena—Valparaiso Section.—This cable was laid in 1876, and interrupted off the Limaree river on July 26, 1877, as was thought, by floods from the river, although in its normal condition it is practically a dry bed before it reaches the sea.

This section was again interrupted on August 15, 1880, by an earthquake; and the same section was again interrupted by a landslide on July 4, 1885, presumably due to an earthquake.

Mollendo—Chorillos Section.—This cable was laid in 1875, and was frequently interrupted off Pescadores point to the north of Mollendo, where considerable inequality of depth is experienced, due presumably to the channels of an extinct or subterranean river, whose estuary may now be some miles at sea, and create periodical submarine convulsions at great depth and at, say, 40 or 50 knots from the coast. In any case, all difficulty has ceased in this locality, since the cable has, for a considerable length, been diverted to close inland and laid as close to the shore as it was safe for a ship to get.

This section was also broken in two different places by an earthquake which occurred on December 10, 1887.

East Coast of South America.—The geological and topographical conditions on the east coast of South America are strikingly different

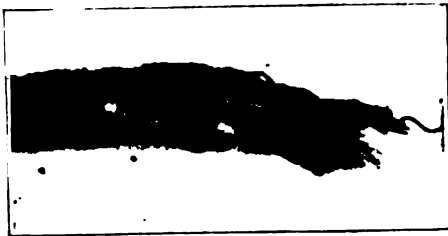


FIG. 7.—NORTHERN COAST OF BRAZIL. THIS WAS PICKED UP AFTER BEING LAID ELEVEN YEARS. THE SHEATHING OF WIRE AND HEMP HAD DECAYED, SO THAT THERE REMAINED ONLY THE CORE TO RESIST THE STRAIN.

from those met with on the west coast. On this latter coast the land plunges rapidly downwards beneath the sea, as a slope produced by bradyseismic thrust and folding, whilst on the former, when measured

over long distances, the slope is gentle, indicating an absence of orogenetic activities. Although the land is generally continued seawards at a low

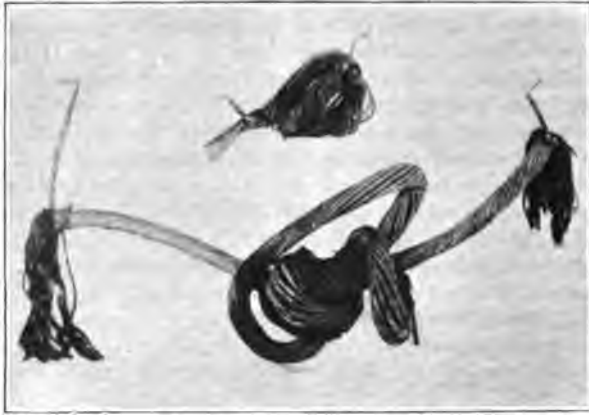


FIG. 8.—PICKED UP IN THE GULF OF MEXICO IN 1888. THE KINKS SHOW HOW MUCH A CABLE WILL STAND AND YET REMAIN IN GOOD ELECTRICAL CONDITION, AS THIS WAS FOUND TO BE.

angle by the deposition of sediments and the scouring action of currents, here and there declivities may have been produced by such epigenic actions.

On the following sections interruptions have been rare or have not occurred:—

Maldonado—Montevideo, since 1875.

Santos—Chuy, since 1892.

Chuy—Maldonado, since 1875.

Rio Grande do Sul—Chuy, since 1875.

From these sections, which lie on the northern side of the Rio de la Plata estuary, as we proceed northwards interruptions have been more and more frequent. They are as follows:—

Montevideo—Buenos Ayres.—October 12, 1889.

Sta Catharina—Rio Grande do Sul.—June 16, 1890.

Santos—Sta Catharina.—March 12, 1890.

Montevideo—Rio Grande do Sul.—April 25, 1889; June 11, 1889*; December 4, 1889; May 4, 1890; December 4, 1891.

Chuy—Montevideo.—June 27, 1892; July 10, 1892* (*restored*); November 11, 1892 (date of *interruption* not recorded).

Rio de Janeiro—Santos.—April 16, 1889; April 5, 1890; December 24, 1890.

Bahia—Rio de Janeiro.—January 31, 1889; September 3, 1889*; September 21, 1889*; July 24, 1891; July 31, 1891; September 4, 1896*.

Fernambuco—Bahia.—April 1, 1889; July 20, 1889; July 14, 1891.

Ceara—Fernambuco.—April 8, 1890; March 14, 1891*; September 1, 1893*; January 12, 1895; March 3, 1896*; March 4, 1897*.

Maranhão—Ceara.—May 22, 1889*; April 29, 1890; January 20, 1891;

January 28, 1891; March 4, 1891*; March 8, 1891*; November 25, 1891; October 11, 1892*; February 12, 1894*; March 6, 1894*; November 25, 1894; April 28, 1896*; December 2, 1896*.

Para—Maranhã.—September 6, 1888; November 2, 1888; May 22, 1889*; December 27, 1889; January 10, 1890; July 24, 1890; January 12, 1891; October 19, 1891; December 2, 1891; January 19, 1892; October 15, 1892*; March 20, 1893*; September 1, 1893*; March 24, 1894*; July 23, 1894*; November 1, 1894; November 10, 1894; November 13 or 15, 1894; January 7, 1895; February 9, 1895*; October 10, 1895*; December 13, 1895*; December 18, 1895*; July 9, 1896*; August 6, 1896*; October 8, 1896*; May 5, 1897*.

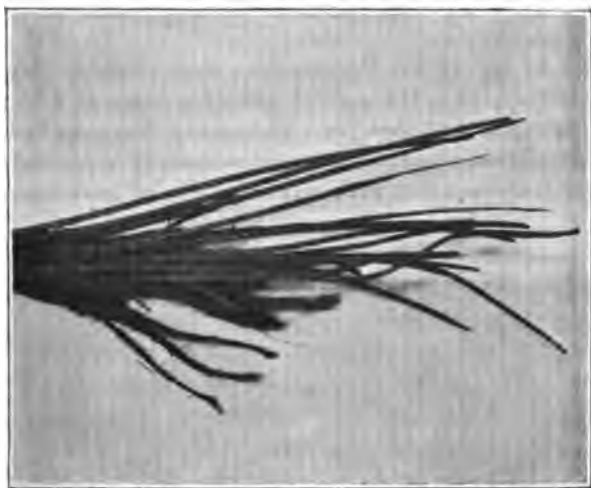


FIG. 9.—WEST COAST OF MOBOCOO. BROKEN DECEMBER 26, 1894. THE WIRES ARE CORRODED TO NEEDLE-POINTS.

In the above list the thirty-one interruptions marked with an asterisk took place whilst horizontal pendulums were in operation in or near Europe.

The European observations were as follows:—

September 18, 1889. At Potsdam, 6.92^h to 9.3^h , there was a large disturbance, which suddenly became great at 7.87^h . At Wilhelmshaven the disturbance lasted from 7^h to 9.5^h . The origin is unknown.

September 5, 1889. At Potsdam there was a heavy disturbance at 22.67^h , with a sudden increase at 23.08 . At Wilhelmshaven similar phases were at 22.5 and 23.06^h . Large disturbances also with unknown origin were noted on August 29 at 18.48^h .

October 9, 1892. At Strassburg and Nicolaiew, disturbances were noted at about 2.45^h to 2.70^h .

March 3, 1891. At Teneriffe, earthquake at 1.79^h . Origin unknown.

May 21, 1889. At Potsdam, a heavy disturbance at 10.55^h to 11.1^h . Origin unknown.

March 20, 1893. At Strassburg and Nicolaiew, at 5.18^h and 5.27^h . At this time there was an earthquake in Catania.

No. III.—SEPTEMBER, 1897.]

T

October 13, 1892. In Strassburg 17-07^h to 17-78^h. An earthquake on the Donau.

September 1, 1893. At Charkow at 9.35 a.m.

February 12, 1894. At Charkow, a strong disturbance at 1^h 35^m.

March 24, 1894. At Charkow, about this time, exceedingly heavy disturbances were recorded, from 17^h 35^m on the 21st to 2^h 48^m on the 22nd; from 9^h 35^m on the 22nd to 3^h 35^m on the 23rd; and on the 24th, from 0^h 26^m to 1^h 2^m.

July 22, 1894. At Charkow, from 11^h 35^m to 17^h 35^m.

October 9, 1895. At 13^h 26^m, slight.

July 8, 1896. At 14^h 54^m and 17^h 46^m at Shide.

October 6, 1896. 21^h 51^m at Shide.

May 5, 1897. 10^h 44^m at Shide.

December 2, 1896. At Shide, 10 a.m. to 11 a.m.

Inasmuch as two of the interruptions took place on May 22, 1889, and two on September 1, 1893, which closely correspond with the unfelt but heavy earthquakes in that year, we may say that out of twenty-nine interruptions sixteen of these have approximately coincided with the times at which earthquakes with unknown origins have been recorded in Europe.

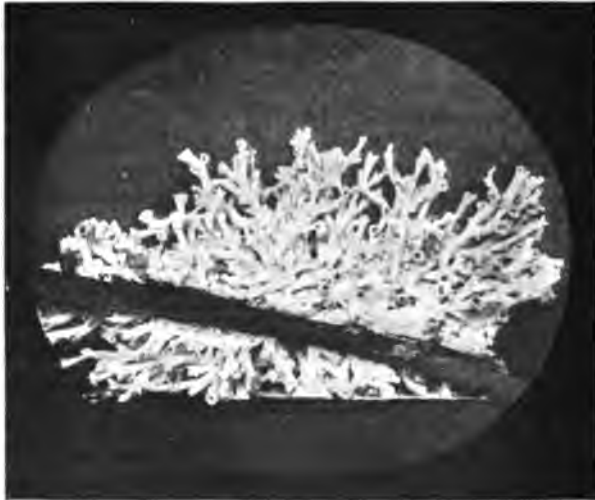


FIG. 10.—CABLE GROWN BOUND WITH CORAL.

Because on the Para—Maranham section * interruptions have been frequent in October, November, and December, and on the Maranham—

* "The Para—Maranham cable is," I believe, a friend writes me, "laid on a shallow muddy bottom, the mud being so fluid that it is said that a schooner with a fair wind can make a good passage when half in mud and half in water." If this is so, then the Amazon floods may have much to answer for in connection with cable-interruption.

Ceara section in November and in March, in searching for the cause of these interruptions we should look to variations in ocean currents or phenomena with a seasonal change.

West Coast of Europe and Africa : Mediterranean.—Interruptions have taken place on the following dates :—

Lipari—Milazzo.—December 1, 1888; March 30, 1889 *; September 15, 1889 *; February 9, 1893 *.

Zante—Canea.—March 29, 1885.

Patras—Corinth.—September 9, 1888; August 25, 1889 * (two interruptions).

The earth-movements which were observed at corresponding times were as follows :—

March 28, 1889. At 7°35' at Wilhelmshaven, fairly large.

September 12, 1889. At 5°50' at Potsdam and from 7° to 9°5' at Wilhelmshaven.

February 9, 1893. At Strasburg 6°23' to 8°48' and at Nicolaeu 6°19' to 8°07', heavy movement. The epicentre possibly near Samothrace. Two other earthquakes were noted on this day.

August 25, 1889. At Potsdam at 7°62' and at Wilhelmshaven from 7°53' to 9°, a large disturbance. Epicentre near Patras.

The Lipari—Milazzo fractures took place in depths of from 400 to 650 fathoms, 2 or 3 miles distant from Vulcano, about north-east from Solfatere.

The Zante—Canea interruption occurred about 5 miles west by south off Sapienza island, in a depth of 1500 fathoms with a clay bottom. Soundings varied as much as 250 fathoms in the length of the ship, and from 1350 to 1834 fathoms in half a mile.

The first of the Patras—Corinth breaks occurred about 2 miles north of Akrata, in mud at a depth of 197 fathoms, whilst one of the second interruptions took place in the same locality, in depths varying between 408 and 270 fathoms within a mile, and the other, in cable No. 2, within half a mile south of Morno point.

Mr. W. G. Forster, writing in the *Transactions of the Seismological Society*, vol. xv., respecting these districts, tells us that after the Filiatra shock in 1886, it was found, by the broken cable 30 miles away, that some 4 knots of the same had been covered by a landslip, whilst the depth of the water had increased from 700 to 900 fathoms. In 1867, after the destruction of Cephalonia, the soundings taken after the shock were different to those taken before. Again, on September 9, 1888, at 5.4 p.m., the town of Vostizza, in the Gulf of Corinth, was destroyed, and simultaneously the cable between Zante, Patras and Corinth was interrupted. The cause of this, as deduced from soundings and the appearance of the fractured cable, appears to have been either a sudden tautening caused by the sweeping down of a mass of clay from a 100-fathom bank to a 300-fathom bank, or the actual yielding of the bed on which the cable lay.

In 1889 a second cable was laid down in the Gulf of Corinth, but this,

when it had been down about three months, was, together with the 1884 cable, fractured at the time of an earthquake on August 25 at 8.51 p.m. The 1889 cable seemed to have been smashed by the movement of a mass of material about a mile in length, whilst the 1884 cable was broken at two points by a slip from a 10 to a 450 fathom bottom.

In the districts considered by Mr. Forster, there are, as he points out, great irregularities in submarine contours, the depths within short distances changing from 50 to 300 and then to 1600 fathoms. By the deposition of silt, and the undermining of steep slopes by bottom currents, the exit of underground springs and even rivers, overhanging shelves, tottering and precipitous rocks, and other unstable arrangements, may suddenly give way and cables suffer rupture.

The facts are that the sub-oceanic contours are such that they might be expected to be unstable, and that these contours, at the time of earthquakes, have suddenly been changed. In one instance there has been an increase in depth of over 2400 feet, and in another of 1200 feet; whilst in the case of the 1889 disturbance, eleven and a half minutes later, unfelt earth-waves of considerable magnitude were recorded at Wilhelmshaven, 1732 kilometres distant. Similar unfelt movements have also been recorded at distant places at about the time when cable-interruptions took place, in every instance where we have been able to make comparisons. The conclusion, then, is that in this region earthquakes occur, producing beneath the ocean what is equivalent to the landslips which similar movements produce on land.

Bay of Biscay.—About 1875 the Direct Spanish cable was broken about 150 miles north of Bilbao by what seemed to be a submarine landslip, which may have been produced by an undercurrent produced by the piling up of the surface waters under the influence of a westerly gale. The soundings showing the neighbourhood of the interruption indicate slopes of 1 in 7 and even 1 in 3, and it is therefore a district in which landslides and dislocations might be expected to occur (Fig. 11). From Mr. R. Kaye Gray I learn that the 1872 Bilbao cable broke down periodically—usually in the month of March, with or after a heavy north-west gale. This took place about 30 miles to the north of Bilbao, and, when repairing, it was invariably found that 4 or 5 miles had been buried. The cause of these interruptions was attributed to a heavy submarine current caused by the piling-up of surface water, cutting the prolongation of a river-bed with steep walls which, when underout, fell in masses to bury the cable.

St. Thomé—St. Paul de Loanda.—Interruptions which have been noted on this section were as follows:—

January 22, 1892; September 13, 1892*; November 24, 1892*; February 17, 1893*; April 11, 1893*; May 30, 1893*; February 5, 1894*; January 22, 1895*; January 15, 1896*; May 2, 1896*; June 15, 1896*.

BAY OF BISCAY.

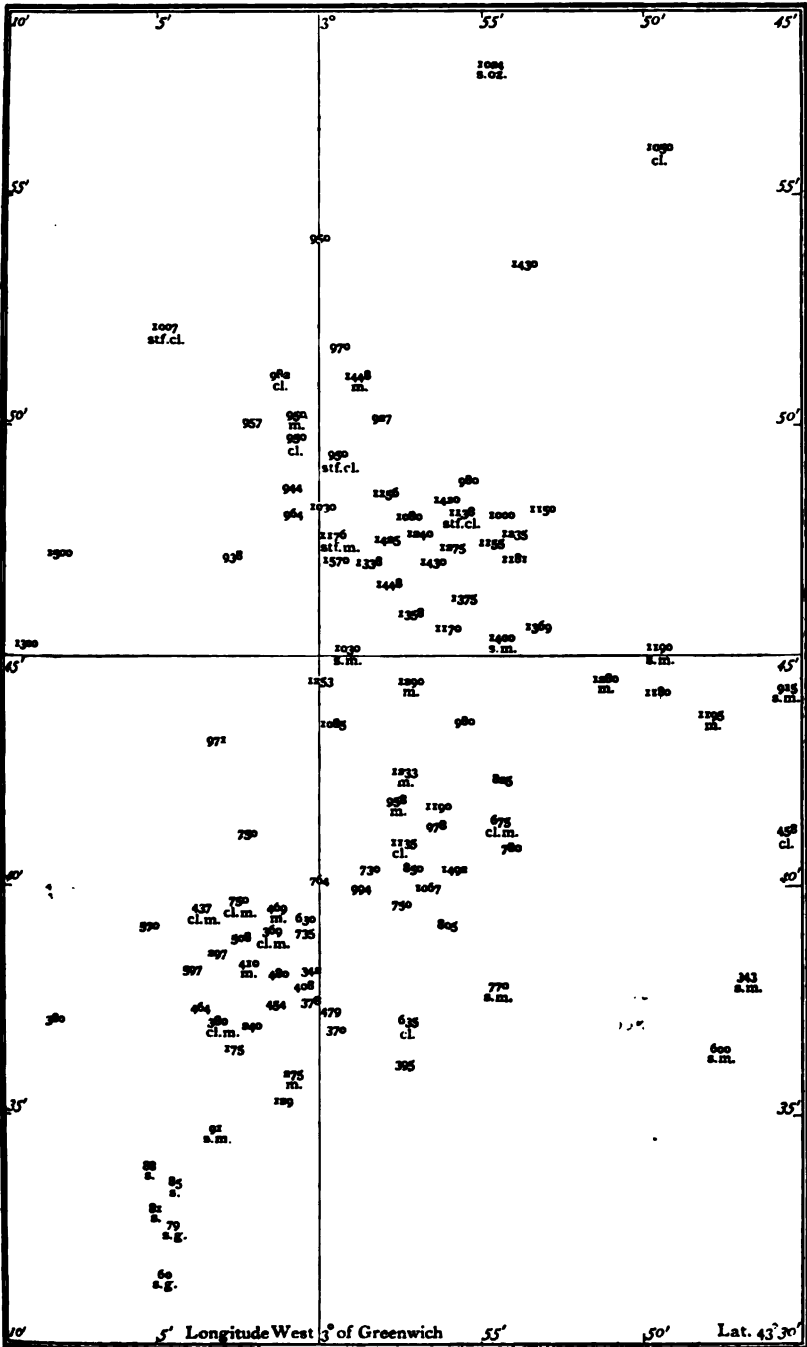


FIG. 11.

The dates on which unfelt earthquakes were recorded were as follows:—

September 13, 1892. At Strassburg a very large disturbance from 9·54^h to 13·31^h. Origin unknown.

February 16, 1893. At Strassburg at 0·08^h. Origin possibly in Japan.

April 11, 1893. At Strassburg and Nicolaiew, 18·58^h to 19^h. Moderate. On April 8 at these stations there was a heavy movement from 1·87^h to 4·17^h. Origin unknown.

May 30, 1893. At the above stations from 4^h 33^m to 5^h 32^m; a great movement.

February 5, 1894. At Charkow from 4^h 54^m to 10^h 34^m there was a strong movement.

January 18, 1895, 2^h 37^m. At many places in Italy.

January 15, 1896, 7^h 10^m. At many places in Italy.

May 2, 1896, 1^h 20^m. Strong through Europe.

June 13, 1896, 14^h 54^m. Strong through Italy.

June 14, 1896, 22^h 46^m. Strong in Shide and over Europe. Origin in the Pacific ocean.

We have, therefore, eleven cases of interruptions, on or near to the dates of nine of which large earthquakes were recorded. It is difficult to imagine that this particular district should be characterized by any seismic activity, but it seems possible that, if it is a district where sediments rapidly accumulate to attain an unstable form, these might from time to time give way under the influence of earth-waves originating at a great distance.

On this particular section Mr. R. Kaye Gray points out that, from the mouth of the Congo, extending seawards, there is a difficult gully to cross, the walls of which are 2000 feet in height! Although the gully widens towards the west, this height is maintained for a considerable distance. The shallowest water is found along the edges of this gully, which therefore has a transverse section not unlike that of a river bounded by a naturally formed *levée*.

The East Coast of Africa.—The following are interruptions noted in various cable sections along the east coast of Africa:—

Mozambique—Zanzibar.—February 1, 1885; April 2, 1885; September 26, 1894*.

Delagoa Bay—Durban.—October 15, 1890; November 18, 1890; December 10, 1894; January 20, 1896*; July 13, 1896*.

Mozambique—Delagoa Bay (Lorenzo Marques).—November 11, 1890; November 18, 1890; January 5, 1893*; January 25, 1893*; June 9, 1895*; December 24, 1896*.

Zanzibar—Mombasa.—December 20, 1890; January 25, 1892; September 4, 1894*; September 26, 1894*; March 6, 1896*; August 23, 1896*; September 23, 1896*.

Aden—Zanzibar.—January 8, 1890; May 11, 1891; December 5, 1891; February 20, 1893*; August 9, 1893*; December 21, 1894; September 2, 1895*; December 24, 1895*; January 27, 1896*; March 16, 1896*; March 23, 1897*(?).

With the nineteen interruptions marked with an asterisk, there are eleven instances where these *may* have corresponded with the records of unfelt earthquakes. Approximate coincidences with earth-movements are as follows :—

January 22, 1893, at 19° 87'. A weak disturbance was noted at Nicolaiew and Strassburg.

September 1, 1894, from 1^h 43^m to 4^h 21^m. Moderate at Charkow.

September 25, 1894, 16^h 49^m to 17^h 8^m. At Charkow.

February 20, 1893, from 19° 23' to 19° 78'. At Strassburg small, origin in Japan.

August 9, 1893, from 17^h 81^m to 19^h 4^m. At Strassburg, moderate.

March 3, 1896, at 16^h 33^m. Recorded through Europe.

August 21, 1896, at 10^h 0^m. Recorded at Padua.

September 2, 1895. At 1^h 3^h to 9^h 6^h and 19^h at Shide.

March 15, 1896. 19^h 36^m at Shide.

September 21, 1896, at 16^h 53^m. Recorded through Europe.

March 23, 1897. At Shide at 4^h 29^h, slight.

Sir James Anderson, in 1887, speaking about the interruptions off the river Rovuma (11° S. lat.), remarks that, so far as soundings showed, there was an even bottom and all that could be desired as a bed on which to place a cable, yet every year the cable broke. The broken ends suggested that the cable had been suspended until it snapped. Although the cable was shifted further out, and then closer in, it still broke. This happened eight times, and it was noticed that the interruptions occurred at about the same time of the year. Seven of these breaks are fairly on the same line, and Sir James's suggested explanation of this cause was that the time when the interruptions occur is at the termination of the rainy season in the African mountains, at which time fresh-water springs take away the bottom on which the cable lies, and leave it suspended.

Mr. John Y. Buchanan suggests that sometimes a cable may be broken in consequence of its slowly subsiding through ooze, until the catenary strain becomes so great that it eventually snaps.

Aden—Bombay.—Interruptions noted on this section were the following :—

July 11, 1881; June 3, 1885; July 27, 1885; July 11, 1888; August 11, 1888.

On the second and last of the above dates the two cables connecting Aden with India were simultaneously broken, and the traffic between India, Australia, and the East had to pass over the land lines of Russia, Persia, and Turkey. The fractures took place on an even bottom a few hundreds of miles from Aden. At the time of the 1885 interruption, a fearful cyclone was raging at Aden, and it is therefore possible that the ruptures may be attributed to causes similar to those which seem to have operated on the Bilbao cables. The place of fracture was 119 knots

from Aden, 20 to 25 miles south of the Arabian coast, at a depth of 870 to 990 fathoms, on an even bottom of mud.

Penang and Madras.—Interruptions noted on this section have been as follows :—

May 12, 1873; November 15, 1875; March 28, 1876; November 9, 1878; April 22, 1880; January 31, 1881; June 6, 1883; November 15, 1883; June 13, 1884; September 2, 1886; November 2, 1886; November 14, 1886; September 22, 1888 (?); May 13, 1890.

On the above dates horizontal pendulums or the equivalent instruments were not in operation, but that these interruptions were partly due to sub-oceanic change may be inferred from the fact pointed out by Sir John Pender in the *Electrical Review* of May 23, 1890, who says that nearly all the interruptions on this line have taken place on very bad ground near the Nicobar islands.

South-East Parts of Asia.—The following completes the list of interruptions on far eastern lines :—

Bangoon—Penang.—September 4, 1886; May 13, 1890.

Singapore—Penang.—November 20, 1873; August 7, 1876; November 8, 1876; December 20, 1876; July 20, 1877; October 19, 1877; September 30, 1878.

Batavia—Singapore.—March 31, 1873 (?); May 20, 1874 (?); August 13, 1874; August 18, 1874; December 14, 1874; September 2, 1875; November 5, 1875; May 9, 1876; June 28, 1876; October 25, 1876; February 27, 1877; September 28, 1877; November 9, 1877; January 22, 1878; May 2, 1878; August 31, 1878; October 28, 1878; December 28, 1878; September 20, 1879; December 3, 1883.

Port Darwin and Java (Banjoewanji).—June 21, 1872; April 27, 1876; November 8, 1877; September 27, 1878; May 29, 1879 (?); July 4, 1879; March 5, 1883; March 10, 1883; April 6, 1883 (?); October 22, 1883; June 29, 1888 (two cables broken); October 10, 1888 (both cables broken); October 22, 1888 (both cables broken); July 11, 1890 * (three cables broken, one being to Roebuck bay); February 23, 1893 *; March 22, 1893 *; September 27, 1893 *; October 25, 1893 * (two cables broken, see *Electrician*, November 3, 1893); October 26, 1893 *.

The horizontal pendulum records are as follows :—

February 22, 1893. At Strassburg, 11°28' to 11°78'; also at Nicolaiew. *Moderate.*

March 20, 1893. At Strassburg, 5°18' to 5°53'; also at Nicolaiew. *Moderate.* Origin probably in Zante.

September 11, 1893. At Charkow, 16° 13' to 17° 50'.

October 22, 1893. At Charkow, 13'.

The two fractures of June 29, 1888, took place 20 and 25 miles south by west of Mount Dodo, Sumbawa, where depths vary from 734 to 1130 fathoms. Sir John Pender, at the ordinary general meeting of the Eastern Extension Australasia and China Telegraph Company (see *Electrician*, October 12, 1888), says that it was found that these breaks resulted from "volcanic" action, and, curiously enough, when the cables were recovered, all sorts of things, even the roots of trees, were found attached to them. The whole thing seemed to be a great upheaval of nature. From the same paper, August 20, 1888, we learn that these two

interruptions took place at points widely separated. In Port Darwin time, the fractures took place on June 29, at 10.40 p.m. The three interruptions of July 11, 1890, took place, in Banjoewanji time, at 1.35 a.m., on a rough, uneven bottom, between Tafel Hoek (Bali) and Balamangan point, Java, where the depths vary from 155 to 927 fathoms. The duplicate cable was broken in three places, and overlaid about 65 miles from Banjoewanji. The three cables run along two sides and near the bottom of a gully separating Baly from Java, and are about 7 miles apart. They practically broke on one line, and the cause was "volcanic" action (see *Electrician*, October 24, 1890, vol. xxv.). In this instance, as in that of June 30, 1888, the submarine displacements extended over an unusually wide area, and when we refer to a chart, it is seen that at a distance of 9 miles in a south-west direction from Tafel Hoek there is depth of 1180 fathoms, indicating a slope of 1 in 7.

The only interruptions which can be compared with the records of horizontal pendulums are the last five. The time of the interruption of March 22, 1893, is not known. The mean Greenwich times and dates at which the remaining four took place in 1893, are as follows:—

1. February 22, between 4^h 20^m and 16^h 20^m.
2. September 12, 12^h 20^m.
3. October 24, 17^h 5^m.
4. October 26, 3^h 0^m.

The conclusion is, that only the first of these four interruptions took place when an unfelt earthquake was recorded in Europe, but similar disturbances were noted on September 11 and October 22.

The following table is a comparison of the days and hours when earthquakes were felt in Java, with the times at which cables were interrupted:—

Shocks felt in Java and Sumatra in approximate G.M.T. (Batavia time - 7 hours).	Date and G.M.T. of cable-interruptions.
1872, June 16, 12 ^h to 14 ^h	June 21
1876, April 23, 10 ^h 15 ^m . Sumatra	April 27
1877, November 3 to 4	November 8
1878, September 21, 19 ^h 30 ^m . Sumatra	September 27
1879, without records	
1883, March 6, 4 ^h 45 ^m . Sumatra	March 5
1883, October 18, 17 ^h 0 ^m . Banjoewanji	October 22
1888, June 29, 21 ^h 33 ^m . Batavia	June 29, 3 ^h 40 ^m
October 8, 12 ^h 18 ^m . Series of shocks	October 9
October 9, 12 ^h 26 ^m	October 22
October 21, 12 ^h 5 ^m . Light shock	October 22
1890, July 10, 16 ^h 50 ^m to 19 ^h 40 ^m . Series of shocks, some heavy. Java	July 11, 6 ^h 33 ^m
1893, February 23, 15 ^h 15 ^m . Java	{ February 23, 4 ^h 20 ^m and 16 ^h 20 ^m
March 22, 13 ^h 32 ^m . Light. Java	March 22 (time unknown)
September 9, 22 ^h 57 ^m . Moderate. Java	September 27, 12 ^h 20 ^m
October 23, 9 ^h 53 ^m . Fifteen shocks, very heavy. Java	
October 25. A light shock	October 25, 17 ^h 25 ^m

For the interruptions of cables on June 29, 1888, and July 10, 1890, we have the assurance of those connected with their management that the cause was volcanic or seismic, whilst the actual or close coincidence in the dates at which the remaining interruptions have taken place with the days on which earthquakes have been felt leads to the belief that the Port Darwin—Java section has suffered more from the effects of sudden sub-oceanic change than from any other cause. The European records of February 22 evidently refer to the disturbance which caused the interruption on that date in Java, between the hours 4:20^a and 16:20^b.

A TABULAR ARRANGEMENT OF THE FOREGOING INTERRUPTIONS.

Name of cables.	Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
North Atlantic	—	—	—	1	—	3	3	—	3	4	—	—	14
St. Louis—Fernando No- ronha	—	—	1	—	—	—	—	—	—	—	—	1	2
Pernambuco—Cape Verde	—	—	—	—	—	—	—	—	1	—	—	—	1
La Libertad—Salina Cruz	—	—	—	—	—	—	—	—	—	—	1	—	1
Panama—San Juan del Sur	—	—	—	—	—	1	1	—	—	—	—	—	2
Sta Elena—Buenaventura	1	1	—	—	—	—	—	1	—	—	—	4	7
Paita—Sta. Elena	—	—	1	1	3	—	—	—	2	—	—	—	7
Mollendo—Chorillos	1	2	4	1	—	2	—	2	—	1	—	2	15
Arica—Mollendo	—	—	—	—	1	2	1	1	—	—	—	—	5
Iquique—Arica	—	—	—	—	2	1	—	—	—	—	—	—	3
Caldera—Antofagasta	—	—	—	—	—	—	1	—	—	—	—	—	1
Valparaiso—Serena	—	—	—	—	—	—	3	2	—	—	—	—	5
Montevideo—Buenos Ayres	—	—	—	—	—	—	—	—	—	1	—	—	1
Sta Catharina—Rio Grande do Sul	—	—	—	—	—	1	—	—	—	—	—	—	1
Santos—Sta. Catharina	—	—	1	—	—	—	—	—	—	—	—	—	1
Montevideo—Rio Grande do Sul	—	—	—	1	1	1	—	—	—	—	—	2	5
Uhuy—Montevideo	—	—	—	—	—	1	1	—	—	—	1	—	3
Rio de Janeiro—Santos	—	—	—	2	—	—	—	—	—	—	—	1	3
Bahia—Rio de Janeiro	1	—	—	—	—	—	2	—	3	—	—	—	6
Pernambuco—Bahia	—	—	—	1	—	—	2	—	—	—	—	—	3
Ceara—Pernambuco	1	—	3	1	—	—	—	—	1	—	—	—	6
Maranhã—Ceara	2	1	3	2	1	—	—	—	—	1	2	1	13
Para—Maranhã	4	1	2	—	2	—	2	2	4	4	4	4	27
Lipari—Milazzo	—	1	1	—	—	—	—	—	1	—	—	1	4
Zante—Canea	—	—	1	—	—	—	—	—	—	—	—	—	1
Patras—Corinth	—	—	—	—	—	—	—	1	1	—	—	—	2
St. Thomé—St. Paul de Loanda	3	2	—	1	2	1	—	—	1	—	1	—	11
Mozambique—Zanzibar	—	1	1	—	—	—	—	—	1	—	—	—	3
Delagoa Bay—Durban	1	—	—	—	—	—	1	—	—	1	1	1	5
Mozambique—Delagoa Bay	2	—	—	—	—	1	—	—	—	—	2	1	6
Zanzibar—Mombasa	1	—	1	—	—	—	—	1	3	—	—	1	7
Aden—Zanzibar	2	1	1	—	1	—	—	1	1	—	—	3	10
Aden—Bombay	—	—	—	—	1	3	1	—	—	—	—	—	5
Penang—Madras	1	—	1	1	1	2	—	—	2	—	5	—	13
Rangoon—Penang	—	—	—	—	1	—	—	—	1	—	—	—	2
Singapore—Penang	—	—	—	—	—	—	1	1	—	1	2	1	6
Batavia—Singapore	1	1	1	—	3	—	—	3	3	2	2	3	19
Port Darwin—Java	—	1	3	2	1	2	2	—	2	5	1	—	19
	21	12	25	14	19	19	28	16	28	20	22	26	245

The foregoing table is a list of the thirty-eight lines just discussed along which one or more cables are laid. Since these lines were established, the number of interruptions which have occurred have been at least 245. For certain lines it would appear that fractures were more frequent at one season than at others, and that therefore a proper analysis of the table or its parts, such, for example, as those to which earthquake statistics have been subjected, might lead to the discovery of periodicities in cable-interruptions. Unfortunately, because the material in our possession is yet so meagre, such discussions must for the present be reserved.

Out of the 245 breaks, 87 of them, each marked with an asterisk, occurred at the times when instruments were in operation which would record unfelt earthquake effects. Fifty-eight of the 87 cable interruptions occurred at or about the times when Europe was agitated by these unfelt movements. The fractures accompanying earthquake, or, as it is sometimes called, volcanic movement—which could be felt, and which in two instances caused destruction on neighbouring shores, were at least 10 in number. The Java records might possibly raise this number to 24. In three of these instances, two or three cables were broken simultaneously, and in these cases, the submarine dislocations extended over a wide area; in the Gulf of Corinth great changes in ocean depth were brought about, and from this latter place we know the motion to have radiated, so that a few minutes after the interruption well-defined diagrams of earth-waves were obtained at localities 1000 miles distant, at places where no movement could be felt.

Instances like the latter clearly establish a connection between cable-interruptions, earthquake-motion which has been felt, submarine dislocation, and the records of horizontal pendulums in distant localities where earth-movements have not been felt. This being the case, and because earthquake-motion cannot be felt at great distances from its origin, it is reasonable to conclude that the records of unfelt earthquakes which approximately coincide in time to those at which cables have been interrupted may sometimes indicate that submarine geological changes have accompanied seismic efforts.

Although certain conclusions arrived at in this paper are definite, until the materials necessary for analysis can be obtained, others remain matters of inference. The records of interruptions for the lines mentioned are, we have reason to believe, incomplete. The horizontal pendulum records with which to make comparisons have not only been few in number, but, because they are confined to Europe, could only be expected to throw light upon disturbances originating at a great distance which were exceptionally large. The records of earthquakes which have been felt are confined to an imperfect list for Java, a few from the Mediterranean, and a few reported from the west coast of South America. Lastly, the hours, and in some cases even the days, on which cable

interruptions have taken place, together with the probable cause of these interruptions, are unknown. These latter facts are no doubt to be found in the archives of many cable companies, and it would be to the interest of all who desire to increase our knowledge of sub-oceanic change if comparisons could be made between the records of unfelt earthquakes now published, and the times and circumstances at and under which corresponding cable-ruptures have taken place.*

All that it is expected to find is, that a certain and probably a small proportion of these interruptions may correspond in time with seismic disturbances, and, because we know that certain cables have been lost by landslips and dislocations accompanying earthquake-movement, it is to be hoped that the expectation may be regarded as a reasonable conjecture.

An Attempt to estimate the Frequency of Submarine Dislocations.— If it can be assumed that the majority of cable-interruptions are due to submarine displacements, and not to faults inherent in the cables themselves (which are comparatively of rare occurrence), the swaying of suspended sections under the influence of waves and currents, the movements of marine creatures, the boring of a *teredo*, and other exceptional causes, then the tables which have been given of cable fractures will give some idea of the frequency of such displacements. Because the list of interruptions for a number of the lines mentioned are imperfect, and because each cable follows a path carefully chosen as not being likely to suffer from submarine disturbance, the frequency of dislocation derived from such an assumption is more likely to be a minimum than a maximum. From the known number of interruptions which have occurred on sections of given length in a given number of years, the table (p. 281) of dislocation frequency per mile of coast per year has been computed.

The coasts taken are the east and west sides of South America and Africa. The total length considered representing shores which are steep and those which are gently inclined is about 11,000 miles. The general result which is reached is that the dislocations per mile per year, on the coast-lines considered, which may be taken as having on the average a character similar to that of the coast-lines of the world, are represented by the number 0·0023, that is to say, there is on the average, one dislocation for every 434 miles per year. If we increase this number to 500 miles, and remember the character of the records and that of the facts to which they refer, although we have attributed *all* the interruptions to submarine change, we are inclined to the opinion that the estimate is not too great. This being granted, then, as there are about 156,000 miles of coast-line in the world, if the same were surrounded by loops of cables, although each section might be laid in

* The writer, whose address is Shide Hill House, Newport, I.W., England, would be glad to receive any information respecting the day, hour, and probable causes of failure, connected with cable-interruption.

the most favourable position, more than three hundred interruptions resulting from submarine disturbance might be expected to occur every year. In deep water on a level soft bottom experience shows that a

CABLE DISLOCATION PER MILE PER YEAR.

Name of cable.	Length in nautical miles.	Number of breaks per mile per year.
Mollendo—Chorillos	510	0·002
Arica—Mollendo	146	0·003
Iquique—Arica	128	0·0040
Antofagasta—Iquique	250	0·0000
Caldera—Antofagasta	229	0·0004
Coquimbo—Caldera	215	0·0000
Valparaiso—Coquimbo	219	0·001
Santos—Chuy	744	0·000
Maldonado—Montevideo	72	0·000
Chuy—Maldonado	125	0·000
Rio Grande do Sul—Chuy	148	0·000
Monte Video—Buenos Ayres	32	0·004
Sta Catharina—Rio Grande do Sul	397	0·0004
Santos—Sta Catharina	293	0·0005
Montevideo—Rio Grande do Sul	349	0·006
Chuy—Montevideo	201	0·001
Rio de Janeiro—Santos	223	0·009
Bahia—Rio de Janeiro	768	0·0011
Pernambuco—Bahia	404	0·0036
Ceara—Pernambuco	481	0·0018
Maranhã—Ceara	408	0·004
Para—Maranhã	381	0·008
St. Thomé—St. Paul de Loanda	785	0·008
Delagoa bay—Durban	348	0·002
Mozambique—Delagoa Bay	971	0·001
Zanzibar—Mombasa	150	0·007
Aden—Zanzibar	1914	0·0008
	10,891	0·0023 average.

cable may remain undisturbed and unchanged for long periods of time, indicating, as we have already pointed out, that geological change is proceeding with extreme slowness.

SECTION IV.

Conclusions and Suggestions for a Seismic Survey of the World.

Because earthquake origins are more numerous beneath the sea than upon the land, it is fair to assume that the bradyseismical operations resulting in the folding, bending, crushing, faulting, and thrusting of rock masses are more active in the recesses of the ocean than they are upon our continents. Sub-oceanic volcanic activity, as, for example, that which is met with in the mid-Atlantic, probably indicates the existence of bradyseismic movement and a relief of strain. The concentration of detritus derived from continental surfaces along coast-

lines on tracts which are comparatively small, indicates that beneath the sea the growth by sedimentation is greater per unit area than the similarly estimated loss is by denudation on the land. This rapid submarine growth, largely under the influence of gravity, but modified by hydrodynamic action, leads to the building up of steep contours, the stability of which may be destroyed by the shaking of an earthquake, the escape of water from submarine springs, the change in direction or intensity of an ocean current, or by other causes which have been enumerated. That submarine landslides of great magnitude have had a real existence is proved for certain localities by the fact that after an interval of a few years very great differences in depth of water have been found at the same place, whilst sudden changes in depth have taken place at the time of and near to the origin of submarine earthquakes (see p. 272). Large ocean waves unaccompanied by volcanic action indicate that there have been very great and sudden displacements of materials beneath the ocean. The most important evidence of sub-oceanic change is, however, to be found amongst the archives of the cable engineer. The routes chosen for cables are carefully selected as being those where interruptions are least likely to occur, and yet, as it has been shown, something which is often of the nature of a submarine landslip takes place and some miles of cable may be buried. Here we seem to have proof positive, especially along the submerged continental plateaus, of sudden sub-oceanic dislocation. Because these changes are frequent, it is reasonable to suppose that sedimentation and erosion, and other causes which lead up to the critical conditions, are geologically rapid.

Briefly, the foregoing notes and facts indicate that beneath the oceans certain important geological changes are more rapid than they are upon land, whilst new sources from which information respecting these changes may be obtained are pointed out to the student of dynamical geology.

The more important of these sources are the experiences of the cable engineer and the records of seismographs, which are sensitive to unfelt movements. When a number of these instruments have been established round the world, on the borders of great oceans, and on oceanic islands, it is difficult to overestimate the practical and scientific results which will follow.

The greater number of records, as it has been shown, would refer to disturbances which originated beneath the sea. From the times at which earth-waves arrived at different stations, as, for example, on the two sides of the Atlantic, it would be possible to localize their origins, and in time districts would be indicated which it would be well for those who lay cables to avoid. Work of this nature has, by means of ordinary seismographs, been *partially* accomplished for Japan, and the seismic maps of that country (see *Seism. Jour.*, vol. iv.) show that sub-oceanic disturbances originating *near to the coast* are herded in groups.

Should a trans-Pacific cable be landed in that country, to effect this through the middle of one of these groups would be inviting its destruction.

If we had the means of knowing that when an interruption occurred in a cable at the same time an unfelt earthquake had been recorded, we should then be in a position to attribute the fault to its proper cause. The practically simultaneous failure of three Atlantic cables in 1884 led to the hypothesis that they had been broken by the grapnels of a repairing vessel; fortunately for the owners of this vessel, it could not be substantiated.

From the *Electrician* of August 20 and October 12, 1888, we learn that the simultaneous interruption of the two cables connecting Java and Australia in 1888 cut off the latter from the outside world for nineteen days, and gave a pretext for calling out the military and naval reserves to meet the contingency of war having broken out. In 1890 three cables were simultaneously broken, and telegraphic communication with Australia was cut off for nine days. On these occasions, had there been established in Australia a proper instrument for recording unfelt movements of the ground, it is extremely likely that the cause of the interruption would have been recognized as due to seismic action, and the fear of war and the probable accompanying commercial paralysis would have been averted. Other direct benefits, which have already been derived from the records of instruments such as it is here proposed to establish round the world, are that they enable us to extend, correct, and even to cast doubt upon certain classes of telegraphic information published in our newspapers.

Late in June last year we learned from our newspapers that a great disaster had taken place in North Japan, and that nearly 30,000 people had lost their lives. Seismograms taken in the Isle of Wight not only indicated how many maxima of motion had taken place, but showed that there had been an error in transmission of two days, the catastrophe having taken place on the evening of June 15, so that all who were to reach the stricken district after that date were in safety.

On August 31 of the same year, the Isle of Wight records showed that a disturbance similar to that which had occurred in Japan had taken place. On account of this similarity, it was stated that we should probably hear of a great earthquake having taken place in or near that country on the above date at 5.7 p.m. Four weeks later this was verified by mail. Another instance occurred some weeks later, when our newspapers announced that a great earthquake had taken place and several thousand lives had been lost in Kobe. No doubt those who had friends and property in that city were filled with anxiety. On this occasion the Isle of Wight instruments were still indicating that nothing of the magnitude described could have occurred. Later it was discovered that the telegram was devoid of all foundation.

If we next turn to the scientific aspect of the proposed investigations, we at once recognize the importance of the results which it is hoped may be obtained for the hydrographer and the student of physical geography and geology.

The greatest result which it is hoped may be achieved is to accurately determine the rate at which earthquake motion is propagated over long distances. In some instances the rates which have already been determined are so high, reaching 12 and more kilometres per second, that the supposition is, that motion does not simply go round our Earth, but that it goes *through* the same, and if this is so, then a determination of these rates of transit will throw new light upon the effective rigidity of our planet.

That these suggestions have been well considered is testified by the issue of the following circular, copies of which have already been forwarded to certain countries by the Foreign Office:—

SEISMOLOGICAL INVESTIGATION.

COMMITTEE APPOINTED BY THE BRITISH ASSOCIATION.

Lord Kelvin, F.R.S.	Prof. J. A. Ewing, F.R.S.
Prof. W. G. Adams, F.R.S.	Prof. C. G. Knott.
Dr. J. T. Bottomley, F.R.S.	Prof. A. G. Lebour.
Sir F. J. Bramwell, Bt., F.R.S.	Prof. R. Meldola, F.R.S.
Prof. G. H. Darwin, F.R.S.	Prof. J. Milne, F.R.S., Secretary.
Mr. Horace Darwin.	Prof. J. Perry, F.R.S.
Major L. Darwin.	Prof. J. H. Poynting, F.R.S.
Dr. C. Davison, Secretary.	Dr. Isaac Roberts, F.R.S.
Mr. G. F. Deacon.	Mr. G. J. Symonds, F.R.S., Chairman.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Burlington House,
London, W.

_____, 1897.

To _____

SIR,

It has been established that the movements resulting from a large earthquake originating in any one portion of our globe can, with the aid of suitable instruments, be recorded at any other portion of the same; therefore, the Seismological Investigation Committee of the British Association are desirous of your co-operation in an endeavour to extend and systematize the observation of such disturbances.

Similar instruments should be used at all stations; and the one recommended by this Committee as being simple to work, and one that furnishes results sufficiently accurate for the main objects in view, is indicated in the accompanying report.*

* The report referred to will be found in the 'Reports of the British Association for 1896,' pp. 180-231. There is a sketch of the instrument on p. 187, and an example of a record on p. 229.

We desire to know whether you are disposed to purchase, and make observations with, one of these instruments, the cost of which, including photographic material to last one year, packed for shipment, is about £50. Should you reply in the affirmative, we shall be pleased to arrange with a competent maker for the construction of an instrument for you, and to furnish instructions respecting installation and working. In case an instrument be established at your observatory, we should ask that notes of disturbances having an earthquake character be sent to us for analysis and comparison with the records from other stations. From time to time the results of these examinations would be forwarded to your observatory.

The first object we have in view is to determine the velocity with which motion is propagated round or possibly *through* our Earth. To attain this, all that we require from a given station are the times at which various phases of motion are recorded; for which purpose, for the present at least, we consider an instrument recording a single component of horizontal motion to be sufficient. Other results which may be obtained from the proposed observations are numerous.

The foci of submarine disturbances, such, for example, as those which from time to time have interfered with telegraph cables, may possibly be determined, and new light thrown upon changes taking place in ocean beds.

The records throw light upon certain classes of disturbances now and then noted in magnetometers and other instruments susceptible to slight movements, whilst local changes of level, some of which may have a diurnal character, may, under certain conditions, become apparent.

Trusting that you will find it possible to co-operate in this endeavour to extend our knowledge of the Earth on which we live,

We remain, Sir,

(On behalf of the Committee,)

Your obedient servants,

G. J. SYMONS, Chairman.

C. DAVISON, } Joint Honorary

J. MILNE, } Secretaries.

It is requested that replies be addressed to—

The Seismological Committee,

British Association,

Burlington House,

London, W.

Before the reading of the paper, Admiral Sir W. J. L. WHARTON, Vice-President (in the chair), said: Mr. Milne requires no introduction from me, for he has read papers here before, and he has a very important communication to make to us to-night, which I will now ask him to read.

After the reading of the paper, the following discussion took place:—

Sir ARCHIBALD GEIKIE: We have all listened with pleasure to this paper. "All roads lead to Rome," and when I read the title, "Sub-oceanic Changes," I knew that in Mr. Milne's plan of the world every road leads to the earthquake. I was prepared, therefore, to find that sub-oceanic changes were largely of a seismic kind. I have listened with great interest to all that he has said to us with regard to the data he has been able to obtain from the cable companies. I think that is really the important part of the paper. We know so little of what takes place in the deeper parts of the ocean, and only by direct experiment can we obtain the necessary information. The experiments carried on by the cable companies reveal that a good many changes from time to time take place. There is one misapprehension

which I dare say the author did not mean to convey, viz. that earthquakes are mainly submarine, and belong more to the ocean than the land. I don't think that is quite the case, even on his own showing. He told us that the continents begin at the bottom of the continental slopes, and that about the bottom of these slopes earthquakes chiefly take their rise. We have long known that the margins of the continents are critical lines; that geological changes have been apt to take place there more frequently and with greater vigour than elsewhere. Britain, for instance, lies on the margin of the European continent, and I suppose there is no area of the same size on the face of the globe which contains within it so marvellous a record of volcanic action. Going back from comparatively recent to the most remote geological times, the borderland of the continent seems to have been always the most sensitive tract, and it is there that volcanoes and earthquakes have been most apt to occur. When Mr. Milne speaks about earthquakes being more under the sea than on the land, I would modify that statement by saying that, while earthquakes undoubtedly originate under the sea, they nevertheless belong to the great continental uplifts on the face of the globe rather than to the sea-bottom. The bottoms of the great oceans are comparatively quiet, undisturbed regions, except along the lines where submarine ridges occur, and where probably volcanic operations are at work. Then as to another point which the author passed rapidly over—the deposits worn off the face of the land and laid down on the sea-bottom. He spoke of some experiments with an aquarium, by dropping fine sand from a point into the water, and so building up cones. Now, I imagine that when a river or series of rivers enters the sea, the material transported from the land is not thrown down in cones, but spreads out pretty evenly over the sea floor. If you take a wide view of the subject, and make a section across the submarine continental plateau to the great ocean floor beyond, you will find that instead of cones, sheets of sediment, sloping more or less gradually from the edge of the land, are spread out towards the deeper water. It may be that from time to time ocean currents disturb this sediment. We do not know very much about what ocean currents do at any great depth. This is a point on which the cable companies may be able to throw some light. That there may be a good deal of burying and chafing of cables by material heaped on them is probable; Mr. Buchanan has remarked that submarine cables may quietly subside in soft ooze, which, accumulating over them, may cause such a strain on them when they are pulled up as to make them actually break. That the cables may break by fretting against steep slopes of rock of broken and irregular contours, I think highly probable; that this takes place from time to time along the seaward faces of continents seems exceedingly likely. I should like to separate the actual observations which the author has brought before us from the speculations he has founded upon them. All Mr. Milne's speculations are suggestive. You may not perhaps concur with him in every point, but you cannot help feeling that the observations and speculations are those of an observant and thoughtful man. They make you think anew about what you supposed you knew quite well, and, by putting things in another light, open your eyes, and make your mind more ready to receive the fresh information he gives you.

Prof. PERRY: I should have preferred to hear what Mr. Gray has to say; indeed, I have nothing to say on the subject, except that perhaps, if Sir Archibald Geikie would think that Mr. Milne was only imitating in a little bowl or aquarium what occurs in the huge ocean, he will see that the little slope of sand Prof. Milne formed may not be so very dissimilar from the bank formed in the ocean. Prof. Milne has, at two or three lectures where I have heard him, speaking of seismic phenomena, attracted my attention and tried to attract the attention of the

audience to the usefulness of seismic survey. At one time he told us—and I know it is quite true—that these observations he made during so many years have given much useful information as to how to build houses in an earthquake country. Another time he told us another use of these observations. To-night he has been telling us about deep-sea cables, and with regard to these, I would submit, with all deference to Sir Archibald Geikie, that Prof. Milne's idea as to their fracture is surely a reasonable one. When we have three cables many miles apart, of different ages, breaking at the same time, it is very unlikely that their fracture can have been due to their gradual sinking in ooze. In the usefulness of seismic observation in house-building and cable-laying, I am as much a believer as Prof. Milne can want any of his hearers to be, and I grant that he appeals in the right way to a popular audience, but it seems to me that his information is of enormously greater value than he has yet stated.

We live upon a huge object, 8000 miles thick, and we have a small amount of knowledge about its mere skin, say 2 miles of its thickness. Lord Kelvin tells us that it must be very rigid and yet very hot inside; geologists think it must be liquid; men who study magnetism say that they are in a state of perpetual ignorant wonder about the Earth's inside; we all know that, whatever be the state of the matter inside, it must be quite different from that of all stuff known to us. Now, Milne's experiments and observations have not gone very far as yet, but so far as they have gone they show that they can reveal to us some of the Earth's secrets. It is very wonderful that when he sees a record of a distant earthquake, he can tell whether the motion has travelled 7000 miles or only 1000 miles; in the first case the motion being preceded by long-continued tremors, in the latter by tremors lasting only ten minutes. What is the meaning of the enormous velocity of these tremors? 17 kilometres per second! No known property of rock suggests to us a velocity more than a fifth of this. These messages of his have come, not along the surface, but through the body of the Earth; properly observed and studied, they will surely give us information which we at present see no other means of getting. Prof. Milne asks for a seismic survey of the Earth; that these messages which are always being sent shall be recorded at a number of places sufficiently far apart. As a member of the Kew Committee, I gave my voice for the putting up of an instrument near London, and this is now being done. I wish God-speed to Prof. Milne in every effort he makes to induce people to establish receiving-instruments all over the world. If people need to be bribed, if these stations cannot be established unless they are likely to be useful to builders and telegraph people, by all means let us hear about earthquake-proof walls and railway bridges and cables; but I venture to tell this audience that the matter is one of very much greater importance—it concerns not merely our material well-being, but our knowledge of the secrets of nature.

Mr. MATTHEW H. GRAY: I have very little to add to what we have heard to-night from Prof. Milne. I am sure it is a most interesting subject. There are many useful points in these observations which Prof. Milne laid before you, which more concern telegraph companies than those interested in establishing seismic stations. Prof. Milne pointed out that Australia might have known that the cables were broken by earth-movements if they had stations for observing them, instead of doing as they did—call out the troops, put ships into commission, send men to the forts, and generally disturb the whole course of peaceful commerce. He has again pointed out in Japan and its vicinity places where it is unsafe to lay a cable, and places where it is unsafe to land a cable; I understand that at the present time the American Government, or some of the people, are laying a cable from San Francisco to Hawaii and Japan, and there is no doubt that the result of

these observations will be of the greatest assistance and help to those engaged in that work. I don't know that I can say anything on the subject of the cause of earthquakes, as it is rather wide of the matter before the meeting. It has occurred to me that the percolation of water through some of the strata, and its reaching shale or some stratified body which absorbs the moisture, would cause a swelling of this particular stratum, and doubtless that would move the overlying rock. This seems rather a small cause for so large an effect, but one remembers the way in which the granite was broken up in the quarries at Assuan. There is one block half hewn from the quarry, about 100 feet long, where they have dug small holes in a line in the granite, and in these they put wedges of soft wood. Water was then allowed to run in a small channel, and the swelling of the wood parted the granite, although it seems an impossible thing to happen. Therefore I think the swelling of the strata due to the percolation of water is of importance, because very great tension being established in the overlying rocks, when the point of elasticity is reached, the rocks suddenly crack, and create those movements Mr. Milne has spoken of. I can only say that I am very glad to have listened to this paper. It throws a great deal of light on the causes of things of which we know very little, and all interested in submarine cables will be much indebted to Prof. Milne for the light, new in many points, which he has thrown on the subject.

Mr. R. KAYE GRAY: I am afraid I cannot say very much on the registration of earth-movements, or how far these are responsible for the interruptions of submarine telegraph cables which lie parallel to shore-lines and across continental slopes. Having considerable experience in cable matters, I can, however, confirm every word Prof. Milne has said as to the continual interruptions of lines laid under these conditions, and can also bear witness that these interruptions are almost always due to submarine landslips. Whether these landslips are caused by earth-tremors, geologists are better able to judge than I; but any one can understand that accumulating slopes of mud or sand must gravitate to the lowest level, and that at certain stages in the accumulation, a state of critical stability is created, which earth-tremors may easily disturb.

I must, on behalf of certain cable companies, thank Prof. Milne for the great care with which he treats questions that are of first importance to us, and for the enormous labour which he has expended in compiling evidence in support of his theories. His work is very useful to the proprietors of cable property, and consequently to the whole world. What the world would be to-day without submarine telegraphic communication—America cut off from Europe, and our colonies cut off from us—is something too terrible to consider, and if any man advances good evidence as to the causes which bring about their interruptions, and thus puts into the hands of the engineers the power of reducing them, he earns public gratitude. If Prof. Milne and other scientific men are working in that direction, it is surely little to ask the public to assist in establishing the seismic observatories which he has so much at heart. So far as I can influence matters, I shall be glad to give him any help that lies in my power.

Admiral WHARTON: Prof. Milne has broken such comparatively new ground and covered so much that he certainly has given all of us much food for reflection. It is extremely difficult to sum up in any way what he has put before us, and make any remarks, except brief ones. The subject of sub-oceanic changes is extremely interesting to me, and I don't think I have ever listened to a paper which has suggested more to me than Prof. Milne's. He would not profess himself, I am sure, to say that he has proved all the propositions he has put before us, but with regard to the most interesting one, the most patent thing is that some earthquakes are caused by the sudden slipping down of steep submarine slopes. That would be an

extremely interesting thing to follow up. He has given us the cue, and no doubt attention will be called to that, and at a future time we shall see whether Mr. Milne's theories are true or not. No doubt there are a great many slips under the sea, but I am a little bit doubtful about some of his evidence as to the actual slopes. I am rather more struck by his suggestion—which is not absolutely new, though he has put it in a new way to me—of the breaking out of submarine springs, and a great many telegraph engineers have very strong ideas on the subject of these springs causing the cables to be broken by moving the material along the bottom of the sea. I have never thought that possible to any extent where cables are broken and found buried, and think it more probable that the cables are broken by the slipping of material, as Mr. Milne suggests. I am inclined to think that undermining by submarine springs is as likely to be a fertile source of slipping as earthquakes. I have had the advantage of carefully reading the paper which he has summarized to-night, and he mentions submarine springs as another cause of sub-oceanic changes.

If he succeeds in getting a sufficient number of instruments established in different parts of the world, on which shocks and tremors can be recorded, there will be more opportunities of finding out whether certain breaks of cable are caused by earthquake, or in some other way. A great many of these breaks, as is well known to telegraph engineers, occur at certain times of the year, which rather points to some such source as submarine springs instead of earthquakes. All these things are complicated.

You will, I am sure, all join with me in thanking Prof. Milne for the most interesting and humorous lecture he has given to-night.

THE PHYSIOGRAPHICAL FEATURES OF THE NYASA AND TANGANYIKA DISTRICTS OF CENTRAL AFRICA.*

By J. E. S. MOORE, A.R.C.S.

THE following is a *résumé* of the topographical notes which I collected concerning the character of the country traversed during a recent journey to Lake Tanganyika *via* the Zambesi river and Lake Nyasa. The information was gathered in order to obtain the kind of grasp of the physiographical characters of the country surrounding and separating the two great lakes, which would be useful in comprehending the special zoological problems I had in hand. It may be said, at the outset, that there exists a great deal of misconception concerning the physiographical characters, not only of the "far interior," but also of many aspects of the country which lies east and west of the Shire river, and which constitutes the southern three-quarters of the environment of Lake Nyasa. The assumption seems to have been implicitly, if not explicitly, made that this lake, because it is long, narrow, and deep, owes its origin to the formation of the great series of rift-valleys which are such a conspicuous feature of the country further north. But a very little acquaintance with the shores east and west, and of the adjacent country to the south, is sufficient to show that the changes in the level of the land which have enabled Nyasa to stand where it is now, 1500

* Map, p. 348.

feet above the sea, had nothing to do with a rift; in fact, when one has reached the foot of Morumbala, facing the Shire river, a country has been entered which is typical of by far the greater part, not only of the Nyasa districts, but of the region known as the Shire highlands also. Here the country is composed of more or less lofty granitic masses, the axes of which run approximately north and south, but which divaricate from one another and enclose wide areas of land, which are now filled with modern alluvium, and form the extensive malarial flats or dambos which are the chief features of the country to-day. In fact, except for narrow rocky eminences visible in all directions, the whole region is composed of a succession of swampy plains at different levels and of widely different areas, many of which have undoubtedly at one time been covered with water, but are now more or less completely filled up with the decomposed granite and gneiss annually swept down into them from the hills by the prolonged tropical rain.

From the Kirk range and the higher portion of the Angoni country on the west, to the lofty mountains behind Lake Shirwa on the east, the whole country, as one moves northward towards Nyasa, is seen, on examination of different portions of it, to be made up in this simple way of successive modern flats and ancient mountain ranges, entirely composed of gneiss and granite, and this necessarily renders the whole district, geologically speaking, without a history.

On ascending from the great Zambesi and Shire river-beds near Katunga, and passing northward across the mountains through the new Blantyre settlement, one reaches a plain which descends slowly towards the east, and stretches between the Zomba mountains on the north and the still greater heights of Mlanje on the south. The eastern extremity of this plain is occupied by the immense reed swamps and foul open salt water of Lake Shirwa, and it terminates still further to the east in the unknown mountainous districts south of the Lujenda river, which flows east and north towards the northern boundary of the province of Mozambique. The horrible nature of the country round Lake Shirwa is almost indescribable, but every objectionable feature of a tropical quagmire seems to have become accentuated about its dismal, sweltering shores, and the crowds of cranes, flamingoes, and screaming water-birds, which jostle one another for room among the reeds, only add to the peculiarly depressing nature of the scene. Above the surface of this detestable lake, which is always blurred by a mirage effect (that seems to be related to the miasmatic stench lying over its surface, and which one can escape by standing up in a canoe), there are two conspicuous islands exactly similar in structure to the granite kopjes which rise above the surface of the plain near the lake.

To the north of the Zomba mountains the Shirwa plain bends west and north, and in the latter direction, as Mr. Hetherwick showed some time ago, the surface of the lake is little more than 50 feet below the

top of the watershed, which slopes down the course of the Lugenda river to the east coast. Westward the plain extends round the mountains north of Zomba, and is in reality only separated by a very slightly elevated tract of forest from the wide extent of marsh which skirts the eastern shore of Lake Pamalombe.

Like Shirwa, Pamalombe forms the umbilicus of another great plain, which is bounded on the east by the western face of the Shire highlands, and on the west by the Kirk range and its northern extensions, while it is shut in and terminated towards the south by an elevated ridge, through a gap in which the Shire river finds its way to the lower plains, down the Murchison cataracts. To the north, this plain is really continuous with the great alluvial flat surrounding the southern shores of Lake Nyasa. Thus it will be seen that beyond the southern extremity of Nyasa there exists to-day a series of great alluvial flats which are approximately of the same height, and throughout their entire extent these flats show abundant evidence of having been covered at one time, or a succession of times, with water. There are many places in which the dry mud and sandy clay which form the soil contain the remains of Melanias and Viviparas now living in Shirwa and Nyasa.

Unfortunately, I was not able to make observations on the plain between Lakes Shirwa and Pamalombe, and consequently am ignorant of its height, but if it is not higher than the top of the watershed north of Shirwa, an elevation in the water of Nyasa sufficient to cover this tract would not only connect Shirwa with Nyasa, but would cover a great part of the Mlanje plain, and the whole of the flats east and west of Pamalombe, as well as those about Fort Johnston south of Lake Nyasa. It would, in fact, extend Nyasa enormously to the south; but such an extension is now impossible, owing to the level of the outlet of the Shire river at the Murchison falls being what it is. This outlet, however, is lower than it was once, owing to the erosion and cutting down of the river-bed by the rains. I shall return to this again.

The depression in which Nyasa lies is divided towards the south into two great arms, one of which to the east is, as I have said, geographically continuous with the Mlanji, Shirwa, and Pamalombe plains; while the other terminates more abruptly in the mountains near Manganga's. The lofty neck which separates these two branches of the lake is a rugged continuation of the branch of the Kirk range which faces Pamalombe to the west, and is terminated to the north in the wild mountain headland above the site of the old Livingstonia Mission. Like the high mountain masses which flank the lake east and west, this tongue is composed almost entirely of granite and granitoid rocks, and the lake lies thus, towards its southern extremity, in a series of deep valleys (see Fig. 1), similar in all geological aspects to those encountered in the Shire highlands. There is nothing suggestive of great faults or the formation of rift-valleys, and what is true of the

southern moiety of the lake is also true of the middle and as far as the commencement of the upper third of the lake's extent.

From Rifu, where the two southern arms unite, the mountain ranges which flank the lake east and west gradually increase in height and grandeur until they produce the sublime scenery about Nkata bay. Beyond this, however, there is a sudden change. Voyaging up the lake as I did along the west coast, one becomes aware of a mountain mass projecting beyond the general coast-line, the contour of which is totally

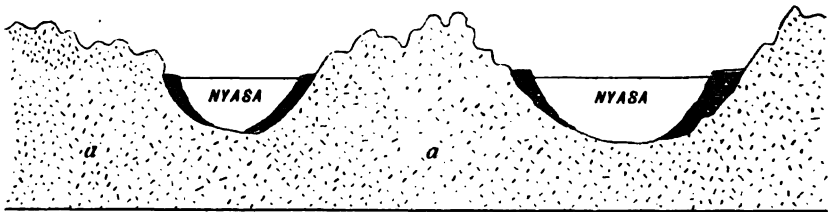


FIG. 1.—SECTION THROUGH THE TWO SOUTHERN ARMS OF NYASA: *a, a*, GRANITE AND GNEISS.

unlike that of any previously seen. Here, instead of the jagged profile or massive form of the gneiss and granite mountains, one sees the terraced outline of a lofty stratified scarp, which, on approaching nearer, is seen to be part of a V-shaped mass of stratified rock, sandwiched in between the gneiss and granite ranges on either side. The top of this mass forms the summit of Mount Waller, the surface of which is approximately flat; but the whole of the strata has a slight dip to

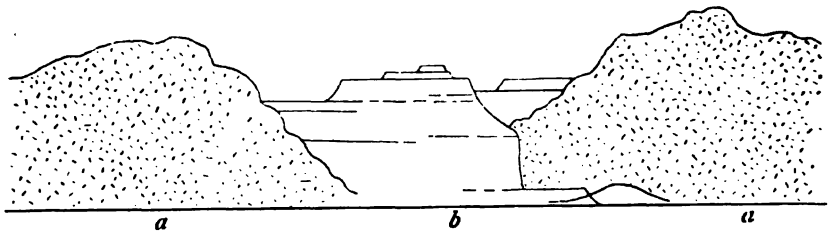


FIG. 2.—THE COAST ROUND MOUNT WALLER: *a, a*, GNEISS MOUNTAINS TO THE NORTH AND SOUTH OF THE STRATIFIED MASS OF MOUNT WALLER, SANDSTONES, ETC., IN BETWEEN (*b*).

the west, so that the crest of the scarp is higher than the plain behind it.

On the north and south this mass is bounded by the gneiss and granite mountains, and the stratified material rests in what appears to be its original position between the hills (Fig. 2). The most characteristic feature which this succession of scarps present to a spectator on the lake is a series of massive red sandstone cliffs. These rest upon a conglomerate base, and this in turn is supported upon a mass of granitoid material

and gneiss. The red sandstone, which is about 800 feet thick, is covered by a series of fine yellow sandstones, and is finally topped by a species of shale, and this is probably related to the displaced coal (which has already been described by Stewart *) from a deep gorge in the south. The exposed faces of red sandstone are much contorted in places, especially towards the north, giving one the impression that this twisting has been produced by the upthrusting of the igneous material upon which they rest. The granitoid base upon which the whole series rests is visible in places just above the present water-level of the lake. Here the great stratified cliffs rise to a height 2500 feet above the water's edge, and their northern extension stands equally perpendicular above a low neck of land which stretches out into the lake to the north. This neck is also composed of stratified material, but the surface rocks themselves are here similar to the yellow sandstones and shales of the top crest of the scarp of Mount Waller. Thus we have here, not only the existence for the first time in the Nyasa region of what are clearly aqueous deposits, but also the existence of a gigantic fault producing the series of imposing sandstone cliffs which in this place face the lake to the east. On ascending Mount Waller in company with Lieut. Rhodes, we saw that the stratified mass lying between the higher igneous ranges extended far inland from the lake-shores, seeming, indeed, to pass completely through the bold coast ranges which fringe the lake, and I subsequently came to the same conclusion when viewing this region from a point on the great Nyika plateau 7700 feet above the level of the sea, and between 20 and 30 miles to the north.

Now, on crossing the lake and looking to the east towards Amelia bay, on the opposite coast, it is curious to find the same set of features again repeating themselves—the same stratified masses lying between granitoid ranges, the same faults and scarps; but this time they look the other way. Thus one encounters at this point on Nyasa, for the first time, all the appearance of a double succession of scarps and intervening lower land, or rather lake bottom, characteristic of the so-called rift-valleys further north.

To the north of Mount Waller, the superficial strata on the neck of land which projects out into the lake have the same tilt as the top of Mount Waller, and are composed, as I have said, of the same material as the upper portion of the Mount Waller scarps; and on this neck there are, as Mr. Swann pointed out to me, above the lowly forest near the lake, some conspicuous white hillocks. These stand some distance back from the lake-shore, and have been freely denuded by rain, etc., into cliffy faces which look in all directions. The white material of which they are composed is a species of limestone, and the strata have the same dip to

* *Proceedings Geo. Soc.*, vol. iii. No. 5, p. 264. See also Drummond's description, 'Tropical Africa,' p. 187.

the west as the yellow sandstones and shales on which they stand. These beds contain fossilized remains of the shells of the molluscs now living in Nyasa, and as their flat tops are some 80 to 100 feet above the water-level, it is pretty clear that they must have been carried upward through the operation of the same great up-push which raised Mount Waller and the adjacent country to its present height. There is every indication here that the formation of the rift has been produced by a crumpling and consequent upthrust of the igneous base (which carries the stratified material) along two parallel lines, one of these being coincident with the hills behind Bandawe and Deep bay, and the other being really a continuation of the great Livingstone range on the other side of the lake. It is, moreover, clear that this elevation must have gone on long after Lake Nyasa had become a lake, as it has thrust up also what were once portions of its deep floor, so that they are now exposed along the flanks of this elevated country as the white masses I have just described; and, lastly, as these beds contain the remains of molluscs identical with those now living in the lake, it is obvious that the faulting which produced Mount Waller must have occurred at what is, geologically speaking, no very remote period of time.

This brings us to a question which was always before me while journeying round Nyasa, as to whether these changes of level of the coasts are still going on, for one of the most marked features of the shores all round the lake are the widely different levels at which the water has stood at different times. The above examples of colossal earth-movements in comparatively recent geological periods lead naturally to the questions, first, whether the apparent changes in the water-level have been, or are in any way connected with such movements; and, lastly, whether such changes in the relative heights of the country are still in progress. It was not, however, until I reached Karonga, some 40 miles north of Deep bay, that I discovered indisputable evidence of localized change of level in the coast-line of the lake. The flat sandy beach of this part of the lake is continued as a great marshy plain, which extends for many miles north, and which has at some time been covered by an extension of the lake itself. This extension of the lake must have reached to, or near, the semi-circle of hills which bound the plain on the east, west, and north. Now there are, in almost every part of Nyasa, evidences of at least three successive beaches. The first of these is 4 or 5 feet above the present wet-season water-level; the next some 10 or 12 feet above this, forming a beach which is almost always covered by enormous baobab trees. For the sake of clearness, therefore, I shall speak of this as the baobab beach. Lastly, there are in some places distinct traces of a third shore 30 or 40 feet above the baobab beach. On the sandy flat at the north end of the lake, the baobab beach is naturally not so easy to trace, as the sand and dust of which the plain is

composed has been blown into the low places and partially fills them up, together with the rank tropical vegetation which springs up on such plains whenever there is sufficient moisture for it to live. But there are here in some places traces of the baobab beach having existed 400 or 500 yards back from the present lake-shore.

About half a mile east of Karonga, where the Kambwi river enters the lake, there are some low sand bluffs forming soft cliffs about 10 feet high; and at one point, where they are most conspicuous, I found the sand to be underlain by a mass of clayey material, which contains the remains of an old plain covered by forest trees, the fragmentary remains of which are now quite blackened, and buried in this clay. The clay dips east and west, and, after a couple of hundred feet, is lost at both ends below the water-level of the lake. Thus we have here a forest which must have existed not only before the baobab beach some 20 to 25 feet above it, but before the much higher third water-level. Either, therefore, this forest must have been lowered before these two beaches were formed, or Nyasa must once have stood a great deal lower than it does even at the present day. There is, however, direct evidence of *local* change of level near this place, which is going on at the present time. Not more than 2 miles west of the clay, Dr. Cross took me to a spot where are to be seen, about 50 feet out in the water of the lake, some trees standing in their original positions, the trunks of which are now covered to the height of 5 or 6 feet; and these trees, the natives assured us, were alive and accessible not many seasons back, although the water of Nyasa has been persistently lower on the whole for several successive years. We have, therefore, evidence of two kinds relating to the level of Nyasa—one afforded by old beaches, which are a general feature of the lake, and the other by the existence of elevations and depressions of localized areas. The latter phenomenon exhibits the action of forces which have produced gigantic effects in the past, and which are seen, by the existence of the raised limestone beds near Mount Waller, to have been operating long after Nyasa had become a lake; and they are still in operation near Karonga at the present day. Thus it would appear that the great granitoid mountain cores which form the lateral walls of the Nyasa valley have been accentuated, if not produced, by the same superficial crumpling and upthrust which is apparent in so many parts of the Earth, and that this localized elevation, where stratified material stretches from ridge to ridge, has given rise to the gigantic faults seen about Mount Waller. Further, owing to the parallel nature of this ridging, parallel faults have been produced on opposite sides of the lake, whereby the sandstone beds, resting almost in their original positions on the igneous cores behind them, have been thrust up into the air, and stand now as conspicuous scarps facing one another on opposite sides. I have laid stress on the apparent manner

of formation of this particular strip of rift-valley, because it is not quite the same as that ascribed by Gregory and others to the numerous structures of the same kind further north. There is no evidence, then, zoological, geological, or otherwise, to show that Nyasa is at all of ancient origin; but it is older than the faults among the sandstone beds along its shores, and this is a point of some considerable interest, to which, when speaking of the relation of Nyasa to Tanganyika, I shall immediately return.

It has already been ascertained that the extreme north of Nyasa is bounded by a number of recent though extinct volcanic cones, the former activity of which has produced the floating pumice stone often found about the northern shores of the lake. According to Joseph Thomson's* geological sketch-map, the country which this volcanic material covers is shown as extending far down the Livingstone range to the south. This is not strictly accurate. The

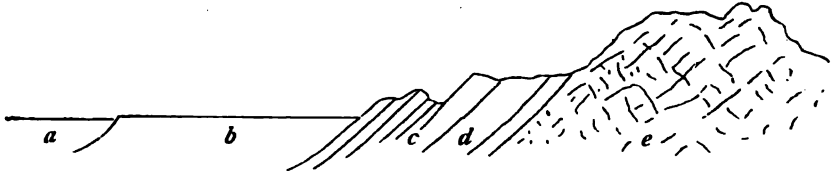


FIG. 3.—SECTION OF COUNTRY FROM KARONGA TO TOP OF PLATEAU, NORTH-WEST: a, LAKE; b, ALLUVIUM OF LAKE-SHORES; c, TRIASSIC BEDS; d, SANDSTONES AND CONGLOMERATES; e, GRANITE AND GNEISS.

volcanic material extends in reality but a little way beyond the extreme north of the lake, and most, if not all, of the western counter slopes of the Livingstone range show a structure of mixed granitoid and gneiss rocks, similar to those of the country further south.

On leaving Karonga, *en route* for Tanganyika, one passes first over the long alluvial plain which skirts the lake, and then up over some forest-clad hills, which form the outer rampart of the great interior plateau; and it is on these lower spurs of the higher mountains beyond that the Triassic beds described by the late Mr. Henry Drummond † occur. This stratified material lies on the flanks of the higher mountains, in a series of beds with a high dip to the south-east towards the lake, and one consequently passes over their denuded extremities in reversed order, the upper being traversed first (see Fig. 3). These beds, however, are not placed directly on the granitic cores which rise clear of all stratified material further inland, but rest on a great thickness of upturned sandstone (Fig. 3), similar in all respects to the massive beds in the Mount Waller series. These red and yellow sandstones and conglomerates are continued up to the top of the plateau to the height of about 4500 to 5000 feet; but they are here seen to be broken through in all

* 'To the Central African Lakes and Back.' 1881. † 'Tropical Africa.' 1888.

directions, by masses of granitic material, which rise in places to the height of fully 7000 feet. These gneiss and granite masses spread out from one another at this point of entry to the plateau into two lofty ranges, one being continued in a north and the other in a south-westerly direction. The entire space between them is filled by an elevated flat of immense extent, covered with forest, and sloping slightly away to the west. This plain carries the Chambezi river, the headwaters of the Congo, and, as far as I could ascertain, is everywhere composed of the sandstones and conglomerates described above. The average height of this plain is about 4500 feet, and it will be remembered that this is about the height to which the flat top of the Mount Waller district reached in the neighbourhood of Deep bay. The plain is certainly extended to an immense distance west and south, and it is in the highest degree probable that the neck of elevated sandstone formation which crosses the granitic ranges in the locality of Deep bay is continuous with this plain, round the so-called Nyika region, to the west, the lofty northern boundary of which is visible as the Konde mountains from the point I have now reached. If this is so—and I have very little doubt of it myself—it will be seen that the great elevated sandstone plain is really continued through the Mount Waller neck, across the bottom of Lake Nyasa to Amelia bay, and there may be in connection with the similar formations which are known to exist further east towards the coast. Now, this sandstone plain is unbroken in its continuity westward to Tanganyika, but a succession of rugged gneiss and granite mountains break through it in a north-easterly direction all the way. On the other side, that is, on the east of this range, the sandstone formations are again encountered, and Mr. Bell informed me that a few miles east of Fife he saw lofty sandstone escarpments, which suggest a reappearance of the rift about Mount Waller to the north of Lake Nyasa. In fact, travelling from Karonga on Nyasa in the direction of Lake Tanganyika, one is nearly always on the western face of a more or less broken-up range of hills, which gradually pass off the track to the east on nearing the country round the southern end of Tanganyika. While on these hills, which are a continuation of the gneiss and granite cores extending north-west from the Karonga plains, every point of vantage which renders a view to the west over the interminable forests possible, discloses the existence of an equally interminable series of western plains which form the great Awemba country. These plains slope everywhere slightly to the west, and their lowest parts in that direction are filled by the vast swamps and open water of Lake Bangweolo. Beyond this lake the plains are terminated by a broken mountainous country, continuous with the hills flanking the shores of Lake Mweru, and about the nature and structure of which little or nothing is known. This description of the country lying along and west of the route from

Karonga to the south end of Tanganyika will be seen to differ markedly from that given by Joseph Thomson in his journey over what might appear at first sight the same track; but this disagreement arises, in part at least, from Thomson's route having been along the top, if not on the eastern counter-slope, of the broken mountain ranges running north-west, which I have just described. He therefore missed the sandstone plains to the west through the greater part of his route, but I am at a loss to understand how he can have come to the conclusion that schists, gneiss, and clay slates extended over the country north of Mambwe, since passing from this point I found no such formation, but passed almost immediately from granite and gneiss to the typical sandstone plains.

On leaving the mountains to the east at Mpanda, and passing north-west towards Tanganyika, the country is *still* composed of sandstone and conglomerates, but here they are much broken and thrown up and down into a rough forest country, the details of which it is exceedingly difficult to understand. These irregularities soon give place, after passing Fwambo's village, to regular faulting, which extends north-west in the same general direction as the axis of Lake Tanganyika itself, and these faults in the high country are in reality the continuation or tailing out of the great Tanganyika series. Still keeping on the elevated plain, but approaching Tanganyika from the south-west corner above the little village of Mbete, the elevated crests of the great northern range are still occasionally visible further and further away to the north-east, until they seem to terminate that way in a solitary mountain peak. The southern arm of Tanganyika, which lies between these hills and the foot of the plateau at Mbete, is not, however, visible until one stands on the crests of the great sandstone cliffs which rise 2000 feet above its western shore. The sublime views from this and similar points along the western escarpments of the lake can be imagined from the colossal magnitude of the physical features which compose the country around, but they are not repeated on the eastern shore. There the country rises gradually from the water's edge, the shore being covered with the broken fragments of the underlying sandstones, which have here the characters of the upper layers along the western cliffs. The eastern slopes are covered with the usual forest, and rise gradually towards that continuation of the north-west range which I have described. In fact, throughout the whole of the southern portion of the lake the country to the east of it appears, so to speak, to be piled upon this range.

Northwards the lake widens out on its western side, into the great gulf known as Cameron bay, and this gap is in reality caused by one of a series of faults the long axes of which lie at right angles to the axis of the lake as a whole. There is evidence of considerable outpouring of lava at Sumbu, the western extremity of this gulf, and a little to the

south, along the lower course of the Lofu river, there is the best example of a rift-valley which I have seen. This valley is simply the exact inverse of what is known as a block mountain, and consists of an oval mass of land, some 35 miles long and 8 to 10 miles broad, which has bodily sunk, so as to leave an enclosing fringe of lofty sandstone cliffs all round. North of this district my observations differ from those of Thomson in a marked degree. In Thomson's geological map the whole of the point marked Kassava in mine is indicated as composed of felspathic rocks. I have travelled over this region twice by land, and been round its shores several times by water, and I can affirm that it is certainly composed, apparently entirely, of the sandstones and conglomerates which compose the adjacent hills. Further, the tract of country covered by the route from Kassava point to Sumbu is also included by Thomson as being within his felspathic area; but I have examples of rocks gathered in this very place, which are indistinguishable from the sandstones and conglomerates in the cliffs above Mbete. There is a species of ironstone here which is not found at Mbete, but otherwise the series appear to be identical. Further, the point of land between Sumbu and Teleka's village is also composed of the sandstone series; and, again, the great cliffs on the northern shore of Cameron bay as far as Pamelo's repeat the same story. Thomson must therefore have fallen into some error over this, or have confused these districts with something which he observed further north. Anyway, it is quite clear that the southern part of what he calls the felspathic area is not at the place where he supposed it to be. The map of this author also represents that part of the east coast of Tanganyika which lies between the Kilambo and Kawa (?) rivers as being composed of gneiss and slate. The shores of this region, however, appear to be composed of sandstones of different varieties, comparable to the upper series of the western coast. The reason of this difference, however, is not so difficult to see, because Thomson left the coast at this point, and journeyed inland and up, thereby coming upon the geological formations characteristic of the mountains inland from the coast; continuing inland, he seems to have come across metamorphic rocks beyond the Kawa (?) river, and to have jumped to the conclusion that these were also present on the lake-coast. This, however, does not appear to be the case, metamorphic rocks not being encountered for many miles north of this point along the shore.

Thus it will be seen that the southern half of Tanganyika lies at the bottom of a succession of great faults in a series of massive sandstones and conglomerates, which seem to extend in unbroken continuity through the great elevated plain of the Awemba country, as far as Nyasa and Angoni land to the south. These massive stratified formations extend thus over a vast area of the African interior; they extend east as well as west along Nyasa, and are

connected together across the Nyasa valley, first by the narrow neck in the region of Mount Waller, and, secondly, beyond the lake to the north. The whole of the high interior plateau, which extends in unbroken continuity far up the coasts of Tanganyika, and is encountered again round the southern shores of Lake Rukwa to the east, stands nearly everywhere about the same average height above the sea. Thus the top of Mount Waller is about 4000 feet; the great sandstone plain west of Mweinwanda's is the same. Lake Bangweolo, which fills the southern portion of this plain, and which is not more than 10 or 12 feet deep, stands between 3000 and 4000 feet. The great plains west of Tanganyika fall to the west from 4500 to 3500 feet. But this vast area of sandstone is pierced in all directions by high upstanding masses of gneiss and granite rocks, which rise as mountain chains above the general level of the sandstone plains, like islands above an ancient sea, and as the sandstone formations rest approximately in their natural positions upon these upthrust igneous rocks, it is by no means impossible that this is what they really are.

Unlike Nyasa, Tanganyika lies wholly in a series of valleys formed by faults running north and south along the interior plateau, and it is obvious that this lake may be as old, but it cannot be older, than the date of formation of the valleys at the bottom of which it now exists. Nyasa, on the other hand, was evidently in existence as a lake (as is evidenced by the limestone beds near Deep bay, which I have described) at a time when similar faulting was going on. But as the fossils in the beds about its shores are similar to the animals now living in the lake, it is obvious that the time of their upheaval cannot have been, geologically speaking, very long ago. There is no geological evidence, that I am aware of, from which any notion of the date of the formation of the Tanganyika faults can be formed, but, according to Gregory, similar rifting has been of comparatively recent date further north. The geological evidence concerning the date of origin of these lakes and their ages relative to each other, therefore, cannot be pushed to any definite conclusion; but there is, on the whole, a certain amount of evidence that Nyasa, as a lake, is the older of the two! I would draw attention to this point, because it has a most important bearing on the zoological problems with which I have been primarily concerned.

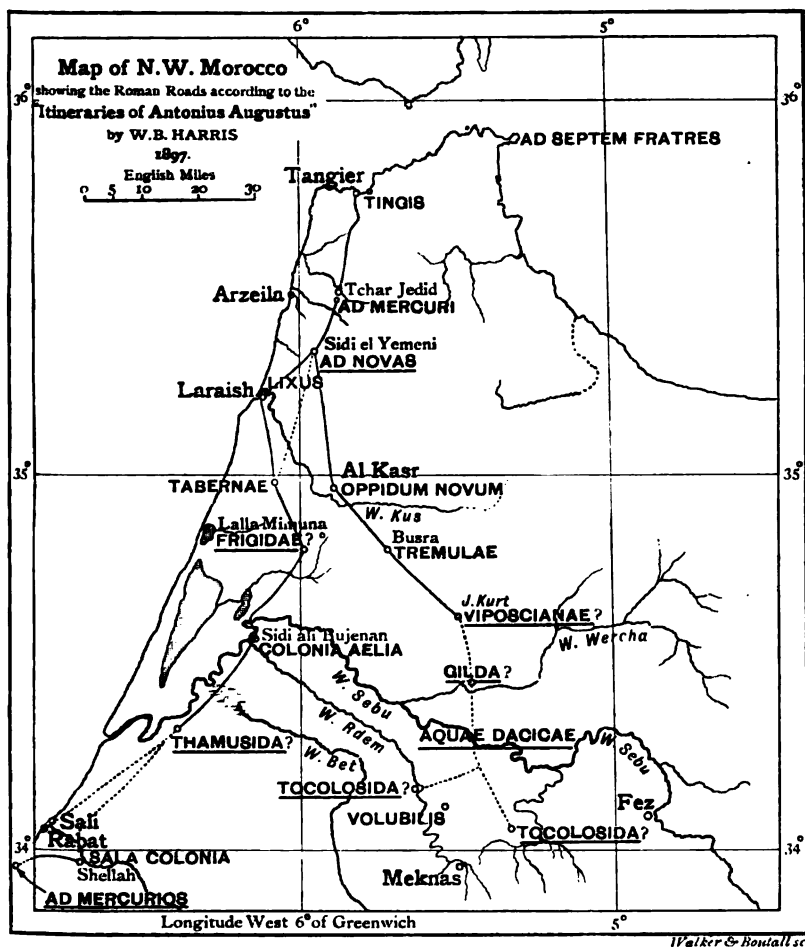
THE ROMAN ROADS OF MOROCCO.

By WALTER B. HARRIS.

THE "road-book," or "Itineraries," of Antoninus Augustus have left us sufficient information to gather some tolerably correct idea of the positions of the towns, etc., that existed at stated intervals along the two main Roman roads of Northern Morocco, for it must be remembered that there

is no evidence to prove that the Romans ever penetrated much to the south of the site of the present city of Meknas (Mequinez).

In the accompanying map the writer shows, as far as present information goes, the sites of the towns and the direction of the roads. Some of the spots were identified by M. Tissot, and the explorations at Volubilis by M. de la Martinière have thrown considerable light upon



the question. In spite of more than one journey to attempt to discover some trace of the sites marked as doubtful upon the accompanying map, the writer has failed to find any satisfactory remains of Roman ruins at or near the spots where one would naturally look for them.

Frigidas seems to have been a collection of small towns or villages, of which ruins still exist. When in 1896 the writer was travelling in this district, he found natives busily engaged in excavating what certainly

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must have been Roman pipes, some 5 inches in diameter, which apparently carried water from a spring on the hillside to a town or village in the plain. It is not impossible that this very water gave the name to the settlement (Frigidæ). Tissot mentions that the spot is still called "Ma Berd" ("cold water"), but the spring to which is applied this name—a very common one in Morocco—is some miles distant, and as "Ma Berd" is constantly cropping up all over North Morocco, it is more than probable that it is only a coincidence, and not that the Latin name still exists to-day in Arabic.

The exact site of *Tocolosida* is unknown. The writer has found two series of ruins either of which might have formed the settlement of that name. Like Volubilis (Kasr Faraun), they are both situated near the district of Zarhun. The one group of remains, the foundations of many buildings of well-squared stone, lies on the right bank of the Wad Rdem, where that river forms the boundaries between the existing tribelands of Geruan and Zarhun. The second possible site is on the summit of one of the Zarhun hills, at the eastern extremity of the mountains of that name, where are to be found the complete walls and gates of a large town, though the workmanship appears to be of later date than the time of Antoninus Augustus. The best mode to reach the ruins is by a sheep-track from the Zauia of Sidi Abdullah ben Aziz, from which they are distant some half an hour's steep climb.

If this latter should be the site of *Tocolosida*, then there is little reason to doubt that *Aquæ Dacicæ* was near one of the many sulphur springs existing on the slopes and in the valleys beneath Jibel Silfet.

M. Tissot places *Viposcianæ* near the present Sôk Jibel Kurt, where there are the remains of some walls standing, and, accepting this theory (not only from the ruins, but also because even to-day the spot lies on one of the best routes in the country for fording the various rivers), *Gilda* should be looked for on the banks of the Wergha, the largest tributary of the Sebu, some 12 or 15 miles above the confluence of the two rivers. Here again the writer failed to discover any signs of ruins. If, however, the former of the two sites of *Tocolosida* is the right one (on the Wad Rdem, a few miles south of Sidi Cassim), then the road must make a more easterly *détour* thence, if *Aquæ Dacicæ* is on Silfet.

Tremulæ is without doubt Busra. Before the writer ever saw the "Itineraries," or heard the name of the Roman stations, he was taken to Busra by the natives to hear a curious underground rumbling sound, as if of a subterranean river. He certainly failed to hear it, but the inhabitants of the neighbouring villages all hear it from time to time, though they asserted that it was not only apparent in the rainy seasons, but came at regular periods. This may well be doubted. It seems much more probable that there exists some subterranean cavern in the

hills near by, which at times finds an outlet for its overflow of water by an underground channel, or possibly a Roman aqueduct.

The other sites are all tolerably certainly identified, and in most of them various degrees of ruins can be seen, though nowhere much more than the remains of buttressed walls, and often only traces of foundations.

RECENT RESEARCHES ON CLIMATE.

By H. N. DICKSON.

THERE has been, within the past few years, a marked tendency to change in the methods of investigation most in favour amongst meteorologists. The fatal blow dealt by Hann to Ferrel's theory of cyclones induced a certain amount of reaction against strictly mathematical methods, and it was not until the general recognition of von Bezold's striking series of papers on the true behaviour of air and vapour in the atmosphere that a fresh start was made, and a new line taken in dealing with the vast masses of observational data continually accumulating. It has become apparent that, however valuable from a purely scientific point of view a rigorous investigation of atmospheric movements may be, the endless irregularities in the distribution of land and sea, in the composition, exposure, and covering of the land surfaces, and in the thermal arrangements at and below the sea surfaces, give rise to abnormalities of such magnitude as to deprive purely mathematical results of much of their practical value. Again, as in space distribution so in time variation, the long-period average, while it rids us of temporary aberrations, also in many cases deceives us as to the real march of events, and we confound frequency with efficiency in comparing effects with what we suppose to be their cause. Finally, we must avoid the other extreme, and not limit ourselves to instants of time and points of space; the eddies and ripples on the atmospheric streams move slowly enough for us to watch their motion, but they are still of the nature of eddies and ripples, and as such must always be uncertain and indefinite; in other words, we cannot look for very much more help than we have already got from the synoptic weather chart.

The most hopeful line of inquiry, one to which a daily increasing number of meteorologists are directing their attention, may be briefly described as consisting of a closer study of the great atmospheric areas of cyclonic and anticyclonic circulation, and of the transitional regions lying between them. We have, for example, such systems as the Atlantic anticyclone, the great Eurasian system extending from Germany to China, and the so-called Greenland depression: the

monumental labours of Buchan and Hann have clearly defined the average limits and intensities of these systems at different seasons in so far as this is possible by mean isobaric lines, but we as yet know little in detail as to the changes of relations taking place amongst them from one month to another in any single year, and less as to the causes which produce these changes. It seems more and more evident, however, that a study of the successive variations occurring within these immense, and, be it added, somewhat sluggish systems, and on the surfaces upon which they lie, will tell us enough about them to allow of their variations being predicted, and such prediction, although it would not help in detailed short-period forecasting for small districts, would afford a method of general long-period forecasting which might prove of the greatest economic value.

In this connection, it may be worth while once more to point out the immense simplification which might be introduced in the elementary parts of physiographical teaching by the popular recognition of these great atmospheric systems. The prevailing winds and ocean currents are a formidable tax on the student's memory when each, as still usually happens, has to be learned separately, but the natural grouping of trade winds, westerly variables, belts of calms, drift currents, etc., round these systems is at once simpler, more accurate, and more scientific.

It is difficult, without going further into mathematical technicalities than is admissible here, to give a satisfactory outline of the chief papers to which we owe the great promise of progress. The preliminary papers of Dr. W. Zenker, of Berlin, have been noticed in the *Journal* from time to time, and his methods and results are amplified and extended in the exhaustive memoir on "Der thermische Aufbau der Klimate aus den Wärmewirkungen der Sonnenstrahlung und des Erdinnern,"* recently published. The first part of this memoir is devoted to a development of methods, and attempts to account for the estimated quantities of heat received from the sun at different parts of the Earth's surface (i.e. in different latitudes) at different seasons. The "condition of continuity" being that as much heat is given off as is received, since the atmosphere does not become permanently hotter or colder, a careful examination is made of the heat-changes taking place under typical "oceanic" and "continental" conditions. The purely oceanic conditions are the most difficult to realize, since the isothermals drawn over the oceans are still to some extent hypothetical, but such a station as Yakutsk is almost wholly free from any but continental influences. One of the most interesting comparative results is that in a typical continental climate the sun-effect shows itself completely on the temperature of the atmosphere after an interval of

* 'Nova Acta Academiæ Cæsareæ Leopoldino-Carolinæ Germanicæ Naturæ Curiosorum,' tomus lxxvii.

twenty-four days, while in a typical oceanic climate the interval is thirty-nine days, *e.g.* the maximum air temperature occurs twenty-four and thirty-nine days respectively after the sun reaches its highest point. This result may be taken as an example of several elements which lead in various ways to a quantitative estimation of the relation between continental and oceanic influences in the climate of any given region. The second part of Dr. Zenker's memoir consists of an application of his methods to the great climatic regions of the globe, and it offers many interesting opportunities of tracing the extension of land influences over the oceans and of ocean influences over the land. The weak point in the investigation, which as a whole must be accepted as an important contribution to knowledge, is the weight necessarily given to estimations of the humidity of the atmosphere. The observations of this factor, especially at sea, are still lamentably defective, and none of the instruments at present available seem to give really trustworthy results. The cloud observations which find a place in Dr. Zenker's work are also open to a good deal of criticism.

Working on somewhat similar lines, but by different methods, Dr. H. H. Hildebrandsson, director of the Meteorological Observatory at Upsala, has recently communicated to the Swedish Academy of Sciences a memoir on "Centres of Atmospheric Activity." A discussion of the variations of pressure in the great atmospheric systems discloses the existence of certain oscillatory movements, which, when we know more about them, may afford a direct path towards forecasting in the mode we have already hinted at.

The work of Prof. Pettersson, of Stockholm, in the same direction has already been noticed in the *Journal*. It stands, as it were, intermediate between the investigations of Zenker and Hildebrandsson, and brings into strong relief the importance for all climatological investigations of a further study of the surface changes taking place at sea. When we clearly understand the precise physical relations existing between the surface waters of the ocean and the air resting upon them, it seems likely that the logs of a few liners will supply all the information required to frame a forecast of a cold or wet winter, a hot or cloudy summer.

Turning to recent accessions in the way of observational material, one of the most important is the series of current charts of the North Atlantic recently issued by the Meteorological Office. These confirm, amongst other things, the evidence obtained by other methods as to the feebleness and irregularity of the drift currents in the North Atlantic, formerly ascribed to the influence of the "Gulf Stream." In connection with the meteorology of this region, we may mention a paper of interest read before the Royal Meteorological Society on the rainfall of Dominica, by Mr. C. V. Bellamy, the map showing very prettily the effect of a land elevation lying across the path of a steady wind from seaward.

The collection of sunshine records progresses steadily, although there is still much uncertainty about the merits of various forms of sunshine recorders. Probably, the observations of sunshine are still more complete in the British Isles than in any other country, but Herr Helmuth König, of Hamburg, has found sufficient material for a first attempt to draw 'isohelic' lines for Western Europe. The present writer attained some measure of success in drawing such lines for the British Isles from the ten years' observations published by the Meteorological Office, but, until a more uniform system of recording is generally adopted, it seems hardly worth while to subject the data to rigorous discussion. Herr König's sunshine map is nevertheless extremely suggestive in many ways. An interesting addition to sunshine statistics appeared in *Symon's Meteorological Magazine* for March last, in the shape of three years' records for Kimberley, South Africa. The average recorded during 1894-95-96 was 3260 hours, being, according to Mr. W. Ellis, 74 per cent. of the possible.

A short paper recently issued as a supplement to Bulletin No. 10 of the *Société Khédiviale de Géographie* gives some new information about the climate of Alexandria, as compared with that of Cairo. Its author, Prof. Eugène Franceschi, might perhaps have done well to say less about Cairo and more about Alexandria, but he at least provides additional data for the discussion of the meteorology of the extremely interesting region which lies between Asia and Africa. The publications of the Meteorological Office referring to the Red Sea, and of the Palestine Exploration Fund, might now perhaps be combined with such papers in a more detailed examination of the complex transitional phases observed in this region during, for example, the months of September and October, than has hitherto been attempted.

Lastly, attention should be drawn to some studies of temperature changes, evaporation, and condensation on different species of land surfaces, notably an extremely able one by Herr P. A. Müller, "Ueber die Temperatur und Verdunstung der Schneeoberfläche und die Feuchtigkeit in Ihrer Nähe," published as a continuation of previous work, in the *Memoirs of the Imperial Academy of Sciences of St. Petersburg*. We have already touched upon the value of detailed study of the relations of water surfaces to the strata of air resting upon them, but the importance of similar work under the more variable land conditions cannot be over-estimated, and we commend the investigation of questions of exposure of different surfaces of soil and vegetation at varying slopes and in different directions to the attention of inquirers in this country, where as yet little or nothing has been done.

THE VOLCANOES OF THE BRITISH ISLANDS.*

THIS large and handsome book contains the personal work of the Director of the Geological Survey, extending over a great number of years. In the intervals of routine duties he has inspected practically all the volcanic rocks of the country, and made himself master of the extensive literature relating to them. Sir Archibald Geikie gives first an outline of volcanic phenomena in general, to serve as an introduction to the special descriptions of the rocks of different ages. He treats the subject from the geological point of view, but with constant reference to the effect of geological structure on geographical form. For the purpose of a study of volcanic phenomena, he shows that no better situation than the British Islands can be found, although the latest volcanoes have been extinct for millions of years, and their surface forms have vanished. This is due to the wide range of geological formations, their great distortion and erosion, which exhibit sections of volcanic rocks formed deep below the surface, and to the remarkably detailed geological mapping of the country. The situation of Great Britain on the transitional area between ocean and continent is also favourable for the manifestation of volcanic phenomena. These he proceeds to trace for each of the great geological periods, the Pre-Cambrian, Cambrian, Silurian, Old Red Sandstone, Carboniferous, Permian, and Tertiary. The remarkable fact is brought out, that while all the rock-systems of the Primary were laid down during periods of marked vulcanism—more particularly the Old Red Sandstone and Carboniferous—the whole Secondary period seems to have been free from any disturbance of the kind, while in Tertiary times the manifestations reappear on a larger scale than ever before.

The volcanic elements of British scenery are due almost always to denudation removing the softer strata and leaving the hard volcanic rocks projecting in bold forms. The rocks themselves are either cooled from a molten state (in a general sense lava or trap), or accumulations of volcanic ashes. The latter make up the greater part of the English lake district, and of such hill ranges as the Pentlands, Ochils, and Sidlaws. The cooled molten rock has either been poured out as lava on the sea-bed or on land surfaces, forming sheets or plateaux, like the great plateau isolated fragments of which appear in Antrim, the Hebrides, the Faëroes, and Iceland, or else as dykes injected through earlier rocks as intrusive sheets or sills, like the Great Whin Sill of the north of England, or the sills which form the line of Salisbury crags at Edinburgh and the terraces of Little Cumbrae island, or as bosses or laccolites which give rise to not a few modern hills, or finally as

* 'The Ancient Volcanoes of Great Britain.' By Sir Archibald Geikie, F.R.S. With seven maps and numerous illustrations. 2 vols. London: Macmillan & Co., Ltd. 1897.

“necks,” the solidified plug of lava which sealed some old vent, and now plays the rôle, it may be, of a castle site or the nucleus of a town.

The conclusions arrived at are summarized by the author, and we give a concise statement of them—

The region lies along the edge of the North Atlantic ocean, a typically volcanic tract, and the British volcanic rocks stretch over a district ranged from north to south, but only on the western side. East of a line drawn from Berwick by Leicester to Exeter, although there are abundant exposures of all rocks from the Carboniferous to the Pleistocene, there is no trace of volcanic action. Part of this tract in the west was recurrently the scene of volcanic action along the whole range of time, while other regions are conspicuously free from any trace of such effects. At all times the orifices of the volcanoes seem to have been opened along the lines of low valleys, and not on ridges. The volcanic effects are not results of mere local action, but are directly related to the great cosmical processes of the entire globe, and high volcanic activity seems to have been generally associated with a downward movement of the crust. In all geological ages volcanic effects have been similar, falling into a few general types, but the degree of intensity has varied, and at times all activity has ceased for long periods. The exposures in Great Britain allow the whole history of a volcanic period to be studied from beginning to end by means of the differing character of the erupted material, which varies in homogeneity and in chemical composition at different stages, *e.g.* the earlier eruptions of each period were more acid, the later more basic lavas, but in the interval between consecutive periods the magma had been restored to its earlier condition, from which it gradually varied as the period proceeded.

The book is effectively illustrated by reproductions of photographs of the author's sketches and diagrams, and by a series of admirable geological maps.

SOME GEOGRAPHICAL PROBLEMS.*

By J. SCOTT KELTIE, LL.D., Sec. R.G.S.

We meet this year in exceptional circumstances. Thirteen years ago the British Association met for the first time in a portion of the Empire beyond the limits of the British Islands. During these thirteen years much has happened of the greatest interest to geographers, and if I attempted to review the progress which has been made during these years—progress in the exploration of the globe, progress in geographical research, progress in geographical education—I could not hope to do it to any purpose in the short time during which it would be right for a president to monopolize the attention of the Section. But we have, at the same time, reached

* Presidential Address to Section E, at the Toronto Meeting of the British Association, August, 1897.

another stage in our history which naturally leads us to take stock of our progress in the past. We have all of us been celebrating the sixtieth year of the glorious reign of the Sovereign, of whose vast dominions Canada and the United Kingdom form integral parts. The progress made during that period in our own department of science has been immense; it would take volumes to tell what has been done for the exploration of the globe. The great continent of Africa has practically been discovered, for sixty years ago almost all but its rim was a blank. In 1837 enormous areas in North America were unexplored, and much of the interior of South America was unknown. In all parts of Asia vast additions have been made to our knowledge; the maps of the interior of that continent were, sixty years ago, of the most diagrammatic character. The Australian interior was nearly as great a blank as that of Africa; New Zealand had not even been annexed. Need I remind you of the great progress which has been made during the period both in the north and south polar areas, culminating in the magnificent achievement of Dr. Nansen? It was just sixty years ago that the great antarctic expedition under Sir James Ross was being organized; since that, alas! little or nothing has been done to follow up his work. Sixty years ago the science of oceanography, even the term, did not exist; it is the creation of the Victorian era, and may be said almost to have had its origin in the voyage of the *Challenger*, which added a new domain to our science and opened up inexhaustible fields of research. I have thought, then, that the most useful and most manageable thing to do on the present occasion will be to indicate briefly what, in my estimation, are some of the problems which geography has to attack in the future, only taking such glances at the past as will enable us to do this intelligibly.

It has been customary for the occupants of this chair to try to define the field of geography, and on occasions, in somewhat too apologetic language, to justify its existence as a section of a scientific association. I do not think this is any longer necessary. Even in England and America, during the last thirteen years, geography has done work enough to prove that she has a mission which no other department of research can fulfil. I say thirteen years, because that not only carries us back to the last Canadian meeting of the British Association, but to the year when the Royal Geographical Society undertook an inquiry into the position of geography at home and abroad, mainly with a view to the improvement of geographical education in England. During that time a good deal has been written as to the field and scope of geography, and a good many definitions given. But we really did not require to go to Germany to teach us as to the field and functions of geography. Sixty years ago, the then President of the Royal Geographical Society, Mr. William B. Hamilton, delivered the first presidential address ever given at that Society, and his conception of the field and aims of geography was as exalted and comprehensive as the most exacting German geographer could wish. It is too long to quote here.*

It would be difficult to improve upon Mr. Hamilton's definition, and it shows that a correct conception of the wide and important field of geography is no new thing in England. He proceeded to indicate what remained to be done in the field of exploration, and I commend his address to any one desirous of forming a conception of the vast progress that has been made since it was delivered, sixty years ago. Since I am dealing with definitions, I may be permitted to quote that given by one so severely scientific as General Sir B. Strachey in a course of lectures which he gave at the University of Cambridge in 1888, in connection with the establishment of a lectureship in Geography in that university. "The aim of geographical

* *Journal R.G.S.*, vol. viii. 1838.

science," he says, "is to investigate and delineate the various features of the Earth; to study the distribution of land and sea, the configuration and relief of the surface, position on the globe, and so forth, facts which determine the existing condition of various parts of the Earth, or which indicate former conditions; and to ascertain the relations that exist between these features and all that is observed on the Earth. . . . I claim for geography," Sir R. Strachey says, "a place among the natural sciences as supplying the needful medium through which to obtain a connected and consistent conception of the Earth and what is on it." He gives a list of the various matters which, in his conception, it is the business of geography to deal with, and they are varied and important enough to satisfy the demands of the most exacting. "These are," he says, "the studies through which scientific geography will lead you, teaching you to view the Earth in its entirety, bringing together the great variety of objects seen upon it, investigating their connection, and exploring their causes; and so combining and harmonizing the lessons of all the sciences which supply the key to the secrets of Nature." *

I think we may briefly define geography as the science of the topographical distribution of the great features of the Earth's surface and of all that it sustains—mineral, vegetable, and animal, including man himself. In fact, man is the ultimate term in the geographical problem, the final object of which is to investigate the correlation between humanity and its geographical environment.

I may be pardoned for dwelling at some length on the function and field of geography. It is a subject that has been occupying the attention of geographers in England for some years, and it may not be without interest to our colleagues on this side of the Atlantic to know the conclusions which we have come to. Moreover, it seems necessary to arrive at some clear conception on the matter, with a view to the researches of the future. I say that the subject has been occupying our attention in England for some time; it has done so, I may say, as a result of the inquiry by myself on behalf of the Royal Geographical Society to which I have referred. The object of that inquiry was mainly to collect information as to the position of geography in education at home and abroad. The report which I presented to the Society attracted some attention, and whether as a result of that or not it is hardly for me to say, but certainly since that inquiry some twelve years ago the position of geography in England has considerably improved both in education and as a field for research. Better methods have been introduced in our schools; a much wider scope has been given to the subject; in many quarters teachers have shown themselves anxious to be guided in the right direction; and, above all, both Oxford and Cambridge at length consented to the establishment of lectureships in geography. A school of young geographers has grown up, consisting of men who have had a thorough university training in science and letters, and who are devoting themselves to the various branches of geography as a speciality. In this way the arid old text-books and characterless maps are being supplanted by others that will bear comparison with the best productions of Germany. Photography and lantern slides illustrating special geographical features are coming into use in schools; and in other directions appliances for use in education are being multiplied and improved. A British geographical literature is growing up, and if, as I hope, the progress be maintained, we shall be able to hold our own in geography with any country. The interest in the subject has been extended by the foundation of geographical societies in various large centres; whereas thirteen years ago the only geographical society was that of London, there are now similar societies in

* 'Lectures on Geography delivered before the University of Cambridge.' London: 1888.

Manchester, Newcastle, Liverpool, and Edinburgh, the last with branches in Glasgow, Dundee, and Aberdeen. If this progressive movement is maintained, as there is every reason to hope it will be, the scientific and educational aspects of geography in Britain will be more nearly on a par with exploration in which our country has so long held the lead.

In the United States I found that the position of the subject in education was not much more satisfactory than it was in England. Since then there is reason to believe considerable progress has been made. One of the best text-books on physical geography, Hinman's 'Eclectic Physical Geography,' is of American origin; while in the States, as in England, a school of scientific geographers has arisen which bids fair to give the subject a high place in that country. I fear, from what I can learn, that the position in Canada is not as satisfactory as it ought to be. It seems to me, then, that one of the great problems which geographers have to face in the future, is the place which this subject is to hold in education—both as a body of information and as a discipline. We have been making progress, and if we persevere with intelligence and firmness, and maintain the subject at the highest standard as a field of research, there can be little doubt of our success.

There is a prevalent belief that geographers have nothing more to learn in Europe—that that old continent has been thoroughly explored. It is true that nearly every country in Europe has been, or is being, trigonometrically surveyed. Except some parts of the Balkan peninsula and North of Russia, the topography of the continent has been accurately mapped on scales and by methods sufficient, at least, for the purposes of the geographer. Yet there are districts in the Balkan peninsula—for example, Albania—which are as vaguely known as Central Africa. But it is a delusion to think that, because a country has been fully mapped, the occupation of the geographer is gone. It is only when a region at large is adequately mapped that the work of geographical research begins. The student, with a satisfactory map of a definite district as his guide, will find on the spot abundant occupation in working out its geographical details, the changes which have taken place in its topography, and the bearing of its varied features upon its history, its inhabitants, its industries. This kind of work has been in progress in Germany for over ten years, under the auspices of the Central Commission for the Scientific Geography (*Landeskunde*) of Germany, with its seat at Stuttgart. Under the collective title of '*Forschungen zur Deutschen Landes- und Volkskunde*,' a long series of monographs by specialists has been published, dealing in minute detail with one or more aspects of a limited district. Thus we have such memoirs as 'The Plain of the Upper Rhine and its Neighbouring Mountains,' by Dr. Richard Lepsius; 'The Towns of the North German Plain in relation to the Configuration of the Ground,' by Dr. Hahn; 'The Munich Basin: a Contribution to the Physical Geography of Southern Bavaria,' by C. Gruber; 'The Mecklenburg Ridges and their Relation to the Ice Age,' by Dr. E. Geinitz; 'The Influence of the Mountains on the Climate of Central Germany,' by B. Assmann; 'The Distribution and Origin of the Germans in Silesia,' by Dr. K. Weinhold; 'Mountain Structure and Surface Configuration of Saxon Switzerland,' by Dr. A. Hettner; 'The Erzgebirge: an Orometric-Anthropogeographical Study,' by Dr. J. Burgkhardt; 'The Thuringian Forest and its Surroundings,' by Dr. H. Pröscholdt, and so forth. There is thus an inexhaustible field for scientific geography in its most comprehensive sense—a series of problems which may take generations to work out. In a less systematic way we have similar monographs by French geographers. One or two attempts, mainly by teachers, have been made in England to do similar work, but the impression generally produced is that the authors have not

been well equipped for the task. I am glad to say that in England the Royal Geographical Society has initiated a movement for working out in a systematic fashion what one may call the regional geography of the British Islands, on the basis of the one-inch maps of the Ordnance Survey. It is a strange thing that the geography of the mother country has never yet been systematically worked out.

Taking the sheets of the Ordnance Survey map as a basis, it is proposed that each district should be thoroughly investigated, and a complete memoir of moderate dimensions systematically compiled to accompany the sheet, in the same way that each sheet of the Geological Survey map has its printed text. It is a stupendous undertaking that would involve many years' work, and the results of which when complete would fill many volumes. But it is worth doing; it would furnish the material for an exact and trustworthy account of the geography of Britain on any scale, and would be invaluable to the historian, as well as to others dealing with subjects having any relation to the past and present geography of the land. The librarian of the Society, Dr. H. R. Mill, has begun operations on a limited area in Sussex. When he has completed this initial memoir, it will be for the Society to decide whether it can continue the enterprise, or whether it will succeed in persuading the Government to take the matter up. I refer to work of this kind mainly to indicate what, in my conception, are some of the problems of the future which geography has to face, even in fully surveyed countries. Even were the enterprise referred to carried out, there would be room enough for special researches in particular districts.

But while there is an inexhaustible field in the future for geographical work in the direction I have indicated, there is no doubt that much still remains to be done in the way of exploring the unknown, or little known, regions of the globe. Let us briefly refer to the problems remaining to be solved in this direction. Turning to the continent of Asia, we find that immense progress has been made during the past sixty years. In the presidential address given sixty years ago, already referred to, Mr. Hamilton says of Asia, "We have only a very general knowledge of the geographical character of the Burman, Chinese, and Japan empires; the innumerable islands of the latter are still, except occasionally, inaccessible to European navigators. Geographers hardly venture on the most loose description of Tibet, Mongolia, or Chinese Tartary, Siam, and Cochin China." Since then the survey of India, one of the greatest enterprises undertaken by any state, has been completed, and is being rapidly extended over Burma. But I need not remind you in detail of the vast changes that have taken place in Asia during these years, and the immense additions that have been made to our knowledge of its geography. Exploring activity in Asia is not likely to cease, though it is not to be expected that its inhospitable centre will ever be so carefully mapped as have been the mountains of Switzerland.

The most important desiderata, so far as pioneer exploration in Asia is concerned, may be said to be confined to two regions.* In Southern and Central Arabia there are tracts which are entirely unexplored. It is probable that this unexplored region is in the main a sandy desert. At the same time it is, in the south at least, fringed by a border of mountains whose slopes are capable of rich cultivation, and whose summits the late Mr. Theodore Bent found, on his last and fatal journey, to be covered with snow. In exploration, as in other directions, it is the unexpected that happens; and if any traveller cared to face the difficulties—physical, political, and religious—which might be met with in Southern and Central Arabia, he might be able to tell the world a surprising story.

* For part of what follows with reference to Asia, I am indebted to a valuable memorandum on the subject drawn up by the late Mr. Ney Elias.

The other region in Asia where real pioneer work still remains to be done is Tibet and the mountainous districts bordering it on the north and east. Lines of exploration have in recent years been run across Tibet by Russian explorers like Przevalsky, by Rockhill, Prince Henry of Orleans and Bonvalot, by Bower, Little-dale, Wellby, and Malcolm. From the results obtained by these explorers we have formed a fair idea of this, the most extensive, the highest, and the most inhospitable plateau in the world. A few more lines run in well-selected directions would probably supply geography with nearly all she wants to learn about such a region, though more minute exploration would probably furnish interesting details as to its geological history.

The region lying to the north of the Himalayan range and to the south of the parallel of Lhasa is almost a blank on the map, and there is ample room here for the enterprising pioneer. The forbidden city of Lhasa is at present the goal of several adventurers, though as a matter of fact we cannot have much to learn in addition to what has been revealed in the interesting narrative of the native Indian traveller, Chandra Das. The magnificent mountain region on the north and east of Tibet furnishes a splendid field for the enterprising explorer. Mrs. Bishop recently approached it from the east, through Sze-chuen, and her description of the romantic scenery and the interesting non-Mongolian inhabitants leaves us with a strong desire to learn more. On the south-east of Tibet is the remarkable mountainous region, consisting of a series of lofty parallel chains, through which run the upper waters of the Yangtse, the Mekong, the Salwin, and the Irawady. This last-named river, recent exploration has shown, probably does not reach far into the range. But it will be seen by a glance at a map that the upper waters of the other rivers are carried far into the heart of the mountains. But these upper river courses are in great measure conjectural, and have given rise to much controversy. There is plenty of work here for the explorer, though the difficulties, physical and political, are great.

But besides these great unexplored regions, there are many blanks to be filled up in other parts of Asia, and regions which, though known in a general way, would well repay careful examination. There is the mountain tract between the upper Zarafshan river and the middle course of the Surkhab tributary of the Oxus, and the country lying between that and the Oxus. There is the great Takla-Makan desert in Chinese or Eastern Turkistan, part of which has recently been explored by Russian expeditions and by that young and indefatigable Swedish traveller, Dr. Sven Hedin. It is now one of the most forbidding deserts to be found anywhere, but it deserves careful examination, as there are evidences of its once having been inhabited, and that at no very remote period. It is almost surrounded by the Tarim, and on its eastern edge lies Lob-nor, the remarkable changes in which have been the subject of recent investigation. As readers of Dr. Nansen's 'Voyage of the Fram' will remember, the Siberian coast is most imperfectly mapped; of course, it is a difficult task, but it is one to which the Russian government ought to be equal. China has on paper the appearance of being fairly well mapped; but as a matter of fact our knowledge of its mountain ranges and of its great river courses is to a large extent extremely vague. All this awaits careful survey. In North-Eastern Manchuria and in many parts of Mongolia there are still blanks to be filled up and mountain and river systems to be surveyed. In the Malay peninsula and in the great array of islands in the east and south-east of Asia—Sumatra, Borneo, the Philippines—much work still remains to be done. Thus for the coming century there will be abundance of work for explorers in Asia, and plenty of material to occupy the attention of our geographical societies.

Coming to the map of Africa, we find the most marvellous transformation during the last sixty years, and mainly during the last forty years, dating from Livingstone's memorable journey across the continent. Though the north of Africa was the home of one of the oldest civilizations, and though on the shores of the Mediterranean, Phœnicians, Carthaginians, Greeks, and Romans were at work for centuries, it has only been within the memory of many of us that the centre of the continent, from the Sahara to the confines of Cape Colony, has ceased to be an unexplored blank. This blank has been filled up with bewildering rapidity. Great rivers and lakes and mountains have been laid down in their main features, and the whole continent, with a few unimportant exceptions, has been parcelled out among the Powers of Europe. But much still remains to be done ere we can form an adequate conception of what is in some respects the most interesting and the most intractable of the continents. Many curious problems still remain to be solved. The pioneer work of exploration has to a large extent been accomplished; lines have been run in all directions; the main features have been blocked out. But between these lines the broad meshes remain to be filled in, and to do this will require many years of careful exploration. However, there still remain one or two regions that afford scope for the adventurous pioneer.

To the south of Abyssinia and to the west and north-west of Lake Rudolf, on to the upper Nile, is a region of considerable extent, which is still practically unknown. Again, in the Western Sahara there is an extensive area, inhabited mainly by the intractable Tuaregs, into which no one has been able to penetrate, and of which our knowledge is extremely scanty. Even in the Central Sahara there are great areas which have not been traversed, while in the Libyan desert much remains to be done. These regions are of interest almost solely from the geographical and geological standpoints. But they deserve careful investigation, not only that we may ascertain their actual present condition, but in order, also, that we may try to discover some clues to the past history of this interesting continent. Still, it must be said that the great features of the continent have been so fully mapped during the last half-century that what is required now is mainly the filling-in of the details. This is a process that requires many hands and special qualifications. All over the continent there are regions which will repay special investigation. Quite recently an English traveller, Mr. Cowper, found not far from the Tripoli coast miles of magnificent ruins and much to correct on our maps. If only the obstructiveness of the Turkish officials could be overcome, there is a rich harvest for any one who will go to work with patience and intelligence. Even the interior of Morocco, and especially the Atlas mountains, are but little known. The French, both in Tunis and Algeria, are extending our knowledge southwards. All the Powers who have taken part in the scramble for Africa are doing much to acquire a knowledge of their territories. Germany, especially, deserves praise for the persistent zeal with which she has carried out the exploration of her immense territories in East and West Africa. The men she sends out are unusually well qualified for the work, capable not simply of making a running survey as they proceed, and taking notes on country and people, but of rendering a substantial account of the geology, the fauna, the flora, and the economic conditions. Both in the French and the British spheres good work is also being done, and the map of Africa being gradually filled up. But what we especially want now are men of the type of Dr. J. W. Gregory, whose book on the Great Rift Valley is one of the most valuable contributions to African geography ever made. If men of this stamp would settle down in regions like that of Mount Ruwenzori, or Lake Rudolf, or the region about Lakes Bangweolo and Tanganyika, or in the Atlas, or in many other regions that could be named,

the gains to scientific geography, as well as to the economical interests of Africa, would be great. An example of work of this kind is seen in the discoveries made by a young biologist trained in geographical observation, Mr. Moore, on Lake Tanganyika. There he found a fauna which seems to afford a key to the past history of the centre of the continent, a fauna which, Mr. Moore maintains, is essentially of a salt-water type. Mr. Moore, I believe, is inclined to maintain that the ancient connection of this part of Africa with the ocean was not by the west, as Joseph Thomson surmised, but by the north, through the Great Rift Valley of Dr. Gregory; and he strongly advocates the careful examination of Lake Rudolf as the crucial test of his theory. It is to be hoped that he, or some one equally competent, will have an opportunity of carrying out an investigation likely to provide results of the highest importance.

But there are other special problems connected with this, the most backward and most repellent of continents, which demand serious investigation, problems essentially geographical. One of the most important of these, from the point of view of the development of Africa, is the problem of acclimatization. The matter is of such prime importance that a committee of the Association has been at work for some years collecting data as to the climate of tropical Africa. In a general way we know that the climate is hot and the rainfall scanty; indeed, even the geographers of the Ancient World believed that Central Africa was uninhabitable on account of its heat. But science requires more than generalities, and therefore we look forward to the exact results which are being collected by the committee referred to with much hope. We can only go to work experimentally until we know precisely what we have to deal with. It will help us greatly to solve the problem of acclimatization when we have the exact factors that go to constitute the climate of tropical Africa. At present there is no doubt that the weight of competent opinion—that is, the opinion of those who have had actual experience of African climate, and of those who have made a special study of the effects of that climate on the human constitution—is that, though white men, if they take due precautions, may live and do certain kinds of work in Tropical Africa, it will never be possible to colonize that part of the world with people from the temperate zone. This is the lesson taught by generations of experience of Europeans in India. So far, also, sad experience has shown that white people cannot hope to settle in Central Africa as they have settled in Canada and the United States and in Australia, and make it a nursery and a home for new generations. Even in such favourable situations as Blantyre, a lofty region on the south of Lake Nyasa, children cannot be reared beyond a certain age; they must be sent home to England, otherwise they will degenerate physically and morally. No country can ever become the true home of a people if the children have to be sent away to be reared. Still, it is true our experience in Africa is limited. It has been maintained that it might be possible to adapt Europeans to Tropical Africa by a gradual process of migration. Transplant Southern Europeans to North Africa; after a generation or two, remove their progeny further south; and so on, edging the succeeding generation further and further into the heart of the continent. The experiment—a long one it would be—might be tried; but it is to be feared that the ultimate result would be a race deprived of all those characteristics which have made Europe what it is. An able young Italian physician, Dr. Sambon, has recently faced this important problem, and has not hesitated to come to conclusions quite opposed to those generally accepted. His position is that it has taken us centuries in Europe to discover our hidden enemies, the microbes of the various diseases to which northern humanity is a prey, and to meet them and conquer them. In Africa we have a totally different set of enemies to meet, from

lions and snakes down to the invisible organisms that produce those forms of malaria, anæmia, and other diseases characteristic of tropical countries. He admits that these are more or less due to heat, to the nature of the soil, and other tropical conditions, but that if once we knew their precise nature and modes of working we should be in a position to meet them and conquer them. It may be so, but this is a result that could only be reached after generations of experience and investigation; and even Dr. Sambon admits that the ultimate product of European acclimatization in Africa would be something quite different from the European progenitors. What is wanted is a series of carefully conducted experiments. I have referred to the Blantyre highlands; in British East Africa there are plateaus of much greater altitude, and in other parts of Central Africa there are large areas of 4000 feet and over above sea-level. The world may become so full that we may be forced to try to utilize these lofty tropical regions as homes for white people when Canada and Australia and the United States become over-populated. As one of my predecessors in this chair (Mr. Ravenstein) tried to show at the Leeds meeting some years ago, the population of the world will have more than doubled in a century, and about 180 years hence will have quadrupled. At any rate, here is a problem of prime importance for the geographer of the coming century to attack; with so many energetic and intelligent white men all over Africa, it should not be difficult to obtain the data which might help towards its solution.

I have dwelt thus long on Africa, because it will really be one of the great geographical problems of the coming century. Had it been as suitable as America or Australia, we may be sure it would not have remained so long neglected and despised by the European peoples as it has done. Unfortunately for Africa, just as it had been circumnavigated, and just as Europeans were beginning to settle upon its central portion and trying to make their way into the interior, Columbus and Cabot discovered a new world, a world as well adapted as Europe for the energies of the white races. That discovery postponed the legitimate development of Africa for four centuries. Nothing could be more marked than the progress which America has made since its re-discovery four hundred years ago, and the stagnation of Africa which has been known to Europe since long before the beginning of history. During these four hundred years North America at least has been very thoroughly explored. The two great nations which divide North America between them have their government surveys, which are rapidly mapping the whole continent and investigating its geology, physical geography, and its natural resources. I need hardly tell an audience like this of the admirable work done by the Survey of Canada under Sir William Logan, Dr. Selwyn, and his successor, Dr. George Dawson; nor should it be forgotten that under the Lands Department much excellent topographical work has been carried out by Captain Deville and his predecessors. Still, though much has been done, much remains to be done. There are large areas which have not as yet even been roughly mapped. Within quite recent years we have had new regions opened up to us by the work of Dawson and Ogilvie on the Yukon, by Dr. Bell in the region to the south of Hudson bay, by the brothers Tyrrell in the Barren Lands on the west of the same bay, by O'Sullivan beyond the sources of the Ottawa, and by Low in Labrador. But it is not so long since that Dr. Dawson, in reviewing what remains to be done in the Dominion in the way of even pioneer exploration, pointed out that something like a million square miles still remained to be mapped. Apart from the uninhabitable regions in the north, there are, as Dr. Dawson pointed out, considerable areas which might be turned to profitable agricultural and mining account of which we know little, such areas as those which, as already mentioned, have been recently mapped on the south of Hudson bay and beyond the Ottawa. Although the eastern and the western provinces have been very fully

surveyed, there is a considerable area between the two lying between Lake Superior and Hudson bay which seems to have been so far almost untouched. A very great deal has been done for the survey of the rivers and lakes of Canada. I need hardly say that in Canada, as elsewhere in America, there is ample scope for the study of many problems in physical geography—past and present glaciation and the work of glaciers, the origin and *régime* of lake-basins, and the erosion of river-beds, the oscillation of coast-lines. Happily, both in Canada and the United States there are many men competent and eager to work out problems of this class, and in the reports of the various surveys, the transactions of American learned societies, in scientific periodicals, in separate publications, a wealth of data has already been accumulated of immense value to the geographer.

Every geologist and geographer knows the important work which has been accomplished by the various surveys of the United States, as well as by the various State surveys. The United States Coast Survey has been at work for more than half a century, mapping not only the coast, but all the navigable rivers. The Lake Survey has been doing a similar service for the shores of the great lakes of North America. But it is the work of the Geological Survey which is best known to geographers—a survey which is really topographical as well as geological, and which, under such men as Hayden, King, and Powell, has produced a series of magnificent maps, diagrams and memoirs of the highest scientific value and interest. Recently this survey has been placed on a more systematic basis; so that now a scheme for the topographical survey of the whole of the territory of the United States is being carried out. Extensive areas in various parts of the States have been already surveyed on different scales. It is to be hoped that in the future, as in the past, the able men who are employed on this survey work will have opportunities of working out the physiography of particular districts, the past and present geography of which is of advancing scientific interest. Of the complete exploration and mapping of the North American continent we need have no apprehension; it is only a question of time, and it is to be hoped that neither of the governments responsible will allow political exigencies to interfere with what is really a work of national importance.

It is when we come to Central and South America that we find ample room for the unofficial explorer.* In Mexico and the Central American States there are considerable areas of which we have little or only the vaguest knowledge. In South America there is really more room now for the pioneer explorer than there is in Central Africa. In recent years the Argentine Republic has shown a laudable zeal in exploring and mapping its immense territories, while a certain amount of good work has also been done by Brazil and Chili. Most of our knowledge of South America is due to the enterprise of European and North American explorers. Along the great river courses our knowledge is fairly satisfactory, but the immense areas, often densely clad with forests, lying between the rivers are almost entirely unknown. In Patagonia, though a good deal has recently been done by the Argentine Government, still in the country between Punta Arenas and the Rio Negro, we have much to learn; while on the west coast range, with its innumerable fjord-like inlets, its islands and peninsulas, there is a fine field for the geologist and physical geographer. Indeed, throughout the whole range of the Andes systematic exploration is wanted, exploration of the character of the excellent work accomplished by Whympy in the region around Chimborazo. There is an enormous area lying to the east of the Northern Andes, and including their eastern slopes, embracing the

* I am indebted for much of the information relative to South America to a valuable Memorandum by Sir Clements R. Markham and Colonel G. E. Church.

eastern half of Ecuador and Colombia, Southern Venezuela, and much of the country lying between that and Northern Bolivia, including many of the upper tributaries of the Amazon and Orinoko, of which our knowledge is of the scantiest. Even the country lying between the Rio Negro and the Atlantic is but little known. There are other great areas, in Brazil and in the Northern Chaco, which have only been partially described, such as the region whence the streams forming the Tapajos and the Paraguay take their rise, in Mato Grosso. A survey and detailed geographical and topographical description of the whole basin of Lake Titicaca is a desideratum. In short, in South America there is a wider and richer field for exploration than in any other continent. But no mere rush through these little-known regions will suffice. The explorer must be able not only to use his sextant and his theodolite, his compass, and his chronometer; any expeditions entering these regions ought to be able to bring back satisfactory information on the geology of the country traversed, and of its fauna and flora, past and present. Already the revelations which have been made of the past geography of South America, and of the life that flourished there in former epochs, are of the highest interest. Moreover, we have here the remains of extinct civilizations to deal with, and although much has been done in this direction, much remains to be done, and in the extensive region already referred to, the physique, the traditions, and the customs of the natives will repay careful investigation.

The southern continent of Australia is in the hands of men of the same origin as those who have developed to such a wonderful extent the resources of Canada and the United States, and therefore we look for equally satisfactory results so far as the characteristics of that continent permit. The five colonies which divide among them the 3,000,000 square miles of the continent have each of them efficient Government surveys, which are rapidly mapping their features and investigating their geology. But Australia has a trying economic problem to solve. In none of the colonies is the water-supply quite adequate; in all are stretches of desert country of greater or less extent. The centre and western half of the continent is covered by a desert more waterless and more repellent than even the Sahara; so far as our present knowledge goes, one-third of the continent is uninhabitable. This desert area has been crossed by explorers, at the expense of great sufferings, in various directions, each with the same dreary tale of almost featureless sandy desert, covered here and there with spinifex and scrub, worse than useless. There are hundreds of thousands of square miles still unknown, but there is no reason to believe that these areas possess any features that differ essentially from those which have been found along the routes that have been explored. There have been one or two well-equipped scientific expeditions in recent years that have collected valuable data with regard to the physical characteristics, the geology and biology of the continent; and it is in this direction that geography should look for the richest results in the future. There remains much to be done before we can arrive at satisfactory conclusions as to the physical history of what is in some respects the most remarkable land area on the globe. Though the surface water-supply is so scanty, there is reason to believe that underneath the surface there is an immense store of water. In one or two places in Australia, especially in Western Queensland, and in New South Wales, this supply has been tapped with satisfactory results; millions of gallons a day have been obtained by sinking wells. Whether irrigation can ever be introduced on an extensive scale into Australia depends upon the extent and accessibility of the underground water-supply, and that is one of the geographical problems of the future in Australia. New Zealand has been fairly well surveyed, though a good deal remains to be done before its magnificent mountain and glacier system is completely known. In the

great island of New Guinea both the British and the Germans are opening up the interiors of their territories to our knowledge, but the western and much larger portion of the island presents a large field for any explorer who cares to venture into its interior.

The marvellous success which has attended Dr. Nansen's daring adventure into the arctic seas has revived a widespread interest in polar exploration. Nansen may be said to have almost solved the north polar problem—so far, at least, as the Old World side of the pole is concerned. That some one will reach the pole at no distant date is certain; Nansen has shown the way, and the legitimate curiosity of humanity will not rest satisfied till the goal be reached. But arctic exploration does not end with the attainment of the pole. Europe has done her share on her own side of the pole; what about the side which forms the Hinterland of North America, and specially of Canada? To the north of Europe and Asia we have the scattered groups of islands, Spitsbergen, Franz Josef Land, Novaya Zemlya, and the New Siberian islands. To the north of America we have an immense archipelago, the actual extent of which is unknown. Nansen and other arctic authorities maintain that the next thing to be done is to complete exploration on the American side, to attempt to do for that half of the north polar region what Nansen has done for the other half. It may be that the islands which fringe the northern shores of the New World are continued far to the north; if so they would form convenient stages for the work of a well-equipped expedition. It may be that they do not go much further than we find them on our maps. Whatever be the case, it is important, in the interests of science, that this section of the polar area be examined; that as high a latitude as possible be attained; that soundings be made to discover whether the deep ocean extends all round the pole. It is stated that the gallant Lieut. Peary has organized a scheme of exploring this area which would take several years to accomplish. Let us hope that he will be able to carry out his scheme. Meantime, should Canada look on with indifference? She has attained the standing of a great and prosperous nation. She has shown the most commendable zeal in the exploration of her own immense territory. She has her educational, scientific, and literary institutions which will compare favourably with those of other countries; her press is of a high order, and she has made the beginnings of a literature and an art of her own. In these respects she is walking in the steps of the Mother Country. But has Canada not reached a stage when she is in a position to follow the maternal example still further? What has more contributed to render the name of Great Britain illustrious than those great enterprises which for centuries she has sent out from her own shores, not a few of them solely in the interests of science? Such enterprises elevate a nation and form its glory and its pride. Surely Canada has ambitions beyond mere material prosperity, and what better beginning could be made than the equipment of an expedition for the exploration of the seas that lie between her and the pole? I venture to throw out these suggestions for the consideration of those who have at heart the honour and glory of the great Canadian dominion.

Not only has an interest in arctic exploration been revived, but in Europe at least an even greater interest has grown up in the exploration of the region around the opposite pole of the Earth of which our knowledge is so scanty. Since Sir James C. Ross's expedition, which was sent out in the year 1839, almost nothing has been done for antarctic research. We have here to deal with conditions different from those which surround the north pole. Instead of an almost landless ocean, it is believed by those who have given special attention to the subject that a continent about the size of Australia covers the south polar region. But we do not know for certain, and surely, in the interests of our

science, it is time we had a fairly adequate idea of what are the real conditions. We want to know what is the extent of that land, what are its glacial conditions, what is the character of its geology, what evidence exists as to its physical and biological conditions in past ages? We know there is one lofty, active volcano; are there any others? Moreover, the science of terrestrial magnetism is seriously impeded in its progress because the data in this department from the antarctic are so scanty. The seas around this continent require to be investigated both as to their depth, their temperature, and their life. We have here, in short, the most extensive unexplored area on the surface of the globe. For the last three or four years the Royal Geographical Society, backed by other British societies, has been attempting to move the Home Government to equip an adequate expedition to complete the work begun by Ross sixty years ago, and to supplement the great work of the *Challenger*. But though sympathy has been expressed for antarctic exploration, and though vague promises have been given of support, the Government is afraid to enter upon an enterprise which might involve the services of a few naval officers and men. We need not criticize this attitude. But the Royal Geographical Society has determined not to let the matter rest here. It is now seeking to obtain the support of public-spirited men for an antarctic expedition under its own auspices. It is felt that antarctic exploration is peculiarly the work of England, and that if an expedition is undertaken, it will receive substantial support from the great Australasian colonies, which have so much to gain from a knowledge of the physical condition of a region lying at their own doors, and probably having a serious influence on their climatological conditions. Here, then, is one of the greatest geographical problems of the future, the solution of which should be entered upon without further delay. It may be mentioned that a small and well-equipped Belgian expedition has already started, mainly to carry out deep-sea research around the south polar area, and that strenuous efforts are being made in Germany to obtain the funds for an expedition on a much larger scale.

But our science has to deal not only with the lands of the globe; its sphere is the whole of the surface of the Earth, and all that is thereon, so far at least as distribution is concerned. The department of oceanography is a comparatively new creation; indeed, it may be said to have come definitely into being with the famous voyage of the *Challenger*. There had been expeditions for ocean investigation before that, but on a very limited scale. It has only been through the results obtained by the *Challenger*, supplemented by those of expeditions that have examined more limited areas, that we have been able to obtain an approximate conception of the conditions which prevail throughout the various ocean depths—conditions of movement, of temperature, of salinity, of life. We have only a general idea of the contours of the ocean-bed, and of the composition of the sediment which covers that bed. The extent of the knowledge thus acquired may be gauged from the fact that it occupies a considerable space in the fifty quarto volumes—the ‘*Challenger Publications*’—which it took Dr. John Murray twenty years to bring out. But that great undertaking has only, as it were, laid down the general features of the oceanic world. There is plenty of room for further research in this direction. Our own surveying ships, which are constantly at work all over the world, do a certain amount of oceanic work, apart from mere surveying of coasts and islands and shoals. In 1895 one of these found in the South Pacific soundings deeper by 500 fathoms than the deepest on record, that found twenty years earlier by the *Tuscarora* to the north-east of Japan. The deepest of these new soundings was 5155 fathoms. In the interests of science, as well as of cable-laying, it is desirable that our surveying ships should be encouraged to carry out work of this kind more systematically than they do at present. This could surely be arranged

without interfering with their regular work. We want many more observations than we now have, not only on ocean depths, but on the nature of the ocean-bed, before we can have a satisfactory map of this hidden portion of the Earth's surface, and form satisfactory conclusions as to the past relations of the ocean-bed with what is now dry land. I believe the position is maintained by geologists, that from the remote period when the great folds of the Earth were formed the present relations between the great land-masses and the great oceans have been essentially the same; that there have no doubt been great changes, but that these have been within such limits as not to materially affect their relations as a whole. This is a problem which further oceanic research would go a long way to elucidate. That striking changes are going on at the present day, and have been going on within the human period, cannot be doubted. Some coast-lines are rising; others are falling. Prof. John Milne, our great authority on seismology, has collected an extremely interesting series of data, as to the curious changes that have taken place in the ocean-bed since telegraphic cables have been laid down. The frequent breakages of cables have led to the examination of the sub-oceanic ground on which they have been laid, and it is found that slides and sinkings have occurred, in some cases amounting to hundreds of fathoms. These, it is important to note, are on the slopes of the Continental Margin, or, as it is called, the Continental Shelf, as, for example, off the coast of Chili. It is there, where the Earth's crust is peculiarly in a state of unstable equilibrium, that we might expect to find such movements; and therefore soundings along the continental margins, at intervals of say five years, might furnish science with data that might be turned to good account.

As an example of what may be done by a single individual to elucidate the present and past relations between land and sea, may I refer to an able paper in the *Geographical Journal* of May, 1897, by Mr. T. P. Gulliver, a pupil of Prof. Davis, of Harvard, himself one of the foremost of our scientific geographers? Mr. Gulliver has made a special study on the spot, and with the help of good topographical and geological maps, of Dungeness Foreland, on the south-east coast of Kent. Mr. Gulliver takes this for his subject, and works out with great care the history of the changing coast-line here, and in connection with that the origin and changes of the English Channel. This is the kind of work that well-trained geographical students might undertake. It is work to be encouraged, not only for the results to be obtained, but as one species of practical geographical training in the field, and as a reply to those who maintain that geography is mere bookwork, and has no problems to solve. Prof. Davis himself has given an example of similar practical work in his elaborate paper on 'The Development of Certain English Rivers' in the *Geographical Journal* for February, 1895 (vol. v. p. 127), and in many other publications.

Another important problem to attack, and that in the near future, is that of Oceanic islands. I say in the near future, because it is to be feared that very few islands now remain unmodified by contact with Europeans. Not only have the natives been affected, both in physique and in customs, but the introduction of European plants and animals has to a greater or less extent modified the native fauna and flora. Dr. John Murray, of the *Challenger*, has set a good example in this direction by sending a young official from the Natural History Museum to Christmas island, in the Indian ocean, one of the few untouched islands that remain, lying far away from any other land, to the south-east of the Keelings.

What islands are to the ocean, lakes are to the land. It is only recently that these interesting geographical features have received the attention they deserve. Dr. Murray has for some time been engaged in investigating the physical

conditions of some of the remarkable lakes in the west of Scotland. Some three years ago my friend and colleague, Dr. Mill, carried out a very careful survey of the English lakes, under the auspices of the Royal Geographical Society. His soundings, his observations of the lake conditions, of the features on the margins of and around the lakes, when combined with the investigation of the *régime* of the rivers and the physical geography of the surrounding country, conducted by such accomplished geologists as Mr. Marr, afford the materials for an extremely interesting study in the geographical history of the district. On the Continent, again, men like Prof. Penck, of Vienna, have been giving special attention to lakes, that accomplished geographer's monograph on Lake Constance, based on the work of the five states bordering its shores, being a model work of its kind. But the father of Limnology, as this branch of geography is called, is undoubtedly Prof. Forel, of Geneva, who for many years has been investigating the conditions of that classical lake, and who is now publishing the results of his research. Dr. Forel's paper on 'Limnology: a Branch of Geography,' and the discussion which follows in the Report of the last International Geographical Congress, affords a very fair idea in short space of the kind of work to be done by this branch of the science. In France, again, M. Delebeque is devoting himself to a similar line of research; in Germany Ule, Halbfass, and others; Richter in Austria, and the Balaton Commission in Hungary. I may also here refer appropriately to Mr. Israel C. Russell's able work, published in Boston in 1895, on 'The Lakes of North America,' in which the author uses these lakes as a text for a discourse on the origin of lake basins and the part played by lakes in the changes studied by dynamic geology. Some of the best examples of an exhaustive study of a lake basin will be found in the magnificent monograph on Lake Bonneville, by Mr. G. K. Gilbert, and that on Lake Lahontan by Mr. Israel Cook Russell, published by the United States Geological Survey; the former is indeed a complete history of the great basin, the largest of the interior drainage areas of the North American continent. In the publications of the various surveys of the United States, as well as in the official reports of the Canadian Lake surveys, a vast amount of material exists for any one interested in the study of lakes; in addition, there are the elaborate special Reports on the great lakes by the Hydrographic Department. Indeed, North America presents an exceptionally favourable field for limnological investigation; if carried out on a systematic method, the results could not but be of great scientific interest.

Rivers are of not less geographical interest than lakes, and these have also recently been the subject of special investigation by physical geographers. I have already referred to Prof. Davis's study of a special English river system. The work in the English Lake District by Mr. Marr, spoken of in connection with Dr. Mill's investigations, was mainly on the hydrology of the region. Both in Germany and in Russia special attention is being given to this subject, while in America there is an enormous literature on the Mississippi alone, mainly, no doubt, from the practical standpoint, while the result of much valuable work on the St. Lawrence is buried in the Canadian official publications.

But time does not admit of my going farther. I might have pointed out the wide and vastly interesting field presented by what the Germans call Anthropogeography, dealing with the interrelations between humanity and its geographical environment. Geography, Mr. Mackinder has said, is the physical basis of history; it is, indeed, the physical basis of all human activity, and from that standpoint the field for geographical research is unbounded. But I can only hint at this. I have endeavoured to indicate what are some of the leading geographical problems of the future, first in order to show at this somewhat critical epoch how very much yet remains to be done, how many important lines of inquiry are open to the

geographical student, and that the possibilities of our science are, like those of other departments of research, inexhaustible. My aim has also been to indicate by actual examples what, in the conception of British geographers at least, is the field of our subject. We need not trouble greatly about any precise definition so long as there is such a choice of work for the energies of the geographer. I trust I have been, to some extent at least, successful in the double object which I have had in view in this opening address in a country which presents so splendid a field to the practical geographer.

THE MONTHLY RECORD.

EUROPE.

The Lakes of the Riesen Gebirge.—The investigations, begun in 1895, relating to the mountain lakes known as the "Koppenteiche," were continued in 1896 by Dr. Otto Zacharias. His researches show that the average amount of "Plankton" (micro-fauna) contained in them is only the tenth or twentieth part of that contained in the standing waters of the North German lowlands, so that in a biological sense they may be put down as "desert." This holds especially in the case of the Greater Koppenteich (altitude 3996 feet), whilst the Lesser Koppenteich (altitude 3832 feet), with an area only one-sixth as large, is much more favourably placed. During three weeks in June and July the amount of "Plankton" in the latter proved to be from 0·0004 to 0·0006 per hundred parts of water, while in the former it only reached the small percentage of from 0·00035 to 0·0004. Thus the smaller lake has just enough to fit it for fish-culture (*Coregonus marena*), but not so the larger. As regards the micro-flora of the mud on the lake-bottom (*Diatomaceæ*), a special interest attaches to the presence of *Stenopterobia anceps*. This remarkable and scarce species has hitherto been found only in North America, on the Puy de Dôme (central plateau of France), and in Cornwall. The three small "Kochelteiche" (altitude 4068 feet), which lie in the region of moraines, dating from the Glacial epoch, known as the "Grosse Schneegrube," are marked by a great abundance of diatoms. The general character of the flora is sub-alpine or sub-arctic. Simultaneous determinations of temperature gave (for the afternoon in the middle of July) the following results:—

	Surface.	At 6 metres (19·7 ft.) depth.	At 23 metres (75·5 ft.) depth.
Greater Koppenteich	56·3° Fahr.	51·8° Fahr.	{ 50° Fahr. } { (bottom) }
Lesser Koppenteich	57° Fahr.	{ 49·6° Fahr. } { (bottom) }	—

In the latter the most rapid fall occurred between the surface and a depth of 5 feet, with a difference of 4·1° Fahr., and in the former between 8·2 and 16·4 feet, with a difference of 5° Fahr. A remarkable fact is the comparatively high temperature at the bottom of the larger lake, as also the high level of the zone of most rapid fall of temperature in both. The last circumstance is possibly connected with the length of time that both lakes remain in shadow.

The Botanical Geography of Middle Albania and Epirus.—To the July number of *Petermanns Mitteilungen* Dr. Antonio Baldacci contributes the

first part of a paper setting forth the results of his explorations made in this region, with an eye to the geographical distribution of plants, both wild and cultivated. Among the most interesting observations from a geographical point of view is the fact that, apparently in consequence of the shelter afforded from cold northerly and north-easterly winds by the Dinaric Alps and the other maritime ranges on the west side of the Balkan peninsula, numbers of characteristic Mediterranean forms reach much further north on the eastern than on the western shores of the Adriatic. A map on the scale of 1 : 1,000,000 which accompanies the paper, distinguishes the areas occupied by the characteristic Mediterranean vegetation (the *maquis* of the French, *macchie* of the Italians), as representing which, at least in the parts explored, Dr. Baldacci attaches most importance to the *Quercus coccifera*, the mountain forest region (with conifers, *Cupuliferæ*, etc.), the high mountain region, and swamps, and indicates the place of occurrence of the olive and the Citrus genus, the *Quercus Ægilops* and *Quercus Grisebachii*, the *Cytisus Weldeni*, the *Æsculus Hippocastanum*, the *Nerium Oleander*, *Arce*, *Uthobium*, and *Ozicedri*.

The Wanderings of Prince Charles Edward in 1745.—The latest publication of the Scottish History Society takes the form of a chronological itinerary of the movements of the young Pretender from his arrival in Scotland on June 22, 1745, to his departure for France on September 28, 1746. Mr. W. B. Blaikie, whose ingeniously constructed cosmosphere has been exhibited to the Royal Geographical Society, has shown himself to be no less successful as a student of old topography than as a mathematical geographer. The difficulty of determining the exact stopping-places and the routes followed during the romantic wanderings through the West Highlands which preceded the escape of the Pretender, is clear to any one who has considered the contradictions of published records; but all the difficulties in this case have been overcome. The routes have been placed upon a modern map, and are shown in three colours—red for the rapid advance to Derby, green for the retreat to Inverness, and blue for the flight after Culloden. In this way the different visits to some of the places are shown with great distinctness. It was the author's first intention to have reproduced a contemporary map, but, on account of the defective topography of all of these, he decided that they would be less serviceable than a map based on the Ordnance Survey. It is interesting to recall that the commencement of the Ordnance Survey of the United Kingdom was, like the laying out of the Highland roads, a direct result of the rising in 1745. In a very interesting note on contemporary maps, Mr. Blaikie describes three—one showing the routes of the Pretender by Colonel J. A. Grante, in a French and English edition (both in the British Museum); the second apparently a copy published anonymously in Rome, and now very rare; it is not in the British Museum, the only copy known being in Lord Crawford's collection. The third map could not be identified for some time. It was referred to by Bishop Forbes as the work of John Finlayson, and its identification is an example of acute literary research. Mr. Blaikie found in Scotland a map without name, imprint, or date, but in its title claiming to show "even the secret Routs of the Pr after the battle of Culloden until his Escape to France." In a petition of John Finlayson, when in prison after Culloden, he begs for the return of the plates of his maps; and in another letter he says, "If the contraction Pr give any offence, it can be altered." Other pieces of internal evidence placed the identity of the newly discovered map with Finlayson's beyond doubt. The ingenious author had, of course, endeavoured to secure the favour of both sides for his work by using a contraction which would stand for "Pretender" with the supporters of the Government, and for "Prince" with the Jacobites.

ASIA.

Reports on Burmese Frontier Districts.—During the various minor military expeditions which have been sent to outlying districts of Upper Burma, much geographical information has been collected, and is embodied in the reports of the officers of the Intelligence branch, a number of which have lately been received from the headquarters of that department at Simla. They deal with districts in the north-east, north, and west of Burma, including the northern and least-known parts of the Shan states, the country of the Sana Kachins, on the upper Irawadi, and the Chin hills. All are abundantly supplied with route-maps and sketches of the country passed through. Lieut. C. E. Macquoid reports on a tour made in 1895-96, in the Shan states beyond the Salwin, near the Chinese frontier. The district is chiefly occupied by small Wa states not yet brought under British control, and on the Chinese frontier by savage Wa tribes, still unvisited by Europeans. The Wa states are reported to be very populous. A great quantity of opium is grown, but the country is, as yet, exceedingly poor. No bazaars are held, and there is practically no currency. Reports of the existence of gold are, however, current. On a preliminary trip, Lieut. Macquoid visited the country somewhat farther north, on the east bank of the Salwin, which has hitherto been little known. Pan-Long, a settlement of Panthays, he found to be a prosperous trading centre, and, from its nearness to the future terminus of the Salwin railway, it is likely to become a town of much importance. Between Mandalay and Thibaw the construction of the line was progressing rapidly. A report by Lieut. M. N. Turner has to do with the Sana Kachin expedition of 1895-96. The country of the Sana Kachins lies between the Mali-Kha, or western branch of the Irawadi, and the Kumon range, which forms a barrier on the side of the Hukong valley. It is generally covered with jungle, relieved only by the brown patches which mark the annual clearings of the inhabitants. Bamboos are found everywhere. The general surface is broken, consisting of low steep hills and narrow valleys. A lofty, probably snow-capped range was just visible to the north-east. Lieut. E. S. Carey gives an account of a visit to the jade-mines district east of the Chindwin river, of which Kansai is the principal village. The Kachins of the district build very large houses, which are open to all comers. The Kansai-la, who is the headman of the whole tract, sometimes entertains 100 to 150 guests per night. Besides jade, which is obtained by diving from the bed of the rivers as well as from the mines, rubies and salt are the principal products of the country. Gold is also found. The climate is pleasant by day, but the nights are sometimes unpleasantly cold. Two reports deal with the Chin hills, which, however, are described more fully in the work noticed in the last number of the *Journal* (p. 211).

Surveys in Northern and Central Persia.—During the year 1895, extensive journeys in Northern and Central Persia were made by A. F. Stahl, formerly Director of Posts in that country, chiefly with a view to mineralogical and geological investigations. Valuable results with reference to the topography of the country passed through were also obtained, and these have been published as a supplementary number of *Petermanns Mitteilungen* (No. 118, 1896). The letterpress, which gives a detailed description of the principal routes followed, is accompanied by three maps on the large scale of 1 : 825,000, itself a fourfold reduction from the original scale of the surveys. The map issued by the Russian General Staff was taken by Herr Stahl as the basis for his map as regards the positions of the principal towns, but the intervening country is laid down entirely from his own work, the parts not visited by him being left blank. His routes, however, especially in the Northern Persian highlands, form such a complete network over the country,

that his map shows in detail the features of by far the larger part of the surface. A comparison of Herr Stahl's map with that of Colonel Lovett, published in the R.G.S. *Proceedings* for 1883, and with the Society's map of Persia published in 1892, shows some of the alterations which have been introduced as a result of the German traveller's surveys. The Lar or Lahr, the upper course of the Harhaz or Heraspei, has been followed up almost to its source in about $51^{\circ} 30' E.$, and the course of the Nur, the principal tributary of the same river, has been determined. Herr Stahl places Mount Devavend slightly to the west of the position assigned to it in the Society's map, with the result that the Harhaz, after encircling the mountain, has rather a north-north-easterly than a northerly course. The main channel of the river is also shown as lying entirely to the east of the Amol-Mahmudabad railway, and as having no connection with the stream which enters the sea at the latter place. In Central Persia Herr Stahl's routes did not cover the country so thickly, but they extended in various directions on either side of the direct line from Kum to Yezd and Kerman. Throughout this distance the country offers no hindrances to the construction of a good road, but the traffic would not repay the outlay. Between Nain and Anarek Herr Stahl found a marked line of depression, which does not appear to be shown on previous maps. The lowest point cannot be much more than 3000 feet above the sea. As regards the formation of the Persian salt-deserts, he rather attributes it to the action of atmospheric precipitation than to purely aërial causes.

AFRICA.

Captain Böttogo's Expedition.—A report by Lieuts. Vannutelli and Citerni, the European survivors of Captain Böttogo's expedition, is published in the *Bolletino* of the Italian Geographical Society (1891, No. 8). From the Daua (*Journal*, vol. viii. p. 516) the expedition made its way to the Amara country on the left bank of the Sagan, in about $5^{\circ} 23' N.$, $38^{\circ} 15' E.$ This river is evidently the Galana Amara of Dr. Donaldson Smith, which enters Lake Stefanie. After visiting Lake Pagade, the Wallamo country, and the Omo, it proceeded southwards to Lake Rudolf, and after again exploring the Sagan, followed the unvisited western shore of that lake to about $3^{\circ} 8' S.$ In November, 1896, Dr. Sacchi returned southwards towards Lugh with the collections, while the bulk of the expedition continued in a north-westerly direction along the western edge of the Ethiopian highlands. The unhealthy nature of the country induced Captain Böttogo to make for the mountains, ascending the river Upeno (apparently the Baro or an affluent), and relations were entered into with the Galla Chief of Lega and Sajo, whose residence appears to have been close to Gobo, reached by J. M. Schuver in 1892. The chief, however, proved treacherous, and the encounter in which Captain Böttogo lost his life took place. The survivors were held captive for some time, but were finally sent to Adis Abeba by order of Menelek. Colonel Leontieff, in a letter to the *Novoye Vremia*, reproduced in the Italian *Bolletino*, states that Böttogo succeeded in proving the identity of the Omo with the Sobat, thus verifying the view taken by Dr. Beke so far back as 1848. The Italian officers, however, appear to be silent on this point. Prof. Keller, who has himself made extensive journeys in Somaliland, writes concerning the fate of Dr. Sacchi, which is still involved in some obscurity. A recent telegram from Zanzibar seems to indicate that he was killed in an Abyssinian raid in the country of the Boran Gallas. A part of the scientific notes collected by the main expedition after his departure have been saved.

The Southern Borderlands of German East Africa.—When Baron v. Schele and Captain Ramsay, in 1894, made their way from Amelia bay on Lake Nyasa to Kilwa, by a new route across the southern part of the Rufiji basin, Herr

Lieder, the geologist of the expedition, was sent southwards to Mpamba bay, in order to explore a more southerly route from that point to the coast. Captain Ramsay's large-scale map was published in 1894 in the *Mitteilungen aus den Deutschen Schutzgebieten*, and the same valuable publication now gives (1897, part 2) a detailed account of Lieder's journey, accompanied by a map on the scale of 1: 800,000. Herr Lieder's account gives a large amount of information on the physical geography, as well as on the inhabitants, trade routes, etc., of the country traversed. The route from Mpamba bay, though used by small trading caravans, is far more difficult than that from Amelia bay, the ascent to the high plateau which separates Lake Nyasa from the headwaters of the Rovuma being steep, and the paths bad. The whole country around the Rovuma sources—an undulating plateau about 3000 feet above the sea—is inhabited by the Wangoni, known to the coast peoples as Magwangwara from the Lumagwangwara, a tributary to the Rovuma. Since they have been cut off from intercourse with the more southern Zulus, they have mixed with the natives of the country, and have even lost their Zulu speech, although their customs have been adopted by the subject tribes. In the southern part of their district a small settlement of coast traders was founded in 1890. The granite of the region of Mpamba bay soon gives place eastward to gneiss, which, sometimes with a surface layer of laterite, occupies most of the Wangoni country. Still further east the plateau between the Rufiji and Rovuma basins is in great measure composed of sandstone. The route led along its southern margin, which is deeply cut by streams flowing to the Rovuma, and overlooks a much lower tract of country in that direction. The surface was generally covered with thin tree-savannah, with very little undergrowth. It is entirely uninhabited, though traces of a former population were everywhere visible. The sandstone region ends at the Moheesi, the only stream on this route to the coast which presents any difficulties to caravans. In the rainy season it attains a breadth of nearly 300 yards and a depth of 15 feet, and is impassable. Beyond this the route led through a better-known country. At Masasi the Rovuma basin was left, and the way to Kilwa followed the northern edge of the Mwera plateau, which bounds the basin of the Umbekuru on the south.

Journeys in German East Africa.—We learn from the *Deutsches Kolonialblatt* (May 15) that G. Schillings, who accompanied Dr. Schoeller on his expedition to the Victoria Nyanza, has, since his return to the coast, made a new journey to the Masai steppe, for the purpose of reaching the Lake Kiniarok reported by Dr. Fischer and Dr. Baumann. Three forced marches over the waterless steppe brought the traveller to a series of small lakes, twelve in number, formed by the accumulation of rain-water in the hollows of the surface rock, some being of considerable depth. Only three contain water throughout the year. Lake Kiniarok does not exist, but the name applies to a sandy plateau, which from a distance may present the appearance of a lake. Numbers of steep mountains rise from the surface of the plain in the neighbourhood of the lakes, but the scarcity of water prevented their exploration. *Globus* (vol. lxxii. No. 1) publishes news from Zanzibar containing some details respecting Lieut. Werther's expedition (*Journal*, vol. viii. p. 175), which reached the coast in May last. The traveller had succeeded in reaching the summit of Mount Gurui, the ascent of which, to within a few hundred feet of the top, was made in 1894 by Count von Götzen (*Journal*, vol. iv. p. 273). Its height is reckoned by Lieut. Werther at about 10,200 feet. The mountain is undoubtedly an old ruined crater, furrowed by deeply eroded ravines. The diameter of the crater is rather over half a mile. Its wall is broken through on the south-east, but is more intact elsewhere; and Lieut. Werther was able to climb both of its highest segments. A new lake is said to have been discovered by

him in the great East African trough. Two small lakes have also been lately discovered between Mounts Meru and Kilimanjaro by Lieut. Merker (*Mitt. aus den Deutschen Schutzgebieten*, 1896, No. 4). Lieut. Engelhardt has lately made journeys in the *Hinterland* of Lindi (*D. Kolonialblatt*, June 1 and 15), during which he examined the capabilities of the Rovuma as a navigable route into the interior. He thinks that even at high water the stream can never serve as a continuous waterway, although certain sections have depth enough of water to float fairly large craft. The region traversed by him west of Lindi was generally fertile, no barren steppes being met with. The country north of the Rovuma and westward of Masasi is, with the exception of the Majeje mountains, a gently undulating wooded country, well watered by tributaries of the Rovuma. Wax, the produce of wild bees, has been collected in considerable quantities from this district during the last two years. The rubber-supply from the hilly country near the coast has, however, diminished greatly, owing to reckless destruction of the lianae.

Expeditions in the Somali and Galla Lands.—Several expeditions are now in the field, having for their object the completion of the exploration of the countries south of Abyssinia. Count von Wickenburg, an Austrian officer who has spent some time travelling in the East, started from Zeila in April for Harrar and Adis Abeba, whence he hopes to make his way by the Omo and Lake Rudolf to Uganda. The country west of Lake Rudolf is also the objective of Mr. Bennett Stanford, who lately started from Berbera for the interior, accompanied by his wife. A second British expedition is that of Lord Delamere, who has likewise started from Berbera. Dr. Atkinson, Lord Delamere's colleague, is, we understand, making his way from Brava to join the main expedition at Lugh, on the Jub.

Railways in South Africa.—The railway from Cape Colony to Matabeleland had progressed as far as the 382nd mile from Mafeking in the middle of July last, and only 98 miles remained to be laid between the point then reached and Bulawayo. The formal opening is expected to take place in November. Arrangements have already been made to connect Bulawayo with the terminus of the Beira railway, and thus complete the circuit between the south and east coasts of South Africa. The construction of a narrow-gauge line in German South-West Africa has also been decided upon, and the *personnel* and necessary materials were, according to the *Kolonialzeitung*, despatched from Germany early in August.

AMERICA.

The Earliest Use of the Name America.—Although it is well known that the first suggestion of the use of "America" as the designation of the New World was made by Martin Waldseemüller (or "Hylacomylus") in his *Cosmographie Introductio* published at St. Dié in 1507, some uncertainty has hitherto prevailed as to the earliest definite adoption of the suggestion by other writers and cartographers. This has been caused by the doubt attaching to the question of the date of the earliest globes, or sets of gores, which contain the name America.* An interesting discovery has lately been made by Prof. Elter, of Bonn, which seems definitely to assign the earliest use of the name (on any map which has come down to us) to the year 1510. In the copy of the 1482 (Ulm) edition of Ptolemy, in the library of Bonn University, he found a manuscript map by the

* Mr. Thaöher, in his lately published work on the discovery of America, considers the first map with the name America to be that accompanying the edition of the *Polyhistor*, published at Vienna in 1520.

hand of Henricus Glareanus, dated 1510 in the handwriting of the author, on which the legend "Terra America" appears on the southern portion of the New World. A pamphlet (in Latin) has lately been issued by the Bonn University Press, containing a dissertation by Prof. Elter on the early use of the word America, together with some interesting particulars with reference to Glareanus, showing his services to the cause of geography. Born in 1488, he entered the University of Cologne in 1506, and took his doctor's degree in 1510, the same year in which he drew the map in question. He was made "post laureate" by the Emperor Maximilian in 1512, and in 1529 became professor at Friburg. Other maps from his hand appear on another page of the Ptolemy above referred to, and also in his own copy of the *Cosmographia Introductio*, now in the Munich University library. The former are remarkable as being, perhaps, the first examples of circumpolar charts in existence. He also published in 1527, at Basle, a treatise on geography, which met with such favour that a number of reprints were called for within a few years. The manuscript maps, of which facsimiles accompany the brochure, are of special interest, as helping us in some measure to reconstruct the lost map of Waldseemüller, drawn to accompany the *Cosmographia Introductio*. From the statements of Glareanus himself, it is evident that they were based on that lost map, which, could it be found, would no doubt prove to contain the name America. In giving that name to the quarter of the world explored by Americus, Waldseemüller must have intended it to apply only to South America, for, while the four quarters of the globe are distinguished by colours on Glareanus's map, the continental parts of North America are painted of the same colour as Asia, and the West Indian islands are coloured as belonging to Europe. Moreover, North and South America are shown as separated by a strait.

Exploration of the River Aisen, Chili.—The Chilean Expedition, composed of Drs. Steffen and Dusen, O. von Fischer, and others, which started in January last for the exploration of the Aisen, returned in May to Santiago crowned with success (*Globus*, vol. lxxii. p. 51; *Aus allen Weltteilen*, 1897, col. 651). The Aisen empties itself by a broad estuary, in about 45° 20' S. lat., into the channel which runs behind the Chonos archipelago. Ascending from its mouth, the explorers soon found that it divides into two branches, the larger coming from the northwest, the smaller from the east. Both were explored by separate sections of the expedition. The larger branch was found to spring from a fine glacier, which apparently occupies the watershed between the Aisen and Lake Fontana. Both parties finally reached Lake Nahuelhuapi, and made their way across the cordillera to Puerto Montt. The expedition is said to have shed new light on the Chilean-Argentine boundary question.

The Interoceanic Canal Projects.—Dr. H. Polakowsky, who contributed an account of the Nicaragua canal scheme of Menocal to *Petermanns Mittheilungen* in 1890, again discusses the subject in the June number of that periodical for this year, chiefly with reference to the report of the commission of investigation appointed by President Cleveland (Report of the Nicaragua Canal Board: House of Representatives, Document No. 279, Fifty-fourth Congress, first session). In his former paper Dr. Polakowsky had pointed out the grounds for doubting the advisability of the route adopted for the eastern section of the canal terminating at Greytown, and in his present communication he states that we now know that the Colorado arm of the San Juan delta (in Costa Rican territory) offers a much better route, not merely than that adopted by Menocal from the Ochoa dam across the mountains to Greytown, but also than the bed of the river-arm which retains the name of the San Juan. According to Squier, more than two-thirds, according to Pio Viquez, more than four-fifths, of the volume of the San Juan passes by the

Colorado arm. Moreover, the American commission has confirmed the fact already known that the harbour of Greytown could be kept in a tolerably serviceable condition only at great expense, and it would be much easier to maintain a harbour at the mouth of the Colorado. The cost of construction of the Nicaragua canal is estimated by the commission at 133,470,000 dollars, as against Menocal's estimate of 66,460,000, and the estimate of 69,890,000 dollars made by the Maritime Canal Company of Nicaragua. Dr. Polakowsky, on the other hand, believes that with capable and honest management the cost (exclusive of interest during the period of construction) would amount to between 150 and 160 million dollars, and in these circumstances he asks whether it would not be well for the United States Government, before giving their support to any scheme, to wait till the privilege of the Nouvelle Compagnie Universelle du Canal de Panama expires (October, 1904), and then try to ascertain whether it would not be better to construct a Panama canal without locks even at the cost of 200 to 250 million dollars. He adds that a new scheme laid before the President of the Geographical Society of Berlin by Mr. Karwiese, a German-American, is at least worthy of serious examination. It is a modification of the scheme originally brought forward by Messrs. L. Wyse, Armand Reclus, and P. Sosa. The proposal is to utilize the lower part of the Tuira (the stream that enters the head of the Darien estuary and through that the gulf of San Miguel in the east of Darien), to form a summit basin by damming the Chucunagua, to cross the Cordillera by a tunnel 3 miles long, and to terminate on the Atlantic side at the small port of Acanti (Gandi, Tolo, Estola).

Travels in Colombia.—The July number of *Petermanns Mittheilungen* publishes a letter from Dr. F. Regel, dated May 20, 1897, from which it appears that he has completed his researches on the *paramos* lying east and south of Antioquia. All his collections and effects were already on the way to Europe, where he himself expected to arrive at latest by the middle of June. He mentions that he had visited the canal works at Panama, and observed how they were being slowly but steadily carried on. From 4000 to 5000, according to other accounts 8000, workmen are said to be employed, besides 2000 officials, and good work is being done, especially at the Panama entrance, and also at Culebra.

AUSTRALASIA AND OCEANIC ISLANDS.

Meteorological Observatory for Mount Kosciusko.—We learn from the *Brisbane Courier* that the amount necessary for the establishment of a tentative meteorological station on Mount Kosciusko has been generously promised by the Hon. R. Barr-Smith, of South Australia. It is hoped that low-level observations for comparison may be obtained from stations in the various Australian colonies, and that such results will be forthcoming as will lead to the establishment of a permanent station on the mountain.

Mr. Woodford's Report on the Solomon Islands.—In his capacity of Acting Deputy Commissioner for the British Solomon Islands, Mr. C. M. Woodford last year made several tours of inspection through the group, and the results of his inquiries as to the prospects and resources of the islands are embodied in a Consular Report lately issued. Local trade is at present carried on with the aid of small vessels of from two to sixty tons, which collect the produce and convey it to central stations to await the periodical visits of Sydney vessels. At present eighteen trading firms or individuals have dealings with the Solomons, ten being British. Copra is the chief article of export, the islands presenting unequalled advantages for the growth of the coco-nut palm, and the trade would admit of large extension, especially if the system of drying were improved. The next article in importance is ivory-nut. The palm which produces it grows wild throughout the group in

inexhaustible quantity, and there seems a steady though not large demand for the produce. Pearl-shell (including a small quantity of the finest "gold-edged" variety), turtle-shell, and Bêche de mer complete the list as it stands at present. The Marau Company have lately acquired a tract of land on the north coast of Guadalcanar for agricultural experiments, and it is proposed to grow cacao, coffee, vanilla, and other products. Rubber may possibly prove a product worth exploiting, whilst sago might be manufactured from the pith of the ivory-nut palm. A valuable dark wood resembling ebony is found on New Georgia. Mr. Woodford recommends the small island of Tulagi, north of Guadalcanar, as a suitable site for a government residence.

POLAR REGIONS.

The Belgian Antarctic Expedition.—This expedition left Antwerp on August 16, on board the *Belgica*. Its commander, Lieut. de Gerlache, is supported by Lieuts. Lecoins and Danco, and by MM. Arctowski and Racovitz, as scientific members of his staff. The American scientist, Dr. Cook, will, it is said, join the expedition at Montevideo. It is proposed, after coaling at the Falkland islands or the straits of Magellan, to make for the land discovered by the *Jason* to the east of Graham's Land, and to advance as far as possible southwards into the George IV. sea. On the approach of winter, i.e. in about March, 1898, the *Belgica* is to make for Melbourne, and, after refitting, to spend some months cruising in the Pacific. During the next summer of the southern hemisphere the expedition hopes to proceed towards Victoria Land, and effect a new determination of the southern magnetic pole.

Light and Plant-growth in the Arctic Regions.—Prof. Wiesner, of Vienna, started for Advent bay, Spitsbergen, on July 18, in order to commence there a series of investigations into the climate of the arctic regions as affecting the growth of plants, with especial reference to their requirements in the matter of light. Similar investigations were made by him a few years ago in Egypt, India, and Java.

GENERAL.

Tozer's History of Ancient Geography.—The latest volume of the Cambridge Geographical Series* goes far to fill a serious gap in geographical literature. The need for a concise and interesting history of geography in English has often been expressed, and now, so far as the period covered by his work is concerned, Mr. Tozer has earned the thanks of all concerned in geographical education. A volume dealing with the whole range of time on the lines of M. Vivien St. Martin's 'Histoire de la Géographie,' would have been more welcome still, but we hope that the Cambridge Series will be enriched by other volumes similar to that before us dealing with more recent periods. Mr. Tozer follows Sir E. H. Bunbury's great 'History of Ancient Geography' somewhat closely, but his extensive personal knowledge of the Eastern Mediterranean and Asia-Minor enables him to import a living interest into the work, no chapter of which can fail to interest and most chapters will absolutely fascinate the reader. The book will not supersede Bunbury's monumental work, but rather serve as an introduction to it. In his introductory chapter, Mr. Tozer shows that he takes no narrow view of the scope or of the importance of geography. Beginning with the earliest Greek legendary geography, he treats in turn of the Homeric period, the growth of the

* 'A History of Ancient Geography.' By H. F. Tozer, M.A. Cambridge: The University Press. 1897.

Greek colonies, the speculations of Hecataeus, the history of Herodotus, the expeditions of Alexander and of Pytheas, the Roman conquests, the works of Strabo, Pliny, and Ptolemy. Interspersed with these are special chapters summarizing the progress amongst the Greeks of mathematical and physical geography, on Roman frontier defences and roads, and on the estimates of mountains in antiquity. No attempt is made to refer to all recent works on classical geography, although, to take one or two cases, it would not have appeared out of place to mention such essays as Dr. Schlichter's on the "Ptolemaic Lakes of Africa," Mr. Ryland's on the "Geography of Ptolemy" (whose theory as to the cause of Ptolemy's mistake in the orientation of Scotland might well have been mentioned), and Mr. Myres's on the "Maps of Herodotus." The footnotes in many cases suffer from the excessive conciseness of the references to authorities, some of which it might be rather difficult to trace.

Geological Bibliography.—Prof. E. De Margerie has produced, under the auspices of the International Geological Congress, a valuable list of geological bibliographies,* which is of considerable geographical importance as well. The plan of the work is based on the late M. James Jackson's list of special geographical bibliographies. No less than 3918 bibliographies are noted, comprising works of every size from a single leaf to many volumes, and dealing with every aspect of geology. The classification adopted shows the vast variety of the matter which had to be brought into shape, and suggests some of the difficulties with which the compiler had to grapple. The first division is into General and Regional Geology. The former includes five main subdivisions, viz. Histories and Bibliographies of Geology as a whole, arranged chronologically; Periodical Bibliographies, grouped according to subject and date; Personal Bibliographies, i.e. lists of the works of individual geologists; Subject Bibliographies, giving the titles of works on special departments of geology, arranged alphabetically according to subject; and General Geological Bibliographies, a list of the works giving references to the literature of the geology of the world or of Europe as a whole. The second part, Regional Geology, is first divided into as many groups as there are countries, lists of the geological writings on which have been compiled. These are arranged alphabetically according to the names of the countries in French, and each is subdivided into eight sections, similar on the whole to the subdivisions of the general part. The work was originally contributed by special correspondents in each of the most important countries represented; but the task of editing and bringing the whole into a uniform form was by no means facilitated by this division of labour. The result is one on which M. de Margerie may well congratulate himself, and he has laid all geological students under a great debt of gratitude.

The Directorship of the Vienna College of Meteorology.—Prof. Julius Hann has, at his own request, been relieved of the post of director of the "Centralanstalt für Meteorologie und Erdmagnetismus," which he held in conjunction with that of Professor of Terrestrial Physics at the University of Vienna, and has been appointed Professor of Meteorology at Gratz, in Styria. Born in 1839 at Linz, in Upper Austria, Prof. Hann has for the last twenty years—ever since the death of Jelinek—been at the head of the Vienna College of Meteorology, and has by the force of his personality won for it the international recognition which it has attained by reason of its important services to meteorology and climatology. The

* 'Catalogue des Bibliographies Géologiques, rédigés avec le concours des membres de la commission bibliographique du Congrès.' Par Emm. de Margerie. Paris: Gauthier Villars et Fils. 1896.

vacant place has been filled by the summons to Vienna, from the University of Innsbruck, of Prof. Joseph Ferster, who was born in 1848 at Neumarkt, in the Tirol. The new director is, after Prof. Hann, the best authority on meteorology in Austria. He has lately issued a work bearing the title 'Das Wetter,' which is a free translation of the English work of the Hon. Ralph Abercromby.

OBITUARY.

Captain Bertram Lutley Sclater, R.E.

It is with much regret that we record the death, from fever at Zanzibar, at the early age of thirty-one years, of Captain B. L. Sclater, whose name has frequently been before our readers during the past few years for his excellent pioneer work in the British Protectorates in East and Central Africa. The deceased officer, who joined our Society in 1891, was the second son of the well-known zoologist, Mr. P. L. Sclater, and was educated at Wellington College and at the Royal Academy, Woolwich. He became lieutenant in the Royal Engineers in 1885, and captain in 1895. On the appointment of Mr. (now Sir Harry) Johnston as Commissioner in British Central Africa in 1891, Captain Sclater was placed on his staff, with a view to the execution of an authoritative survey of Nyasaland. During his two years' stay in the country, he not only carried out this task, but materially aided in the opening up of the country by the construction of roads. He also took part in the military expeditions against the slave-raiding chiefs, receiving the Central African war medal in 1895 in recognition of his services. The general results of his work and observations in Nyasaland were put before our Society in a paper published in the second volume of the *Journal*. In 1895 he was sent to the East Africa Protectorate, entrusted with the task of constructing a road, suitable for wheeled traffic, from Mombasa to the Victoria Nyanza. We have from time to time given details respecting the progress of this important work, which was successfully completed towards the end of last year. Captain Sclater was lately commissioned to convey a steamer in sections along this road to the Victoria Nyanza, but before advancing far he was attacked by fever so severely that he was compelled to return to Zanzibar, where he proved unable to shake off the insidious malady. Captain Sclater received the Cuthbert Peek Grant of our Society in 1891.

Samuel E. Peal, Esq.

The death has been announced of Mr. Samuel Peal, who, during a lengthened residence in Assam, did much to add to our knowledge of the imperfectly known districts and wild tribes bordering on that province. Many of his papers have appeared in the *Journal of the Asiatic Society of Bengal*, and other scientific periodicals. One of the most important, from a geographical point of view, was that in which he described (*J.A.S.B.*, vol. l. part 2, No. 1) a journey undertaken in 1879 to the Nongyang lake on the Burmese frontier, during which he studied the question of the best pass over the Patkoi range. Others of his papers deal with points connected with the ethnology of the Nagas and other hill tribes bordering on Assam. Mr. Peal joined our Society in 1879, and in 1889 contributed to the *Proceedings* a short paper on "River Names in Farther India."

CORRESPONDENCE.

Aide-memoire to a Comparison of Certain Geographical Distances.

BELIEVING that it is more important to avoid ignorance than to acquire knowledge, and that it is better to be never very far wrong than perhaps absolutely right or hopelessly incorrect, it appeared to me that the following coincidences which I have arranged, and which I have found of some personal assistance in the study of geography, may be of interest.

One is accustomed to see maps of continents on small scales and of islands on large, and thus one's ideas of distance are apt to vary according to the size of the country under consideration. A tailor can, from a few salient measurements, realize the exact dimensions involved in constructing a coat, and by remembering the shape of a particular country and the distances between certain known places or features, an approximate idea may be formed of the distance between any two places whose locality is known, or extent of any known region therein. By taking a *fixed unit* of distance and remembering merely the places to which this unit corresponds, the effort of memory is considerably simplified.

I happened to select as the unit, the length of the British Isles, *i.e.* Land's End to the Hebrides (750 miles), and have been extremely surprised at the remarkable number of salient distances to which this unit corresponds. I have found similar results unattainable with any other standard of measurement.

It appears to represent the natural extent of most of the homogeneous countries and of a great many geographical features, as well as the distance at which rival centres of government or important towns have sprung into existence. I have found the system useful as giving an idea of distance in the following amongst many instances, *e.g.* Napoleon's march to Moscow, 1500 miles, of which half was through a hostile country; also as enabling the distances involved in the Russian reinforcement of the Crimea, Turkestan campaigns, and in our own frontier questions in India, Burmah, Egypt, and South and West Africa, to be estimated and compared.

Many more examples might be given, but it is hoped that a recollection of any of them that may strike the fancy may prove useful.

Standard—Land's End to Shetland Islands, distance 750 miles.

EUROPE.

Geographical Features.

Length of Black sea (maximum).	Cape Finisterre to Straits of Dover.
" Caucasus.	Shetland islands to North cape (Ice-land).
" Caspian sea (maximum).	North to south length of Baltic (Tornea to Memel).
Length of Mediterranean—	Black sea to Baltic (Memel).
East coast of Mediterranean to Cape Matapan.	*Baltic to Adriatic (Memel to Trieste).
Cape Matapan (Greece) to Cape Spartivento.	*Trieste to Cape Matapan.
Cape Spartivento (Sardinia) to Gibraltar.	*Cape Matapan to mouth of Danube.
Adriatic to Bay of Biscay (Trieste to Bayonne).	*Mouth of Danube to Trieste.

* N.B.—These form a diamond of two equilateral triangles.

Countries.

Length of Spain and Portugal (Cape St. Vincent to Cape Creux).	Length of Germany (Memel to Treves).
Length of Switzerland and France.	" Turkey (Bosphorus to North-West Bosnia).
" Italy and Sicily.	Length of British Isles (Land's End to Shetlands).
" Austria (east and west).	

Distances between Capital Towns.

London to Christiania.	Copenhagen to St. Petersburg.
" Madrid (approximate).	Moscow to Stockholm.
" Florence.	" Odessa, Moscow to mouth of river Mezen (North sea); north and south length of Russia = 1500 miles.
" Venice.	Moscow to Orenburg, Moscow to Warsaw—east and west breadth of Russia in Europe = 1500 miles.
" Vienna, Vienna to Constantinople; hence London to Constantinople, 1500 miles.	Moscow to Warsaw, Warsaw to Rheims—Napoleon's expedition, 1812.
Vienna to Stockholm.	
Rome to Berlin.	
" Brussels.	
Copenhagen to Dublin.	

ASIA.

Length of Red sea—Suez to Jeddah, Jeddah to Aden.	Eastern coast of India—
Breadth of Arabia—Jeddah to Persian gulf.	Point de Galle to Masulipatam.
Persian gulf to Mediterranean.	Masulipatam to Calcutta.
Caspian to Mediterranean.	Surat to Himalayas.
Caspian to Straits of Ormuz (entrance to Persian gulf).	Bombay to Lucknow.
Caspian to Kandahar.	Bombay to bay of Bengal (east to west).
East to west breadth of Persia (to head of Persian gulf).	Calcutta to river Yang-tse-kiang.
Eastern frontier of Persia.	Calcutta to Chinese frontier (east to west), Chinese frontier (as above) to Hong Kong—Calcutta to Hong Kong 1500 miles.
North to south length of Afghanistan and Baluchistan.	North to south length of Burmah.
Orenburg to Tashkend.	Bay of Bengal to gulf of Tonquin (through Aracan).
Tashkend to Rawal Pindi.	Cochin China to Phillipine isles (east to west).
Eastern frontier of India—Rawal Pindi to Allahabad, Allahabad to Manipur.	Canton to mouth of Yang-tse-kiang (Shanghai).
Length of western frontier of India.	Ningpo to Pechili.
West coast of India—Karachi to Goa, Goa to Point de Galle.	Pechili to Japan.
	Length of Niphon (Japan).

AFRICA.

Gibraltar to Madeira.	Sierra Leone to St. Jago (Cape de Verde islands).
Coast of Algeria.	Timbuctoo to Kumasi.
Coast of Morocco.	Sierra Leone to Kumasi.
South to east and south to west length of Morocco.	Kumasi to Cameroons.
Mean breadth of Sahara desert (north to south).	Cameroons to mouth of river Congo.
Length of Guinea (north to south).	North to south length of Congo State (mean).

Coast of Anzola and Benguela.
 Length of Namaqualand, north to south.
 Cape Town to Natal (straight line).
 Length of Cape Colony (north frontier line).
 Length of South African Republic and Orange River Free State.
 North Madagascar to Mauritius.
 North Madagascar to Zanzibar.
 South Madagascar to Delagoa bay.
 Ulundi to mouth of Zambesi.
 Mouth of Zambesi to Victoria falls.

Victoria falls to Tanganyika.
 Victoria falls to Walfish bay.
 Victoria falls to Kimberley (Orange river).
 Kimberley to Walfish bay.
 Cape Town to Mafeking.
 Cairo to Dongola.
 East-west breadth of Egypt (at Wady Halfa).
 White Nile to Zeylah (west to east).
 Northern boundary of Somaliland.

AMERICA.

Mount Hecla (Iceland) to Cape Farewell (Greenland).
 Cape Farewell to Resolution island (Hudson straits).
 Cape Farewell to Cape Charles (South Labrador).
 East to west breadth of Greenland (through Jacobshavn).
 Length of coast-line of Labrador.
 Mouth of St. Lawrence to Quebec.
 North to south length of Hudson bay to Cape Wolstenholme.
 Detroit to south of Hudson bay.
 " Montreal.
 " New York.

Detroit to Charleston.
 New York to Charleston.
 South of Lake Winnipeg to Rocky mountains.
 South of Lake Winnipeg to south of Hudson bay.
 South of Lake Winnipeg to Chicago.
 Bermuda to Cape Hatteras.
 Cape Hatteras to South Florida.
 Mean north to west breadth of Alaska.
 Length of California.
 " Cuba.
 East to west breadth of Ecuador.
 " " Peru.
 " " Bolivia.

AUSTRALIA.

Mean breadth of Queensland (east to west).
 Mean breadth of New South Wales.

Mean breadth of South Australia.
 Coast-line of New South Wales.

F. J. S. CLEEVE,
 Captain R.A.

Prof. Copeland's Revised Map of Franz Josef Land.

I notice in the August issue of the *Geographical Journal* an important and most interesting article by Prof. Copeland. In this article Mr. Copeland endeavours, as Payer's friend, to revise the latter's original map of Franz Josef Land in the light of recent discoveries, and at the same time to retain as much as he possibly can of the *status quo ante*. That is chivalrous; still, in the absence of my friend Mr. Jackson, and pending his return to the inhabited world, I must enter a protest against the attempt to rehabilitate Richthofen peak. For in spite of the fact that Jackson has camped in perfectly clear weather on the spot where Richthofen peak was stated by Payer to rise some 5000 feet above the sea, and that Jackson has seen nothing whatever resembling it (the highest point within some miles being a cape some 700 feet high), Prof. Copeland thinks that Richthofen peak still exists and is approximately of the same dimensions and in the same locality as defined by Payer.

Prof. Copeland writes (*Geog. Jour.*, August, 1897, p. 186): "From these considerations, it seems very probable that Richthofen peak is to be looked for at no considerable distance from the point indicated on the map, and that its height does not differ greatly from 4000 feet."

According to Prof. Copeland, Payer estimated the distance of this peak, when he saw and described it, to be about 60 nautical miles* distant from his point of observation. Now let us see what Jackson, who has twice camped in the very locality allotted to Cape Richthofen, says about it. I turn first to my paper in the *Geog. Jour.*, December, 1895, p. 518—for even then it had been discovered that Richthofen peak was not to be found where the map placed it: "Mr. Jackson camped within a mile of the spot in clear weather, and he states there is not a mountain to be seen, or anything approaching to one, north, south, east, and west, in that locality."

Not far away, however, was a cape, about 700 feet high, and in the following year, in remarkably clear weather, Jackson ascended this cape and sketched and photographed the surrounding locality (see *Geog. Jour.*, December, 1896, p. 552). As this was the nearest approach to the Richthofen peak of Payer, Jackson named the headland Richthofen cape.

This is what he says in one of his 1896 letters: "The cape upon which we got this view" (a view unobstructed by fog in any direction) "is the one in Payer's map upon which his Richthofen peak stands (which does not exist at all, as I told you last year)."

Now, Prof. Copeland would have us believe that what Payer saw at the distance of 60 geographical miles is fact; and that, consequently, what Jackson saw, *when on the very spot in question*, is fiction. At least so it would appear to me. Any one acquainted with arctic travel, or its abounding and deeply interesting literature, knows that it is extremely easy to mistake cloud and fog-banks for distant land. And this would seem to be the solution of Prof. Copeland's difficulty. Indeed, in the professor's contribution to the *Geographical Journal* of this month, I find that he provides this very solution (see *Geog. Jour.*, August, 1897, p. 189): "The greatest error in the original map is the north-eastern part, where Payer shows the large Dove glacier extending far to the north, in place of the open sea with a solitary group of islands which Nansen found in that region. There seems little doubt that Payer on his northward journey mistook fog-banks on the eastward horizon—possibly in combination with the ice-hummocks, which would naturally be found on the margin of the fiord ice—for an extension of Wilczek Land towards the north beyond the latitude of $81^{\circ} 5'$. This mistake is the more pardonable," etc.

This explanation of Payer's apologist might reasonably, I think, be extended from the glacier to the peak. For if Payer could lay down a glacier of vast extent where no such glacier existed, and when within *twenty* miles of its supposed position, how much more easily could he establish a mountain where no mountain stands, when *sixty* miles distant from its reputed locality?

To the outsider, of course, the probabilities admit of no comparison. *The man on the spot* knows more about that spot than the man whose nearest approach to it is 60 miles away.

ARTHUR MONTEFIORE BRICE,
Hon. Sec. Jackson-Harmsworth Expedition.

157, Strand, W.C., August 9, 1897.

* This is Prof. Copeland's statement. I make the distance less, both in Payer's original and Prof. Copeland's revise.

GEOGRAPHICAL LITERATURE OF THE MONTH.

*Additions to the Library.*By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademia.	Mag. = Magazine.
Ann. = Annals, Annales, Annalen.	P. = Proceedings.
B. = Bulletin, Bollettino, Boletim.	R. = Royal.
Com. = Commerce, Commercial.	Rev. = Review, Revue, Revista.
C. Rd. = Comptes Rendus.	S. = Society, Société, Selakab.
Erdk. = Erdkunde.	Sitzb. = Sitzungsbericht.
G. = Geography, Geographie, Geografia.	T. = Transactions.
Ges. = Gesellschaft.	V. = Verein.
I. = Institute, Institution.	Verh. = Verhandlungen.
J. = Journal.	W. = Wissenschaft, and compounds.
M. = Mittheilungen.	Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

- Austria—Bohemia.** Bourlier.
Bibliothèque d'Histoire contemporaine. Les Tchèques et la Bohême Contemporaine. Essai d'histoire et de politique. Par Jean Bourlier. Paris: J. Alcan, 1897. Size 7½ × 5, pp. x. and 266. *Price* 2s. 6d.
A sketch of the history of Bohemia and of the present position of Bohemian affairs.
- Belgium and Holland.** Baedeker.
Belgium and Holland including the Grand Duchy of Luxembourg. Handbook for Travellers by K. Baedeker. With 14 Maps and 21 Plans. Twelfth Edition. Leipzig: Karl Baedeker; London: Dulau & Co. 1897. Size 6½ × 4½, pp. lxii. and 418. *Price* 6s. *Presented by Messrs. Dulau & Co.*
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A gloomy view of the condition of British colonies sixty years ago.

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The Unity of the Empire. (Abstract of Lectures delivered before the Society by Prof. J. Kirkpatrick, M.A., LL.D., and Prof. G. W. Prothero, M.A., D. Litt., in January and March, 1897.)

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Challenger Expedition Reports. Portraits of the Contributors, reproduced from the photographs presented by them to John Murray, Naturalist on the *Challenger Expedition* and Editor of the "Challenger" Reports; with Facsimiles of the designs for the cover and dedication of the Album containing them, by Walter Crane. London: Dulau & Co., 1897. Size 12½ × 10½. 19 Plates of Portraits.

This interesting volume is a reduced facsimile of a presentation-album given to Dr. Murray, of the *Challenger*, by the contributors to the 'Reports' of that expedition, and it contains the portraits of them all. Being uniform in size with the official 'Reports,' it forms a concluding volume which no library possessing that work would willingly be without.

Classification of Science.

Arctowski.

La Généalogie des Sciences. Quelques remarques sur la Bibliographie des Mémoires scientifiques et le Principe de la Classification naturelle des Sciences. Par Henryk Arctowski. [Extrait du *Bulletin de l'Institut international de Bibliographie* (2^{me} Année, 1897, fascicule 3).] Bruxelles: F. Larcier, 1897. Size 10 × 6½, pp. 20. Presented by the Author.

An appeal for the consideration of the historical development of a science in constructing a scheme of classification.

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A careful summary of the economic geography of all the continents, with reference to the producing regions and the markets of the world.

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- Constellation-figures.** *J. R. Asiatic S.* (1897): 205-226. **Brown.**
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 Is the Earth a Planet? A Study in Physical and Mathematical Geography. By C. Robertson, M.D. Edinburgh: St. Giles' Printing Co., 1897. Size 9½ × 6, pp. viii. and 82. *Price 2s. Presented by the Publishers.*
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- Educational.** *J. Manchester G.S.* 12, 1896 (1897): 183-187. **Reed.**
 Practical Geography in Manchester. By J. Howard Reed.
 A paper read by Mr. Reed at the meeting of the British Association in Liverpool in 1896.
- Educational.** **Spencer.**
 Chapters on the Aims and Practice of Teaching. Edited by Frederic Spencer, M.A., &c. Cambridge: the University Press, 1897. Size 8 × 5½, pp. viii. and 284. *Price 6s. Presented by the Cambridge University Press.*
 This handbook, especially the chapter on the teaching of geography, by Mr. Yule Oldham, has already been referred to (*ante*, p. 220).
- Educational.** *J. School G.* 1 (1897): 81-85. **Davis.**
 The Use of Geographical Periodicals. By W. M. Davis.
 Prof. Davis gives a capital illustration of the way in which teachers may gain the fullest educational profit from geographical papers. He takes as an example Mr. Clifford's paper on the Malay States in the January number of the *Geographical Journal*, and shows not only how to extract the essential and characteristic facts, but how best to keep a record of such facts available for ready reference.
- Educational—Methods.** **Pasanisi.**
 Il Metodo Ciclico nell'insegnamento secondario della Geografia. Relazione del Prof. Francesco Maria Pasanisi.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 411-419.
- Educational—Methods.** *Rev. G. Italiana* 4 (1897): 204-212. **Bigoni.**
 La geografia nelle scuole classiche, del Prof. Guido Bigoni.
 On the teaching of geography in classical schools, with many references to Italian literature on the subject.

- Educational—Plant-distribution.** *J. School G.* 1 (1897): 97-102. **MacMillan.**
 Geographical Distribution of Plants. By Conway MacMillan.
- Frontier Delimitation.** *P.B. Artillery I.* 24 (1897): 207-230. **Trotter.**
 The Science of Frontier Delimitation. By Lieut.-Colonel J. K. Trotter, R.A.
 A note on this paper will be given.

- Geography.** **Wisotzki.**
 Zeitertömungen in der Geographie. Von Dr. Emil Wisotzki. Leipzig: Duncker & Humblot, 1897. Size 10 x 7, pp. x. and 468. Price 10s.

A series of monographs showing extensive reading and dealing from the historical point of view with special questions in geography. The titles of the separate essays are—On Springs, The Aim of Geography, The Mutual Relations of Mountain Systems, On Pure Geography, An Appreciation of Ritter, Ritter on Vertical Relief, The Term Continent, The Eastern Boundary of Europe, The Divisions of Asia.

NEW MAPS.

By J. COLES, *Map Curator, R.G.S.*

EUROPE.

- Balkin Peninsula.** **Baldacci.**
 Botanische Original-Karte von Mittelalbanien u. Epirus. Bearbeitet von Dr. A. Baldacci. Scale 1: 1,000,000 or 15.7 stat. miles to an inch. *Petermanns Geographische Mittheilungen*, Jahrgang 1897, Tafel 12. Justus Perthes, Gotha, 1897. Presented by the Publisher.

- Caucasus.** **Schuchardt.**
 Das Kharthwelische Sprachgebiet im Südwestlichen Kaukasus von Prof. Dr. Hugo Schuchardt. Scale 1: 1,300,000 or 21.2 stat. miles to an inch. *Petermanns Geographische Mittheilungen*, Jahrgang 1897, Tafel 6. Justus Perthes, Gotha, 1897. Presented by the Publisher.

- England and Wales.** **Ordnance Survey.**

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12, 15; XXII. 4, 5, 6, 7, 8, 9, 10, 11, 12; XXIII. 4, 7; XXIV. 1, 2, 3, 5, 6, 10, 11. *Sussex*, IV. 14; XI. 10, 12, 13, 14, 15, 16; XIII. 8, 16; XIV. 1, 2, 3, 4, 5, 6, 7, 9, 10, 11; XXI. 1, 2, 12, 15; XXII. 4, 5, 6, 7, 8, 9, 10, 11, 12. *Ss.* each.

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Germany.

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Tiefenkarte der Eifelmaare. Nach eigenen Lotungen entworfen von Dr. Wilhelm Halbfass. Scale 1 : 25,000 or 2.5 inches to a stat. mile. *Petermanns Geographische Mitteilungen*, Jahrgang, 1897, Tafel 11. Gotha: Justus Perthes. *Presented by the Publisher.*

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Lepsius.

Geologische Karte des Deutschen Reichs auf Grund der unter Dr. C. Vogels Redaktion in Justus Perthes Geograph. Anstalt ausgeführten Karte in 27 Blättern in 1 : 500,000 (or 7.8 stat. miles to an inch). Bearbeitet von Dr. Richard Lepsius. Lieferung xiii. Blatt 9 u. 10. Lieferung xiv. Blatt 8, and Index. Justus Perthes, Gotha. *Price 3 marks each part.*

The present issues complete this excellent map, and are accompanied by a full index, which adds considerably to its value for purposes of reference.

AFRICA.

Central Africa.

Beringer.

A map of the Shire Highlands (British Central Africa Protectorate). By O. L. Beringer, A.M.I.C.E. Scale 1 : 126,720 or 2 stat. miles to an inch. 2 sheets. 1897. Edward Stanford, London. *Presented by the Author.*

In this map the hills are shown by contour-lines, the heights of the principal elevations being given in feet, all roads and tracks are laid down, and the positions of military posts, police stations, etc., are indicated. As the map is drawn on a large scale, it will be found useful for reference by all persons having an interest in the British Central Africa Protectorate.

German East Africa.

Kiepert and Meisel.

Karte von Deutsch-Ostafrika. Scale 1 : 300,000 or 4.7 stat. miles to an inch. Sheet D iv. Kilimatinde. Berlin: Geographische Verlagshandlung Dietrich Reimer (Ernst Vohsen).

This sheet includes the country lying between latitudes 5° 30' S. and 7° S., and from long. 34° E. to 36°. The routes followed by Cameron, Burton and Speke, Stanley, Emin Pasha, Pearson, Burdo, Prince, and other explorers, are laid down. The latest reliable material has been employed in the compilation of this map, which is a valuable addition to the sheets already published.

AMERICA.

Central America.

Sapper.

Verteilung des Regenfalls im Nördlichen Mittelamerika: Regenfall in der Verapaz in den Monaten Januar u. Juli. Entworfen von Dr. Carl Sapper. Scale 1 : 1,000,000 or 15.7 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1897, Tafel 10. Gotha: Justus Perthes. *Presented by the Publisher.*

Bolivia.

Sanjines.

Mapa Postal de Bolivia. Scale 1 : 3,400,000 or 53.5 stat. miles to an inch. Victor E. Sanjines el Director General de Correos, La Paz, 1896. *Presented by the Direccion General de Correos, La Paz.*

AUSTRALASIA.

New Guinea.

Lauterbach and Kersting.

Vorläufige Skizze des Reiseweges der Kaiser Wilhelm Land Expedition im Jahr. 1896. Entworfen von Dr. Lauterbach und Dr. Kersting. Scale 1 : 3,000,000 or 47.9 stat. miles to an inch. Gesellschaft für Erdkunde zu Berlin. Sitzung vom 2 Januar 1897. *Presented by the Berlin Geographical Society.*

GENERAL.

The Moon.

Weinek.

Photographic Atlas of the Moon. Based chiefly on focal negatives of the Lick Observatory, to the scale of 10 feet to the Moon's diameter, executed by Prof. Ladislav Weinek, Ph.D., sc.D. Maginus sheet. Published by Carl Bellmann in Prague. Presented by the Publisher.

CHARTS.

United States Charts.

U. S. Hydrographic Office.

Monthly Current Chart for the North Pacific Ocean for July, 1897. Published at the Hydrographic Office, Washington, D.C. Presented by the U.S. Hydrographic Office.

PHOTOGRAPHS.

Africa.

Schweinfurth.

Photographs of the Italian possessions on the Red Sea coast of Africa (Eritrea), taken by Dr. G. Schweinfurth in 1894. Presented by Dr. G. Schweinfurth.

This series contains 40 photographs, which have been well chosen to illustrate the nature of the scenery and natives of the Italian possessions on the coast of the Red Sea. They form a valuable addition to the Society's collection.

(1) Group in front of a house at Adi Soga (Mai Mafeles); (2) Camp at Saganaiti; (3) Group in front of a house at Adi Soga (Dembelas); (4) Children sitting round an Abyssinian table in Adi Soga (Mai Mafeles); (5) Shoan horse (the property of S. Guascon, of Massaua); (6) Travelling silvermith of Adi Soga; (7) Glen with pool at Halai; (8) Ditto; (9) *Euphorbia tirucalli* trees near church at Mai Mafeles; (10) Market scene at Halai, with native soldiers; (11) Valley of the Anseba with sycamore trees; (12) Camp below Adi Soga, Adi Golgol on the left; (13) Glen with pools near Halai (east side); (14) Halibaret, view towards the south-east—an *Adansonia* in the foreground; (15) Dr. M. Schoeller and his hunters in Kohaito; (16) Mohamed Okud and Lebal Idris, our guides (Beni Amer, Salendoa); (17) Three Sabo, Assorta, with Omar Ahmed of Kohaito in the centre; (18) Mahio, Glen of the Haddas; (19) Church at Saganaiti; (20) Beni Amer, three of our camel-drivers; (21) Beni Amer hunters; (22) Near Halibaret, view towards south, Kirba Halib peak on the right; (23) Road-making near Ambelaco; (24) Camp near Ambelaco; (25) Eahka glen, Kohaita from the north-west; (26) Glen of Gna, near Saganaiti, with *Ficus palmata*; (27) Grove of *Euphorbia Abyssinica* near the church of Amba Sareb, in the neighbourhood of Godofelassi; (28) *Cassia Arereh* near Mai Mafeles, Dembelas; (29) *Gardenia lutea* near Mai Mafeles; (30) *Aloe shimperi* near Saganaiti; (31) Large rosebush near Halai (*Rosa Abyssinica*); (32) Mansurah valley; (33) Safira, Old Dyke (eastern half), Kohaito; (34) Glen with pool, *Ficus capensis* on the right; (35) Chor Mansurah, Upper Barka (Wadi); (36) Glen with pool at Halai, with *Ficus capensis*; (37) *Bonoeilia papyrifera* near Mai Mafeles, Dembelas; (38) Zad Amba from the south-west, near well on the Shetel river; (39) Large juniper tree near Halai; (40) No title.

Vancouver Island.

Laing.

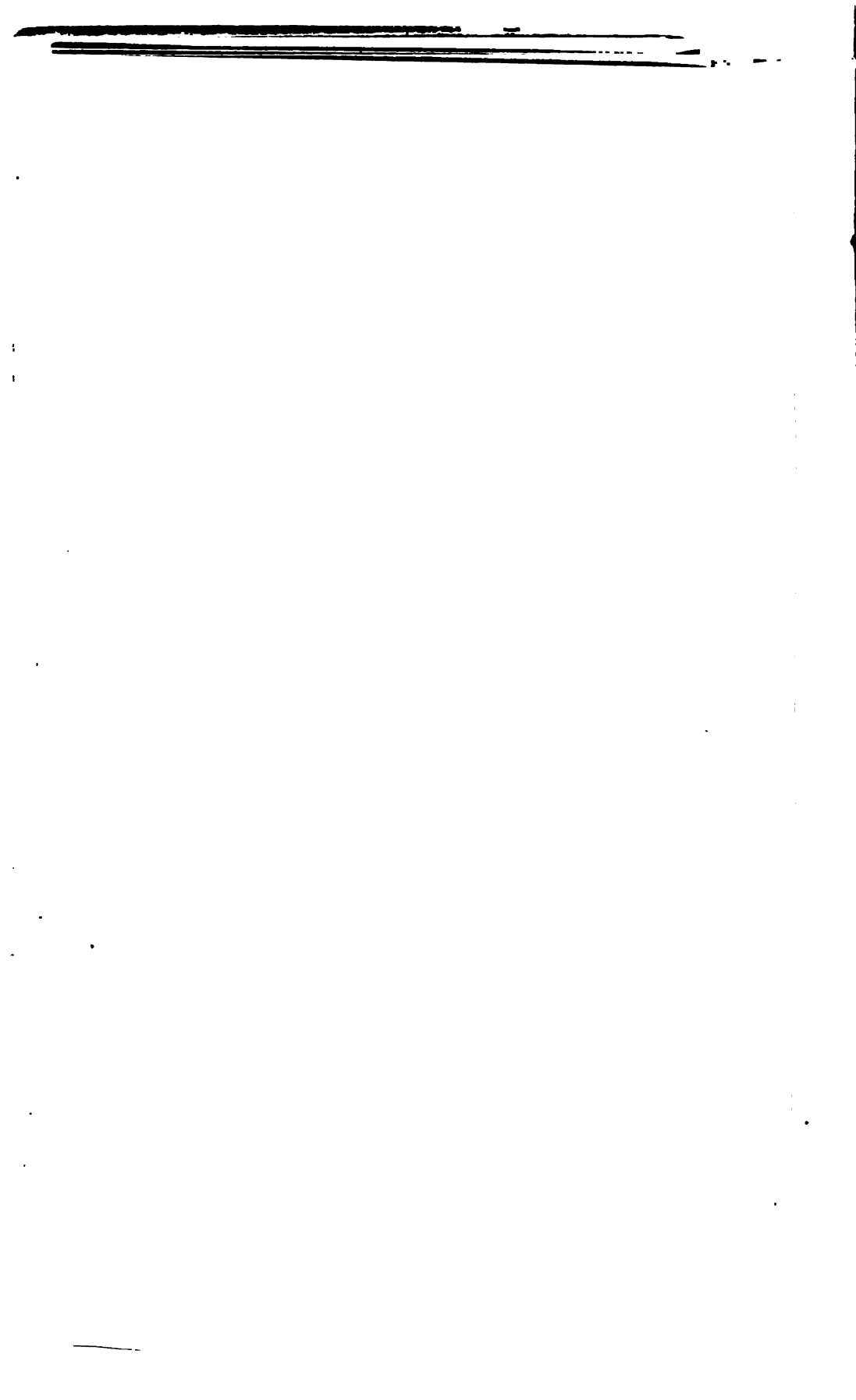
Twenty-one Photographs of Vancouver Island, taken by J. W. Laing, Esq., M.A. Presented by J. W. Laing, Esq., M.A.

The beautiful scenery of the interior of Vancouver island is shown in these photographs, which, though taken under difficulties, are remarkably good specimens of what a traveller may do in this direction.

(1) Our camp, Tahsis valley; (2) Kowse glacier and mountain, 5000 feet, head of Woss lake; (3) Head of Ilupana Aram; (4) The rapids, Nimpkeesh river; (5) McQuinna, chief of Nootka, great grandson of the McQuinna who met George Vancouver; (6) Trout 4½ lbs., caught at head of great central lake; (7) A catch of trout before breakfast; (8) Devil's Club plantation, Tahsis valley; (9) Near the mouth of the Tahsis river; (10) Left-hand river flowing into head of great central lake; (11) Tahsis mount, 5600 feet, and Tahsis river; (12) Our camp on the Kla-Anch river; (13) Nimpkeesh lake; (14) Log jamb on Kla-Anch river; (15) Right-hand river, head of Great Central Lake; (16) Kla-Anch river; (17) Group of Muchalat Arm Indians; (18) Head of Great Central Lake; (19) The rapids of Kla-Anch river; (20) Woss lake (looking up); (21) Connuma peak, 4890 feet.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.





The Geographical Journal.

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OCTOBER, 1897.

VOL. X.

NUPE AND ILORIN.*

By SEYMOUR VANDELEUR, D.S.O., Lieut. Scots Guards.

I HAD so recently the honour of addressing the Royal Geographical Society on a very different part of Africa, that I feel rather diffident in speaking now about a country of which I have had such a short if varied experience, and my excuse must be that I have been induced to do so by others. It will be difficult to eliminate entirely the military from the geographical aspect of the journey, and I am afraid my attention was quite as much taken up with the former as with the latter.

After a long and tedious journey along the west coast of Africa, I arrived with other special service officers on December 26, 1896, at Forcados, in the delta of the Niger, a place which up to that time had been beyond the scope of most people's geographical knowledge, but was soon afterwards to become widely known as the starting-point of the Benin expedition. Here we were met by Mr. Flint, the energetic agent-general of the Royal Niger Company, who is in charge of all the lower part of the river, and were rapidly taken up in his launch to Lokoja. The lower Niger is too well known to need any description by me, and it will be enough to say that on the second day we left the Forcados branch of the Niger, and entered the main river, up which we steamed for another three days before reaching Lokoja, 300 miles from the mouth. The scenery on approaching this place is very fine, and the river winds through high hills of curious shapes, which is a relief after the flat and uninteresting scenery of the lower river. It was a busy scene here, as preparations were being rapidly made for the forthcoming expedition.

* Read at the Royal Geographical Society, May 31, 1897. Map, p. 464.
No. IV.—OCTOBER, 1897.]

Whilst at Lokoja I went down to the chief Abbega's house to see a dance by various tribes, and it was really as curious a performance as one could wish to see. Women, supposed to be possessed of the devil, jumped up into the air, and then came down in a sitting posture, which was meant to squash the devil. The women who did this were usually old and unwieldy, but they repeated it several times, although it must have occasioned them a good deal of pain. Some men made an iron red hot, and then rubbed their feet along it, one even licking it with his tongue, and one could hear the hissing of the burning flesh. The natives are mostly Mohammedans, and what astonished me particularly, after coming from the East Coast, was the enormous amount of cloth which is worn by the people of these parts.

A great deal of work had to be done in getting the instruments ready and rating the chronometers, and on the day before starting I went up to the top of Mount Pati, a high table mountain lying close behind Lokoja, and 1400 feet above the sea. There is a fine view from here over the confluence of the rivers Benue and Niger, where at this time of year a large extent of sandbank is uncovered, but it was spoilt by the Harmattan wind. This wind, bringing with it minute particles of sand from the Sahara, which obscure the atmosphere, is a perfect curse to the geographer, although it may be the means of keeping off some of the hot rays of the sun. Hills not far distant appear dim and indefinite as in a London fog, and it is impossible to select any point on which to take a bearing.

Everything being organized, we marched out of Lokoja on Wednesday, January 6. A long line it was, with about nine hundred carriers and five hundred soldiers, all in single file, and the column must have extended for over two miles. Threading our way through the town, we passed the magazine fort, and marched in a northerly direction, with the river Niger close to our right and a high range of hills to our left. These hills form a series of buttresses jutting out at regular intervals towards the river, and are divided by streams or rivulets, which make their way down through narrow valleys from the high ground of the interior. It was up one of these valleys we turned in a north-westerly direction after going for two miles, and made our camp at Felela Busa. As might be expected with such a large caravan, starting was not at all *couleur de rose*, and many loads had to be repacked and readjusted. Three hundred of the porters were drawn from the coast, among them being Fantis, Ashantis, and natives from Accra and Lagos; the remaining six hundred being Hausas and Yorubas drawn from the country itself, and the latter were far and away the best and strongest. They struck me as being much better clothed than the East Coast porter, though one could not say this at the end of the expedition, as they had literally lost or sold nearly all their clothes. They were much quieter on the march than the porters of the east, and did not sing like them.

Pursuing the same direction, we came to the small village of Emu on the morning of the 8th, after crossing the small river Gadwanga, and the hills still loomed up in the mist on each side of us. The country, covered with grass 3 feet high and low trees, was very dry and burnt up, and it was a relief to see green palm trees on the banks of the stream, along the course of which we continued for the rest of the day. We camped under a high hill, on the top of which lies the village of Jakuro, which we reached the next morning, situated among a lot of rocks, and shaded by magnificent trees. The houses built by the people here are made of mud and wattle in an oblong shape, with



MARCH TO KABBA.

(From a photograph by Dr. Craster.)

thatched roofs, and around the village were small fields of dhurra. The country now became more hilly and undulating, and we made our way by a rocky path sometimes along narrow ridges, and up and down steep declivities, with always the same arid and barren aspect on all sides. There were no shady trees to keep off the rays of the sun, which was very hot in the middle of the day, and as we ascended to the high ground, the difference of temperature became very marked, the minimum for this day being 59°, and the temperature even at 4 p.m., with a swing thermometer, being 94°. We had ascended a great deal since leaving the Niger, and were already at a height of 1000 feet above the sea. Our camp near the village of Akpara, on the 11th inst., was one of our highest points, by boiling-point 1480 feet above the sea, and

it is pleasant to think that behind the low and malarious west coast of Africa and delta of the Niger, there are these fine healthy uplands, where the nights are cool.

Signs of the slave-raiders were now becoming apparent, and we passed two deserted villages which had been raided and burnt by the Bida people; only the blackened walls remained. The country had been completely depopulated by the continuous raids, and the unfortunate natives lived in constant dread of being captured and sent off into the depths of the Western Sudan, with the alternative of dashing off into the bush with their children and some food, and emerging to find their homesteads burnt to the ground.

Akpara, the biggest place we had yet come across, was prettily situated on some high ground with small peaks on each side, and was surrounded by an abundance of plantains, yams, and oranges, the path leading through an avenue of fine trees. The natives crowded together at the cross-roads to see the column pass through, and were mostly dressed in native cloth dyed blue with indigo. After leaving Akpara, the country was barren and deserted until we reached Sura. On January 11, we gradually neared the high rocky hill which is called Pati Sura, under which lies the village, and before halting had a fine view across a valley to the north of Sura, towards a range of hills in the distance. From this place, which is in lat. $8^{\circ} 5' 43''$ N., we altered our course altogether, and steered in a southerly direction to Kabba, the position of which town was at that time uncertain. The track led us close along the base of Pati Sura, and then across a plain covered with low trees and scrub to another ridge of hills, at the base of which we found the river Mimi flowing, a lovely stream of about 30 feet broad, which drains all this country, and runs into the Niger two miles below Lokoja.

We were going along as fast as we could now, without tents and only carrying light loads, and, with the exception of two hours' halt in the middle of the day at the Mimi river and minor halts, we travelled all day. In the afternoon the country became more thickly wooded, and just before halting we reached the village of Epi, hidden away in a dense belt of forest. In the open glades round the houses a great deal of tobacco, yams, and cotton is grown, and the soil seemed very fertile. It was quite like going from light into darkness, and the trees entwined themselves over our heads. We camped on the further side of the forest, at a height of 1660 feet; the monotony of the journey being only broken by the capture of a "dankary," or Nupe soldier, in the grass at the side of the road, who was probably a spy watching our movements. He made a bold bid for freedom, and dashed off into the bush from his captors, being instantly pursued by some carriers and Hausa soldiers, who brought him back in triumph—not, however, without his having bitten a carrier very badly in the mouth before he could be recaptured.

Notwithstanding all efforts to guard him, he managed to escape during the night, and created an alarm in the camp.

When we started the next morning it was very misty, and the grass, here very luxuriant and about 4 feet high, soon wetted every one through and through, until, after going 8 miles, we reached a lovely open country covered with scattered palm trees. We now turned westward again, and crossed a green valley, where signs still remained of a large encampment, probably used by the Fulas some years ago. Two little hills in front gave us our direction, and, after passing



MARCH TO KABBA.

(From a photograph by Dr. Craster.)

between them, we could see the curious-shaped rocky hill at Kabba, and reached the wall of that town at one o'clock after eight days' march from Lokoja. It is a most picturesque place, lying among pine woods, and evidently a shadow of what it had been once upon a time. The mud wall plainly shows the former extent of the town—over a mile from one side to the other—which has been so reduced by raids and slavery for the last quarter of a century, that now there cannot be more than 5000 inhabitants.

The Fula war-camp was situated 4 miles further on, and consisted of an enormous collection of thatched huts and enclosures, covering over a square mile of country. Situated on a slight eminence, the ground round is fairly open, and covered with dried-up grass 3 feet in

height and isolated palm trees. Rocky hills with precipitous sides rise up on each side about 2 miles distant, and form a sort of line of outposts to the camp; the top of one of these overhangs the base to such an extent, that one wonders how it does not overbalance and tumble over. It is a fine country for horses, and there were signs of many of them about the camp, but the Fulas had preferred not to risk an engagement.

The important towns of Gidi and Aieri lie out in this direction. On our return to Kabba, an imposing ceremony was held in the marketplace of the town, where the governor met the chiefs of Kabba and neighbouring towns, and formally proclaimed the freedom of Southern Nupe from the Fula power and the cessation of slavery. The whole force paraded and formed up in two columns facing the town, the seven-pounders drawn by ropes in the centre. The dark green background formed by Kabba hill was covered with groups of natives, perched together on the rocks, and was relieved by the touches of colour of the chiefs' robes. The old king himself was dressed in a red and gold gown very much faded, and a red tarboosh with blue tassel, the others wearing red, blue, and yellow tobies.

Very good cloth is made in the Western Sudan, and there is a great industry at Kano, where cloth is dyed blue with indigo. A great deal of it is worn on the body, and often immense folds wound round the head as a turban. The natives are ugly and unprepossessing, and bear traces of the slavery which has laid such a heavy hand on them. We arrived back at the camp we had left at Sura with the reserve supplies on the 16th, where we found all well; and, after a halt of one day, started on our march to Egbon, which was now almost due north of us. After leaving Sura village the country was wooded and uninhabited, and we descended gradually over rocky and gravelly soil to the Feraji river, which flows to the eastward north of Akpara. Five miles further on we reached the village, which bears the same name, where there is lovely clear water drawn from wells. The country round is very thickly wooded; a great deal of cotton is grown, and I noticed women in a house at work on the looms, which are most ingenious. Just before reaching Feraji we passed by the left of a range of hills running east and west, and I was able to get a glimpse of the country in front of us by ascending a small hill near the track. It seemed fairly level, though to the westward two or three high hills were noticeable.

On the 19th we reached a watercourse and re-entrant into the hills, up which we advanced, and camped beyond the village of Shale. This was an interesting point for us, as we noticed the water was now flowing the other way in a northerly direction into the middle Niger. The country became very barren and arid as we approached the Jakpana hills, and at a cross-roads just before reaching them, a little path led down to a water-hole, which, after being cleared out assiduously, yielded

about three pints of very dirty water. We ascended the hills by a steep path over stony and volcanic ground, some of the lava rocks over which we marched being extremely hot and trying to the naked feet of the porters, and it was a difficult march for them. There are three distinct peaks, the centre being a triangular rock without a particle of vegetation on it, which is visible for many miles, and would seem to have been specially placed there as a point for surveying. We passed over the col between two of the small peaks, and descended into the valley the other side. Before leaving the ridge we had a fine view over the valley to



MARKET CANOE AT EGGA.

(From a photograph by the Earl of Scarborough.)

the west, and, on looking back, two twin peaks of no inconsiderable size, which we had hitherto missed seeing owing to the thick bush, now came into view, forming a gateway at the end of the valley. From this elevation, 1180 feet above the sea, we descended into the plain which borders the Niger, and as we left the rugged sides of the hills, fields of cultivation appeared, and the country became much more prosperous looking. Here we first came upon a Nupe village—Kosobeji by name—utterly different to any village we had yet seen, and remarkable for the neatness of its walls and the structure of its houses; these were nearly all circular, and made of red mud walls with very neatly thatched roofs. Intermingled with little structures of the same

sort for grain, raised from the ground, they were crowded together into the smallest space imaginable, so that one wondered how the natives could move about among them. Nearly every house had a miniature courtyard, separated from the next house by a small wall. An enormous quantity of corn was found here, and it proved to be a food depôt of the southern Nupe army, which had been dispersed at Kabba.

From Kosobeji, a very gradual descent across a great plain covered with dry grass 4 feet high led to the Kampi river, at this time only a few yards broad, but which is evidently a very fine river in the rains, about 150 yards broad, flowing between sandy banks, and emptying itself into the Niger near Egga. As I noticed throughout, this country would present an utterly different appearance in the rains; little ravines and sandy river-beds, which we crossed dryshod, doubtless become seething torrents, and render travelling very difficult, if not impossible, for caravans loaded as we were. On approaching the Kampi river in the early morning, a peak towards Egbon loomed up out of the mist in the distance, the very image of one of the pyramids in Egypt, the side turned to us being lit up by the sun's rays with a beautiful soft yellow colouring, strengthened by the blue shadows on the edges, whilst away over the brown dried-up grass a belt of dark green palm trees indicated the course of the river, making a brilliant contrast with the surrounding country. An hour further on we reached Padda, a large Nupe town of 4000 to 5000 inhabitants, which was flying the Company's flag, and contained many fine circular houses and markets. The people were friendly, and brought out plenty of food—plantains, chickens, and eggs—to the camp, which was posted on an undulation to the west of the town. A road branches off here to Egga, keeping to the north side of the river Kampi. From Padda we soon reached the Niger, passing to the right of three of those curious flat-topped hills peculiar to West Africa, which rose up almost perpendicularly from the ground, echeloned from right to left. They are called the Egbon hills, and are visible from a ridge near Bida; the pyramid peak lies a little to the south of them. Between Padda and the river several small farms, with fields of cultivation round, lie scattered about, the property of the Nupe princes, and worked by their slaves, sent across the river for the purpose.

It was pleasant to see the great river again, after seventeen days' marching through the bush, and we camped at Egbon, a small village, where there was an open space in the woods which border the river, and where the bank shelved steeply down to the water's edge. Close to the side lay the flotilla of armed stern-wheelers and launches which had made their way up from Lokoja under Mr. Wallace, C.M.G., at the beginning of the month, for the purpose of patrolling this portion of the middle Niger; and we realized the advantages of sea power, or what would be more appropriately called river power, by replenishing our stock of provisions, which were by this time running somewhat

short, and getting a certain amount of soda-water, which was a treat after some of the liquid we had been obliged to drink *en route*. The patrolling had been most successful, and by the strategy adopted the two Nupe armies were effectually separated.

Before crossing the river, it may be interesting to give some account of the people against whom we were proceeding. The rulers of all the Hausa states in the Western Sudan are a race known as Fulas. Resembling the Wahuma in Uganda and the Lake regions, they are lighter in colour, taller, and finer looking than the indigenous population. Their history is unknown, but they would seem to be an offshoot of the great race of Gallas in Somaliland and North-East Africa. Coming from the north,



NUPE VILLAGE.

(From a photograph by Joseph Thomson.)

they gradually asserted their superiority, and conquered this country by means of superior military organization and skill, and the havoc wrought by their cavalry. It is hard to realize at home the enormous population existing in Hausaland, which forms the larger portion of Sokoto and Gando. It is estimated by Mr. Robinson at fifteen millions, or one per cent of the world's population, and of these a large proportion are slaves, who, in fact, form a species of coinage in the country. Nupe has always been one of the largest and most important states in the Sokoto empire, and the emir is said to have declared at one time that his rule extended from Guari or Zaria in the north to Asaba in the south, and from Bussa in the west to Keffi in the east—literally, over about 70,000 square miles of country.

Masaba, the founder of the Fula dynasty in Nupe, was a Sokoto prince, related to Othman wad Fodio, the African Napoleon, who, at the commencement of this century, created the immense Fula empire of Sokoto and Gando. Masaba was so deeply indebted to one of his generals, Omru, that he decreed that Omru, though not of royal blood, should succeed him on the throne of Nupe, subject to the assent of Sokoto, but on condition that on Omru's death the throne should return to Masaba's family. Accordingly, Meliki, a Masaba, succeeded Omru, while Muhammed, Omru's eldest son, was given the rank of Markum, or third in succession to the throne, the heir-apparent always holding the rank of Sheaba, and the next heir that of Potum. During Meliki's reign the rank of heir-apparent or Sheaba died out, as successive holders died of poison—one of the disadvantages of having anything to do with the throne in these countries—so that the Potum, Abu Bekri, a Masaba, refused to accept the rank which was left vacant. On Meliki's death, in 1895, Abu Bekri became Emir, or Sultan, and it is with him that the troubles which led to the expedition began, and the Markum Muhammed is the man who has been recently appointed Emir. The Hausas themselves are an intelligent race of traders, and capable of much development. That they can be made into good soldiers was proved during this expedition, and although Moham-medans, the religious question did not occasion any difficulty.

On January 23 we commenced to cross the Niger, which is here about 800 yards broad, and found high grass and very thick bush on the northern bank, through which we made our way by a circuitous path to a creek $2\frac{1}{2}$ miles from the river. This proved to be rather an obstacle, as it was very deep, and on the day following a man was drowned there. Two native canoes were found in the creek, and a steel canoe was transported here from the river, by means of which the crossing of the whole force was effected. This was not the only obstacle in the way, for on the day following a swamp nearly 200 yards broad was met with, which reminded me much of the river swamps in the Lake regions, with the exception of the papyrus, which, fortunately, does not exist in this country. The heavy guns were sadly encumbered by it, and it took severe exertions to get them through. After leaving the swamp we passed several villages and plantain groves, the country being very flat and wooded.

Before reaching the village of Lokicha, where we camped, we had to cross another small swamp, fringed with palm trees. Villages now became very numerous, and the country was thickly populated. On all sides were fields of cultivation, and it was here we came into touch with the enemy, who opposed our advance for the remainder of the march to Bida. As the parties of cavalry were driven back, and we neared the city, the enclosed country gave way to enormous open undulating plains, with here and there a village or farm nestling among a small clump of

trees. It was an ideal battle-field, and as we came down to the ravine, or nullah, through which flows the Rafi Shannu stream, we could see the Nupe army extended along the opposite ridge, and as they retired, and we surmounted this ridge, we had a really magnificent sight towards the town, outside the gates of which, and on the further side of the stream, which passes through the southern portion of the town, were drawn up the Emir and Nupe princes, and the whole of the Nupe army. We were forced to retire on this day, and it was only on the second day that we were able to advance in square with the guns and take the town.

The Fula army consists of hordes of irregular cavalry, with bands of footmen. Firmly fixed in their high-peaked saddles, with enormous



TAKING GUNS ABOARD CREEK.

(From a photograph by Dr. Craster.)

brass and iron stirrups, they galloped along on their long-tailed ponies, covered with gay trappings, waving their swords or spears in the air, with their white robes flying in the wind, accompanied at the same time by the clamour of their small drums, and the deep-based horns which were encouraging them to the attack. Very often an enormous straw hat surmounted the turban which was wound round their heads, or was allowed to fall back and hang over the shoulder. Some of the leaders were splendidly dressed, and wore flat-heeled riding-boots of red leather, which are excellently made in this country.

Bida is a striking place to find in Central Africa, and makes all the

more impression on one, after one has arrived at it from the delta of the Niger, where the natives are of the lowest order of civilization, and a most degraded-looking race, with instincts tending to cannibalism. It is situated on slightly rising ground, and watered by two streams, one of which rises only a short way from the walls; these join together in the southern portion of the town, and flow through a beautifully green valley to the east. A strong wall, 10 feet high, made of red clay, and crenelated with ditch in front, extends round the town, broken down in a few places, and from where we first saw it there appeared to be a mass of lofty thatched houses and high walls, forming enclosures, which, intermingled with fine trees, extended to the north as far as the eye could reach.

It was on January 29 that, as some paper described it, Sir George Goldie made his triumphal entry into Benin, which is as far off from Bida as Paris is from London, and with no railway connection between the two. The main thoroughfares are fairly broad, and lead from one gate to another, bordered by great enclosures and compounds surrounded by lofty walls excellently made, and often 18 feet in height, and the doorways are in some cases roughly carved outside. The walls of the large buildings are very massive, and very often the roofs of the rooms are arched and supported on pillars of black clay, which is polished, and looks exactly like stone. The principal of these palaces are those occupied by the princes of the two great families, the Massaba and Omru. Outside the late Emir Meliki's palace lies the slave-market, where formerly it used to be a common sight to see two hundred slaves exposed of an evening for sale to the highest bidder. Unfortunate creatures raided from various parts of the kingdom, even south of Lokoja in the Company's territories, they used to be sold here as a source of revenue to the Nupe princes.

The entrance to the Emir's palace is covered with a high dome made of bamboos resting on thick walls, and supported at the bottom by short carved wooden pillars. Some tame ostriches and a deer were the sole occupants left in the big outer enclosure, in one of the numerous inner courts of which there is a lovely well of pure water. A great variety of articles were found, including some very good swords, an English general's sword, a claymore, and, curiously enough, a sword belonging to an officer in the 11th Hussars, with a monogram and coronet on it. About 350 rifles, with several tons of gunpowder, different-coloured cloths, silks, and an innumerable quantity of brass basins, lay heaped up on the square. Between the main roads there is a network of narrow streets with walls on each side, and there are many mosques, though none of any size or importance. Round Bida there are some curious little hills of red sandstone, and to the east a stream leads to the Wanangi creek, which in the rainy season forms the nearest means of approach, boats being able to come up to it from the Niger.

On the 31st the governor left the town to meet a large body of traders at the Zongo camp, not far from the walls of the town. A curious assemblage they were, collected from all parts of the Hausa states and the Sokoto empire. Some came from Kano, and others from Kuka on Lake Chad, the inland sea in this western half of Africa, where the valuable blocks of potash are found. There were even traders from Tripoli on the Mediterranean, distinguishable from the others by their spotless white garments and red fezzes; and amongst them stood the inevitable Arab, light coloured, and with black flowing beard, the very picture of a slave-dealer. They were told that they could in future use the shorter route *via* Kano, Zaria and Keffi to Lokoja, instead of coming to Bida, where they would be able to dispose of their goods on the Niger, and would not be taxed in any way. The importance of



FULAS ON THE MARCH.

this trade question, and the opening up of the Niger territories, will be understood when it is realized that at present most of the European goods come across the great Sahara into the Hausa states from the north, several thousand camel-loads of goods coming annually into Kano from that direction, besides quantities of salt, which is in great demand, as it is found nowhere in Hausaland. Camels come down as far south as Bida.

After the governor had returned to the town, I accompanied Major Cunningham, D.S.O., on a reconnaissance to the north. A lovely open country lay spread out before us, across which one could apparently gallop for miles and miles. A few rocky hills stood out on the horizon,

and several villages, consisting of a few curious little circular houses, lay scattered about. As we approached one of them in a slight hollow near a rivulet, two of the enemy's horsemen came into sight, and, disregarding the shots fired at them, immediately galloped off, hotly pursued by a dashing Hussar officer, who died of fever, to our great sorrow, not long afterwards. He had a fast horse, and the wild horsemen of the Sudan were no match for him; a Nupe warrior was seen subsiding out of his unwieldy saddle and ponderous stirrups under the magnetic influence of a revolver-barrel. The horse was a good one, and far the more valuable capture of the two, but now the difficulty was how to secure the pair. This was soon solved by the Nupe making off into some thick grass as hard as his legs could carry him. A mile or two further on we reached a small hill, passing through a cloud of locusts, on the way, which quite obscured the atmosphere; and it was at a village just beyond this, called Sheshi, that we surprised a party of the enemy's horse, and made the lucky capture of Prince Esa, brother to the Markum Muhammed, and one of the most important Nupe princes. The villagers and the few natives we met on our return prostrated themselves on the ground when they saw him.

Bida is an interesting place, with its schools and institutions, and a great many books and boards with Arabic writing, also a very tattered old lion skin with a plan and some Arabic characters marked on it, were found here. There are numerous dye-pits in the town, and indigo forms a valuable article of commerce. The people themselves are great workers in leather, and make very good saddles, scabbards, and slippers; they are also workers in glass. The people are very superstitious, and carry charms wrapped up in little leather and leopard-skin cases, and they even tried to bring disaster upon us by planting little sticks with writing on in the pathway.

At Bida the average minimum temperature was 78°, and the maximum 97°, and we were not sorry to leave it on account of the plague of flies and other insects. It was under very different conditions we marched away across our old battle-field, and reached the former camp near the ravine, and the long line of porters, natives, and refugees extended for miles, confident of being no longer harassed by the enemy, and in danger of their lives. The nine-pounder had broken down, the wheel having been broken the day before, and it looked in a very helpless condition lying at the bottom of a ditch, and it was indeed lucky that this did not happen in the advance. The African porter, with his usual intelligence, decided that, after the fall of Bida, his work was at an end, and that loads of ammunition and provisions were quite a secondary consideration compared to his own loot—an enormous pile of usually the most inconceivable rubbish. With this he tried to steal out of camp in the morning, but was bitterly deceived when he arrived at the deep creek, 2½ miles from the river, and found people there to stop him.

A considerable number of officers and men were invalidated from Egbon, and the remainder, consisting of 23 Europeans and 320 soldiers, embarked on the stern-wheelers and launches for transport to our new base at Jebba, a distance of over 90 miles. The night before we left a tornado of rain swept over the camp, making it very unpleasant for every one, and the rain soon penetrated the light sun-decks of the stern-wheelers, and came down in torrents on people underneath. We used to steam all day, and in the evening drew up alongside the bank, when the men were marched off the ship and bivouacked for the night, and we resumed our voyage early again the next morning. The river



FULA EMISSARIES ENTERING CAMP.

(From a photograph by the Earl of Scarborough.)

is about 600 yards broad, though narrower in places, and some of the reaches even remind one of the Thames, though one is soon disabused of this impression by coming across a native village, with a crowd of black people yelling and gesticulating on the bank. Especially was this the case at a large village called Babefu, where the people were in a great state of excitement, and ran along the bank with us to show their delight at the defeat of the Fulas. The river at Rabba, where the old capital used to be before the days of Bida, is quite lovely; the left bank is about 40 feet high, and rocky, but at the water's edge a few green bushes, and even some palm trees, have found a footing, whilst in

the distance an island divides the channel in two, and beyond it lie the hills behind Jebba. The stream is strong, and navigation intricate; our pilot was quite a character, and kept waving his thin, bony hand to the man at the wheel to point out the course. Jebba, where we arrived on the 8th inst., is very nearly the end of the navigable portion of the river for steamers and launches, as only a few miles up commence the rapids. High hills dominate the right bank, and we could see the high rock called Baikie's seat, which is defended from all intruders by swarms of bees. There is a large island in mid-stream, on which the Company's station and the native village are situated.

The Ilorin country, into which we were now going to march, is bounded by the Ibadan country on the south, which is governed from Lagos; and it was the fact of the Ilorins having attacked the frontier forts held by the Lagos Constabulary which brought on the present expedition. To the north-east lies Borgu, visited by Captain Lugard in 1894, and to the north, on the west side of the Niger, the Bussa country, which was recently entered by the French at the time we were fighting the Ilorins. On February 10 we started on our march south along the same route traversed by Mr. Fowler in his survey, but which I believe has never been described to this Society. Making a short march the first day, we reached a village called Bodi Sadu the next, which forms a regular sort of custom-house for taking toll from the traders who pass along the road. The country was frightfully burnt up and dry at this time of the year, and the difficulties of marching considerable. A sandy path led through low trees and bushes, and across, at times, open spaces covered with dried-up grass, and the aspect of the country during the first part of the march is very similar to the waterless plateau called the Haud in Somaliland. All food had to be carried, and the water in some places was very bad. On the third day, beyond an important village called Lanwa, the only water we could get to drink was unfit even to wash in, and very soon clogged all the filters brought to bear on it.

At first we travelled due south close to a range of hills, which was on our right, whilst on the other side lay the wooded valley in which runs the river Osin, flowing into the Niger not far from Jebba. Several dry watercourses were crossed, and on the 12th we camped at a small stream called the Orere. The small villages we came upon were similar to those we had seen in the march to Kabba, and consisted of big oblong houses, untidily thatched and tumbledown looking, very different from the neat huts in the Nupe country; these were usually arranged round a square, which forms a courtyard and market. The country improves vastly as one enters it and ascends on to the high ground, and there are some very fine trees—acacia trees with red fruit, and baobab trees, also a species of poplar; the villages are often surrounded by rubber trees and small banana groves.

Lanwa is a very large village, and was thronged with natives, mostly dressed in the blue native cloth. At the Arebi river, where we arrived on the 14th, we were already 1100 feet above the sea, having ascended 700 feet from the Niger at Jebba, and we camped near a village which was surrounded by fine rubber trees, slashed by machets to get the rubber.

As we went on along the road to Ilorin the country began to assume more and more of a park-like appearance; as it was on approaching Bida, the tangled bush and undergrowth gave place to rolling plains, dotted about with fine trees of all sorts, and we passed little villages



RIVER NIGER.

(From a photograph by Dr. Crosse.)

hidden away in banana groves. At the first few villages we passed the natives remained at their doors, and everything seemed perfectly peaceful; but as we went on and came down the slope towards the Oyon river, it became apparent that we should have to fight before we entered the town of Ilorin, and we were soon afterwards attacked from all sides. Major Arnold pursued the same tactics as before, and on the second day the square advanced again to the walls of the town, which was entered that afternoon, the 16th, and too much praise cannot be given to the steadiness of the black soldiers. After crossing the Oyon river, a ridge was surmounted, and after passing through some villages and clumps of trees on the top, we came in sight of the town, which

lies on the further side of the Aza river. On all sides lay an open plain, broken here and there by a small village and some cultivation, and perhaps two or three isolated palm trees, and to the north the great Sobi rock formed a prominent feature of the landscape. The Hausa colony all took refuge with us on our approach, with their goods and chattels, and among them the soldiers recognized many of their own relations—the scene in rear of the position, where they were all collected, being a very strange one, and a perfect babel of sound went up from it. These Hausas, most of them peaceful traders, had wished to join us



INSIDE EMIN'S PALACE, ILORIN.
(From a photograph by Dr. Craster.)

before, but had been forcibly prevented from leaving the town. The Emir still refused to come to terms, and, after two hours' delay to allow of negotiation, the bombardment took place, and in the afternoon the force, preceded by the buglers, marched into the town to a large open space with shady trees in front of the Emir's enclosure. The first thing we noticed on entering the square was the gruesome spectacle of the corpse of some malefactor, having been probably executed with untold cruelties, and exposed as a warning to others on a heap of stones. The destruction of the palace—rather a misnomer for this collection of rude stone buildings—was indeed complete, and the market-place, where we pitched our tents, was still filled with the smoke and smell of burning. A curious episode was the fact of the "Fall in" for the guard being sounded that

evening in the market-place of Ilorin by an ex-bugler in the Lagos Constabulary, a few hours previously a slave in the same town, and still with the chains on his legs. Several of the soldiers found brothers and relations who were slaves in the town, and I believe several of them came away with us and enlisted.

The town, though not nearly so imposing as Bida, seemed to cover an immense area of ground, and I afterwards found out, whilst employed in making a plan of it, is 9 miles in circumference,



HAUBA PRIEST AND SOLDIER.
(From a photograph by Dr. Crosse.)

and, except on the north-east, surrounded by a dilapidated mud wall. From the many gateways well-used roads lead in all directions across the open grass country. To the south the houses become more detached, and a large extent of meadowland is enclosed within the outer wall. Magnificent baobab trees, affording splendid shade, adorn the open spaces in the town. The water-supply at this time of year is not first-rate, and there are only some evil-smelling stagnant pools of water at a few of the cross-roads, in addition to the

limited number of wells in the town itself, and the water is mostly drawn from the river Aza outside. The baloguns, or generals of the Ilorin army, and the chief traders have large enclosures and houses, and I entered one of these where a covered-in gateway, with a heavy wooden door made out of three planks about 9 feet in height, admitted one to a courtyard about 40 yards broad, round which the dwelling-houses were situated; the walls of these are massive, and in some cases roughly carved. The occupants had evidently left in great haste, and things were scattered about pell-mell in all directions; on the walls were fastened a few gaudy advertisements and pictures obtained from Lagos, and on the floor there were a number of Arabic manuscripts lying about. Through a door in the further wall one entered into an inner yard, where a lame horse was tethered, and round it there were more horses, probably for slaves and attendants. In the main doorway was fastened a miniature pair of leg-irons, such as is used for manacling slaves, which was reported to be a fetish of some kind to ward off the evil spirit.

The Emir and his chiefs had fled to villages far and wide, but were induced to surrender themselves, and on the 18th a small cavalcade, consisting of the former and his principal generals, arrived to make their peace. Mounted on their small horses covered with picturesque saddle-cloths and head-collars, they presented a curious appearance, and the old Emir himself looked an extraordinary sight with his head wrapt up in several folds of white cloth, forming a great bunch at the back of his head, one fold of which completely covered his face with the exception of his eyes and nose, and the whole was crowned by an enormous native straw hat. During the interview and the parade of troops which followed, they were very nervous and apprehensive of what might happen to them. The troops were drawn up in the square where the British flag was flying, and a treaty was signed giving complete power to the Niger Company over the country and settlement of the Lagos frontier, and the Emir was reinstated.

We set out from Ilorin on our return march on February 19, one of the hottest days I have felt, marching out of the town through what is known as the Hausa gate. Crowds of Hausa people, traders, refugees, and slaves, left the town with us, carrying their goods on donkeys and in baskets on their heads, and blocked up the road. The Harmattan wind was blowing during the march back to the river, and it was hot and dusty. At every few hundred yards little groups of men and women were sitting under shady trees to rest themselves on the journey, their loads lying on the ground near them. Some of the latter were enormous, and must have weighed fully 80 to 100 lbs. The Ilorins are a Yoruba-speaking people, and it is interesting to record that, according to Captain Mockler Ferryman, a desperate fight occurred in 1840 over exactly the same ground that we fought over, between the Yorubas, aided by a

small contingent of Borgus, and the Fulas, and that, after a prolonged contest, the latter eventually utterly routed the pagans, who had lost heart owing to the death of their leader.

Owing to the knowledge gained of the road and the watering-places, the return march of 52 miles was much quicker, and we reached Jebba in four days. Some of the Hausa people were transferred to the north bank to return to their homes; others were offered a free passage down to Lokoja in canoes. Curiously enough, although the middle of the dry season, the sky was nearly always dull and overcast at Jebba, and we had several small showers of rain. Fortunately, the night before we left there was a clear sky, and I was able to take observations.

The journey down river was a most delightful one, and our rapid voyage down to Lokoja was only broken by a stoppage at Moragi, where the governor received the Emir of Lafiagi. He went up the river again from here to Bajibo, to receive an answer from the French officer commanding the expedition which had entered Bussa, and of which he received the first intimation on the road to Ilorin by a messenger from the king of Bussa himself.

Quite an exciting experience was jumping the sandbanks, and the stern-wheeler I was on, called the *Empire*, proved so good at this that it soon distanced the remainder of the fleet, who one after another ran aground, and were lying inert like crocodiles on the treacherous banks of sand, having to drag themselves off by an iron cable. On the 24th we passed Egga, an important station of the Company's, and quite a fine-looking place, with rows of warehouses covered with corrugated iron, and reached Lokoja on the 25th, where there was naturally great excitement at the return of the troops.

People here had had little news of what was going on, and a report at one time that the expedition had been cut up before Bida, and the Nupes were advancing south on Lokoja, caused a general exodus from the town. During the following few days before leaving, Major Cunningham and I went down river in a canoe, and, pitching our tents on the river-bank, did our best to secure some West African antelope without success. We saw a few hartebeest, kobus kob, and wart hog, and the sable antelope and small gazelle exist also. It is difficult for me to give any account of the game in the country, as the expedition was much too large, and conducted in too hostile a country to allow of leaving the column for any distance.

On the high ground above Jebba there are plenty of hartebeest, and on the approach of our advanced party at the first camp from there, an officer saw a lion making off, angry at being disturbed from his resting-place. North of Bida there are also lions. It was on our way down river that we heard of the sad news of the massacre at Benin. The Patanis, a tribe living in the Niger delta only about 80 miles from Benin, whom we went against with a small expedition, were wise in

their generation, and rendered hostages for their good behaviour; so the attack did not take place, and, steaming on rapidly, it seemed like a dream to find one's self again on the mail steamer, which was luckily waiting for us at Forcados. Thanks to the wonderful organization and the success of the operations, we were able to return to England much sooner than had been expected.

It was a great pleasure, on my way home, to receive the news of the honour which had been awarded to me by this Society, which is not only a great encouragement, but recompenses one for the discomforts and hardships unavoidable in African travel.

Before the reading of the paper, the PRESIDENT said: It seems only yesterday that Lieut. Vandeleur read to us his account of the work he had done on the eastern side of Africa—I believe it was the day before he went down to Windsor to receive the reward of his services from Her Majesty the Queen. He has given himself no rest, and since that time—a very short interval—he has been doing admirable work on the western side of Africa, and, judging from his former paper, I think we may promise ourselves a most interesting evening. I will now ask Lieut. Vandeleur to read his paper.

After the reading of the paper, the following discussion took place:—

The PRESIDENT: Sir George Goldie, under whose command Lieut. Vandeleur had the honour to serve when he did this excellent geographical work, will commence the discussion of the paper.

Sir GEORGE GOLDIE: I have one fault to find with Lieut. Vandeleur's paper, namely, that he has not told you enough about himself. I may hope that, as he grows older, he will become cured of that failing. We have heard in this hall a great number of African travellers at various times, but I doubt if any can surpass Mr. Vandeleur in the all-important points of accuracy of astronomical observations and careful mapping, under circumstances so trying as those in which he found himself. In ordinary African travel you can make your camp as spacious as you please, and if troubled with the tumult inside you can go outside, but you cannot do that when making war against vastly superior numbers. Our little zareba used to be crowded every night with 30 Europeans, as many horses, 500 troops, 1000 carriers, and a host of camp-followers, and of course a mass of provisions, war material, and equipment, and I used to admire the calm imperturbability of Mr. Vandeleur in the midst of this, doing his geographical work at such moments as he could be spared from his more important military work.

Then there is another point. You may have gathered from his paper that the health conditions were not exactly of the best kind, notwithstanding the immense precautions which I may say the company took for the comfort of the officers, and the careful and constant attention which Major Arnold, excellent soldier that he is, gave to this matter, but with bad water and exposure to the equatorial sun the health was not good. I may tell you, from the day we started from Lokoja to the day we came back we had with us altogether less than forty Europeans, yet our medical staff had to attend to no less than thirty cases of fever and dysentery, and out of these thirty patients eight were invalidated as unfit to proceed further. But then Mr. Vandeleur, though you would not think it to look at him, is an old and hardened African, and I never saw him disabled for one moment from taking his sights through his sextant or his equally important sights over the barrel of his maxim gun.

Now, Mr. Vandeleur has, I think, given us in his paper and maps—excellent maps—all that there is to be said as to the direct geographical results of our operations; but if you wish me to say any more, I can briefly indicate to you certain indirect geographical benefits, which I think may be reasonably expected. The first of these is the greater security for explorers in these vast Sudan regions. I don't mean to assert for a moment that the Mohammedan potentates of the Sudan have habitually inflicted or promoted violence to white travellers, although many instances to the contrary might be quoted; but if they welcome the coming guest, they have almost invariably failed to speed the parting guest. The whole history of Sudan travel is full of records of long detentions at the various centres. I need hardly point out to you how these detentions exhaust the health and energies of the traveller, to say nothing of his resources. I will give you one instance to show why I think travelling in the Central Sudan will be more expeditious in future. Before I left this last time, I received a letter from the Emir of the powerful state of Zaria, in which he said he had sent criers round all his principal towns—for you must understand, in the Central Sudan they still maintain the system of criers, which is dying out in this country—instructing his people in future to allow white men and everybody connected with them to pass through the country rapidly and quietly. Now, I have dealt with one point of great advantage to geographical research, as a result of our operations; and here is another point—that is, the diffusion of very much needed geographical knowledge in this country about these regions. I am, of course, not alluding to the Royal Geographical Society—they know all about it, but I have noticed a great tendency in the mind of the general public to confuse Benin with Bida. Now, Mr. Vandeleur has told us that the distance from Benin to Bida is the same as that from London to Paris, only with no railway communication. I venture to point out that the gulf between cannot be measured by distance, because, as you know, Benin belongs to the barbarous pagan states which line the Gulf of Guinea, and which have little or no communication between each other; whereas Bida, or rather Nupe, of which Bida is the capital, is a province of that vast Sudan region which runs south of the Sahara, and stretches 3000 miles across Africa, from the frontiers of Abyssinia on the east to the frontiers of French Senegal on the west, a region which has considerable unity for two reasons: firstly, because of unity of metaphysical belief; and, secondly, because of the unity produced by the communications kept up by Hausa caravans continually passing among them, so that the British guns fired at Bida last January have before now reverberated at Khartum, and when the British cannon fire at Khartum their echo will reach to Sokoto. There was a third result of our operations—I think I stated I would mention three—which does not appear at first sight strictly geographical, that is, supposing geography is concerned only with the inert surface of our globe; but I think of later years we have taken a wider view, and recognized that our science is concerned as well with the vegetable and animal life on that globe, and that, of all the species of animals inhabiting the earth, perhaps not the least interesting is that known as man. Now, if we once admit that sociology comes within the sphere of geography, we must admit that the extraordinary phenomenon of universal slave-raiding going on in these regions, and therefore the means for their suppression, are matters fairly to be discussed in this hall—but, indeed, they have already been discussed here. About a year ago, just after I had returned from the Niger, I heard read here two deeply interesting papers on these regions in the same evening, one by a distinguished Fellow of this Society, Mr. William Wallace, C.M.G., who I venture to say is one of the most remarkable men, and one of the most modest men, and therefore one of the least-known men, who during the last twenty years has contributed to the

opening up of the dark continent to European civilization. I should like to say, that Mr. Wallace is here to-night. I wish you could hear him speak presently; but I may tell you, from twenty years' knowledge of him, I am perfectly confident you will not have that pleasure. The other paper to which I referred was by the Rev. Charles Robinson, mentioned by Mr. Vandeleur, who has just returned from Hausaland. In that paper, as in his book, Mr. Robinson painted most vividly the horrors and miseries attendant on slave-raiding in the Central Sudan, and being a most humane man, and feeling and thinking as he did that the burden of crushing so vast an evil ought not to be allotted to the slender resources of a chartered company, he made a strong appeal, or rather he urged a strong appeal should be made, to the Imperial treasury, that out of its vast resources it would crush this gigantic evil. After the paper was read, our President called upon me to speak, and I ventured, while concurring with Mr. Robinson, to point out that, inasmuch as the Imperial treasury had never contributed one shilling towards the creation or development of that vast British sphere, I was not very sanguine they would spend the millions necessary for dealing with this matter under our expensive imperial system. I said then the only alternative was for the Niger Company to follow the policy it had followed since its foundation—a policy successful in crushing slave-raiding south of the Benue; a policy of driving a nail where it would go, of taking a step forward wherever possible, and not attempting to take a step where the obstacles appeared for the time too strong. I was not able to tell you then that a very large step had at that time been decided on, and active preparations were being made to carry that step into effect. You know now from the press what has been done; but I ought to tell you that the work which has been done, although very important, is only part of the whole that remains to be done in that region. Whether the Company will survive to see the conclusion of that work is a matter about which I don't venture to express an opinion; but I think I may prophesy this—whether it survives, as I originally hoped, for another ten years, or whether it expires, as the French papers say it will, within the next ten weeks, whoever takes its place will be compelled to pursue its policy, and in due course of time to enable the industrious and intelligent populations of that vast region to live under a reasonable system of security and liberty.

Major CUNNINGHAM: I feel, after what Sir George Goldie has said and the lecturer has told us, that I cannot tell you anything at all from a geographical point of view. I will only give you a few words from a military point of view, if I may do so at what is, strictly speaking, a geographical meeting. When we arrived at Lokoja at the beginning of January, we found the force already assembled; twenty English officers, most of them quite new to their men. In the English army great stress is laid on sympathy between officers and men, and we rely a great deal on the men knowing their officers. At first sight it seemed a little bit doubtful how it would go, as the officers were mostly strangers; there was only one thing to make up for this—the excellence of the officers, and nothing could have been better than those we had. There is one other point without which things might have gone very differently, and that was the excellence of the preparations and organization, the equipment, the material, and everything, and for that I cannot say how deeply we are indebted to Sir George Goldie and his staff. It was a campaign conducted on a scale usually followed by governments, and really it is wonderful; it makes one feel proud of the British Empire to think a company can do what is usually done by a government. I have had the pleasure of serving more than once with Mr. Vandeleur, and can thoroughly endorse what has been said about his accuracy and work, and the difficulties under which he has had to make his observations. The same thing occurred in other expeditions when I was with him, and I have no doubt he will be equally accurate in the future.

The PRESIDENT: We had the great pleasure of listening to a paper by Mr. Wallace last May, but I fear, from what I hear, that we are debarred from the pleasure of hearing him this evening. I am sure we must all congratulate the naval commander of the Niger expedition for the admirable way in which he brought his vessels to the points where they were wanted, and therefore we accord him our warmest congratulations on his return safely home. I fear that is all we can hope from Mr. Wallace, if he is not inclined to address us. I must, therefore, turn to what was said by Lieut. Vandeleur and Sir George Goldie on the immeasurable gap between Bida and Benin. I cannot help hoping that Major Gallwey, in spite of that vast distance, will kindly give us some account of Benin, especially as he has been so good as to exhibit most interesting and valuable objects, brought by him from Benin, in the next room; on that ground I venture to call upon Major Gallwey.

Major GALLWEY: I did not expect to be put on my feet after a paper about Bida. I have heard the paper with great interest, because, while the Bida campaign was going on, in the Niger Coast Protectorate, in another part of the world not very far off, but further than London from Paris, we were engaged in carrying out the punishment of the king of Benin and his people. I am afraid the geographical knowledge that we gained during the expedition was very small compared to that attained by the surveys of Mr. Vandeleur. At present the Benin country is being surveyed by Captain Carter, Captain Roupell, and Mr. Turner. I hope, therefore, that before many months are over, we shall have astronomical observations to help the Society to put Benin city and neighbourhood on the map.

Of course there has been a great deal of criticism about the late Mr. Phillips and his pacific mission to Benin city. I feel sure that if that officer were alive, he would answer any question that might be put to him satisfactorily; and it is satisfactory to know that, although when we came to the city the king cleared out, we have now got the chiefs and the fetish priests, and it only remains for the king to come in. It is also satisfactory to know that an end has been put to what was probably the cruellest rule in existence. I am sorry I am unexpectedly called upon to speak, but I can add my word of thanks to Mr. Vandeleur for the interesting paper he has read this evening.

The PRESIDENT: I think this Society may congratulate itself and feel proud of the work which has been done by one of its Vice-Presidents. We are delighted to see, on a second occasion in a very short time, our colleague, Sir George Goldie, returned from the Niger region. It is, I think, quite fascinating to think of the admirable way in which his expedition was conducted, of the foresight of its organization, and of the military skill with which success was secured, and Sir George Goldie has just explained to us the value of the expedition from a geographical point of view. It must be a great pleasure to all the officers, and especially to our friend here, the lecturer this evening, to have served under such a chief as Sir George Goldie. Mr. Vandeleur has shown himself to be a most zealous geographer, for it is no easy work to carry on, during arduous military service, a complete series of astronomical observations, requiring much watching at night, much forethought, besides the skill which he has acquired in the use of instruments and in the computation of his observations, and I am sure we must all congratulate Mr. Coles on the great success which has been achieved by one of his pupils. It is now our pleasant duty to pass a vote of thanks, and I am sure it will be carried by acclamation, to Lieut. Vandeleur for the interesting paper he has read to us this evening, and for the work he has done for us in Africa, in completing these surveys, of which we shall have the use, and also for the interesting sketches on the screen which he has shown to us. I may add that we have to thank some other gentlemen as well as Lieut. Vandeleur for the splendid exhibition

you will be able to inspect after the meeting, in the next room. I am sure I may convey to Lieut. Vandeleur the thanks of the meeting.

NOTE.—The accompanying map and plans have been reduced from Lieut. Vandeleur's original drawing, with some additions from documents of the Royal Niger Company.

AN ANGLO-AUSTRALASIAN ANTARCTIC CONFERENCE.

ADVANTAGE was taken by the Council of the Society of the presence in London of the premiers of the Australian colonies in connection with the Queen's Diamond Jubilee, to arrange for a conference on the subject of the renewal of antarctic exploration. All the premiers and agents-general, including those of Cape Colony, were invited to a conference on Monday, July 5, in the Council-room of the Society. The invitation was accepted by the Right Hon. G. H. Reid, Premier of New South Wales; the Right Hon. Sir Hugh Nelson, Premier of Queensland; the Right Hon. Sir Edward Braddon, Premier of Tasmania; Sir Andrew Clarke, Agent-General for Victoria; Sir Saul Samuel, Agent-General for New South Wales; the Hon. W. T. Reeves, Agent-General for New Zealand. Unfortunately, at the last moment the premiers found it impossible to be present, and the colonies were represented by Sir Saul Samuel, Sir Andrew Clarke, and the Hon. Charles Bowen (New Zealand). The President, Sir Clements R. Markham, occupied the chair, and among those present were the Duke of Argyll, the Marquis of Lothian (President of the Royal Scottish Geographical Society), Sir Joseph Hooker, Admiral Sir George Nares, Admiral Sir Erasmus Ommanney, Prof. Rücker, F.R.S., Mr. Yardley, besides the following Members of Council: General Sir Richard Strachey, Admiral Sir W. J. L. Wharton, Sir John Kirk, Sir Charles W. Wilson, Sir George Taubman Goldie, Admiral the Hon. W. J. Ward, Admiral A. H. Markham, Sir Henry Thuillier, Sir George S. Robertson, Colonel Farquharson, Hon. G. C. Brodrick, Colonel G. E. Church, Major L. Darwin, Mr. J. F. Hughes, Mr. A. P. Maudslay, Mr. W. M. Beaufort, Mr. E. L. S. Cocks, and Mr. Cuthbert E. Peek.

The PRESIDENT opened the proceedings with the following address on the Importance of Promoting Antarctic Exploration:—

We, the President and Council of the Royal Geographical Society, have invited to confer with us on the subject of Antarctic Exploration, the premiers of Australasia, who are now in England, and the premiers of New South Wales, Tasmania, Queensland, and the agents-general of New South Wales, Victoria, and New Zealand have accepted our invitation. I am glad also to say that the Hon. Charles Bowen, member of the Legislative Council of New Zealand, is also present. I would mention to our Australian guests who are present, that they meet here

the Vice-Presidents and Council of the Royal Geographical Society; His Grace the Duke of Argyll; the Marquis of Lothian, representative of the Council of the Royal Scottish Geographical Society; Sir Joseph Hooker, the greatest living antarctic authority; Prof Rücker, our greatest authority on terrestrial magnetism; Sir George Nares, one of the two admirals living who have crossed the antarctic circle (Admiral Maclear is the other); and Sir Erasmus Ommanney, who took so strong a part ten years ago in bringing forward this question. The urgency and importance of renewing antarctic exploration is, however, strongly felt throughout the civilized world, and scientific societies in this country are unanimous on the subject. For several years its importance has also occupied the attention of scientific men in the Australasian colonies; the subject has been brought to the notice of the Colonial governments, I believe, on several occasions since 1888, and in that year the Government of Victoria certainly expressed its willingness to take action, if the expedition received similar support from the mother country, and in that year there was a correspondence with the Treasury on the subject.

The time has now come for making a sustained effort to obtain funds for the despatch of an antarctic expedition under the joint auspices of the mother country and the colonies. But before entering upon the main question, I cannot refrain from referring to the geographical record of the colonies, and the part taken in that record by this Society. There is no finer passage in the history of discovery than that embodying the achievements of Australasian explorers. By indomitable pluck and perseverance, by the exercise of all the high qualities which combine to form the most perfect type of a geographical explorer, the vast deserts were traversed from end to end and the discovery of Australia was completed. This Society had some share in promoting the great work of Australian discovery by grants of money—especially on the occasion of the Leichhardt search expedition, and by the bestowal of the Royal gold medal on Australian explorers, and fourteen minor awards on eleven different occasions. Altogether we have conferred awards on twenty-five Australian explorers. In fact, the Royal Geographical Society has for sixty-seven years worked hand-in-hand with the colonies in furthering explorations. It has done so by effectual representations to the home Government in the early days of the colonies, by giving its cordial and active sympathy, by material help, and by conferring its honorary awards. These are our title-deeds for the right of appealing to the colonies now.

The first duty of the colonies was to explore their own territories, and have their coasts surveyed—very arduous and difficult surveys, extending necessarily over many years; but when that work is at length achieved, their clear duty is to take their share in the discovery and exploration of the unknown regions near to but beyond

their own limits, first and principally for their own benefit—which is a very great one—but also as taking a place among the civilized nations of the earth in a way worthy of their traditions and their parentage. In this country we feel that a great duty is neglected while the antarctic regions are unknown. This is the piece of work which faces us, which has got to be done, and which cannot be turned away from without discredit and shame. We feel that antarctic exploration is equally incumbent on our colonies in the southern hemisphere. It is at their doors, at the doors of those great communities which inherit the traditions of Britons.

For the first time, there is now work to be done in which the mother country and the colonies can and ought to co-operate and labour actively together. It is hardly necessary to point out how much good so much co-operation and community of interest in a great and heroic expedition is calculated to do; how the tendency will be to knit more closely the ties which connect us, to strengthen our sympathies, and to make us realize more forcibly perhaps, than in any other way, that we are one people with the same interests and aspirations.

I will now lay before our guests the present aspects and conditions of the antarctic question. Both the Royal Society and the Council of this Society have appointed committees to consider the results to be obtained by an antarctic expedition, and its requirements. The committees have made their reports, that of the Royal Society dwelling mainly on the urgency of a magnetic survey, and that of this Society enumerating the other valuable results of such an expedition, discussing the character of the difficulties to be encountered and the equipment required.

The subject was then brought to the notice of the Admiralty, and the reply of their lordships is dated April 1 of this year. While their Lordships regret that they are unable to take any direct part in organizing an expedition, at the same time they regard the enterprise as one of importance in the interests of science, and one the results of which they will watch with great interest. The Lords of the Admiralty are further prepared to aid in the outfit of the expedition to an exceedingly moderate extent. But we feel confident that this letter is not the last word, and that material assistance will eventually be given, both as regards the loan of officers and the grant of supplies, especially, and almost, I think, certainly, if the colonies resolve to co-operate with us. I may mention that when the resolution was brought forward at the British Association in favour of an antarctic expedition, the present Prime Minister, the Marquis of Salisbury, was on that occasion in the chair, and he put that resolution, which was carried unanimously. I consider that point gives us considerable hope if we should resolve to bring the matter before the Government, and we certainly shall do so if we are encouraged by the co-operation of the colonies.

The reply of the Admiralty made it incumbent on this Society to endeavour to see how they could raise funds for the equipment of the expedition, and the Council took this question into serious consideration. We believe £50,000 will provide for the purchase of a ship, for stores and provisions, and the pay of men for one year; but a proper expedition should have two ships, and its work is well out for three years. We are confident that half the sum I have mentioned can be found in this country; and we believe that, if this is the case, the other half will be provided by grants voted by the Colonial legislatures. We are aware that there must be numerous demands on the Colonial revenues, and that they are limited. But, on the other hand, the advantages far outweigh all such considerations, whether the material advantages of an antarctic expedition are passed in review, or full weight is given to the credit of such an undertaking, or the wisdom of cementing the friendly relations between the mother country and the colonies by common action in a great and good cause, has its influence in the decision. It is well understood now that all scientific knowledge leads directly or indirectly to practical and useful results, and its acquisition is therefore the legitimate work of every government. We earnestly hope that these reasons will guide the deliberations of our fellow-countrymen in the colonies, and, in conclusion, I would ask that this message may be conveyed to them.

Our Society has shown in many ways in times past deep sympathy with the noblest aspirations of our fellow-countrymen in Australasia. This Society is insignificant as compared with any one of the colonies, and we only compare very small things with great in speaking of ourselves, but we are in earnest in this matter. We have numerous calls on our revenues, and they are very limited, yet so convinced are we of the direction in which duty points, that we are prepared to make great sacrifices. I am authorized by the Council to say that up to £5000 we will vote any sum any of the colonies may vote. I can say no more than this to convince our guests we are in earnest, and that, after careful, thoughtful, and mature consideration, we are impressed with the necessity of the renewal of antarctic exploration. Those better able to state the case briefly and clearly are in this room, and will put before you the results of an expedition. We shall then have stated our case, which is a strong one—utility, policy, patriotism, all plead for it—and I leave it with some confidence in the hands of the premiers of the colonies in the southern hemisphere. I will now ask His Grace the Duke of Argyll to state to you his opinion on the value of some of the results to be derived from antarctic exploration.

THE DUKE OF ARGYLL: I hope it will be understood by this meeting that I do not appear here as representing any particular branch of science. My life has been largely passed in pursuits much less agreeable. At the same time, for more than half a century I have had a

deep interest in many branches of the physical sciences, and especially in geology, and I have been President of the Scottish Geographical Society; in one respect, too, I can feel that I am a fit member of this meeting, because for several years it has been to me more and more an earnest desire that the antarctic regions should be thoroughly explored, because of the important questions upon which light must be thrown by that exploration. In the first place, there is one general consideration which has long struck me. It seems to me almost a reproach to civilization and to scientific men that we have arrived at the close of the nineteenth century of the Christian era without knowing the whole superficial appearance of this little planet on which we live. We have come to an age when, by the advancement of the physical sciences, and by the most wonderful discovery that has ever been made—I mean the analysis of light—we are actually able to analyze the substance and distinguish the chemical composition of the most distant objects in space. We can do it almost as correctly as a chemist will analyze a meteorite or an aerolite in his laboratory. This is an astounding result of science, and it does seem a strange contrast, compared with the analysis of the most distant regions in space, that we should not know the whole of this earthly home on which we live. It is only the other day, in the lifetime of most of the gentlemen I see here present, the great majority of whose hair, like mine, is tinged with grey, that we have come to know anything of the interior of one of the great quarters of our globe, viz. the great continent of Africa. Passing from that general consideration, I would like to indicate one or two points connected with geology upon which light might be thrown, I think, by a thorough exploration of the antarctic continent. It was only the other day that, in conversation with my noble friend, Lord Kelvin—who stands *facile princeps* at the head of men of science in all those departments of physics in which mathematics are brought to bear—he said to me that he thought the most interesting question now to be solved was the antiquity of the oceans, of course including in that the antiquity of its continents, i.e. the great land-masses which have been separated on the oceanic surface by some geological operation. Our continents are nothing but large islands surrounded by the sea. Then, of course, the depths and characters of the oceanic spaces are one of the great questions, not only of geography, but of geology. I should like immensely to know—and it would throw a great light on these questions—whether there are any fossiliferous rocks in the antarctic.

We have learned, I think, with astonishment, in a way completely puzzling to our theories as to the decreasing heat of the globe, and its capability of supporting animal and vegetable life, that there are rocks towards the north pole, with fossiliferous beds showing a rich and varied vegetation, thus proving that it was possible to sustain life in those latitudes at some period of the world's history. This is rather

a puzzle to geologists and physicists, and it seems to me that the rocks discovered in Greenland, full of rich fossil vegetation, indicate a close connection between that country and the land we ourselves dwell upon. It is only about thirty-five years ago that, rather by accident than good guiding, I was fortunate enough to discover a small piece of fossiliferous rock in the island of Mull, that contained the most beautifully preserved fossil leaves, which can now be seen in the British Museum. The discovery of that small piece of fossiliferous rock gave the key to the geological age of all the trap rocks of the Hebrides, the Shetland islands, and Greenland. Now, it would be of immense interest if we could discover also in the antarctic continent any fossiliferous beds showing the nature of the vegetation that may once have existed there. It is most probable that when the north pole was of so temperate a character as to bear vegetation of a kind comparable to that now flourishing in Japan, the antarctic lands too were capable of sustaining such life. That would be a very valuable indication as to the conditions under which that vast hollow has been formed in which the almost limitless pacific ocean lies.

There is another point I should like to see more or less decided by the exploration of the antarctic continent, and that is the question which is just now exercising geologists almost more than any other, viz. the effects of what we know as the glacial age. You know, no doubt, that since '41, since the arrival of the great Agassiz in this country, who introduced to the cognizance of British geologists the action of ice in the form of glaciers, the glacial theory has been growing, growing, growing, becoming more fixed in the imagination of the geologists, and giving rise to the theory that all our existing surfaces north of the latitude in which we are now standing, were mainly moulded by a great ice-sheet—not icebergs, not even glaciers in the ordinary sense of the word, but an enormous mass of ice 2000 or 3000 feet thick, which may, though no one knows how, account for the deposit of the superficial gravels and boulders. For myself, I never believed in that theory. I don't believe that an ice-sheet of that kind existed, but if there is any part of the globe where existing facts will throw light on the subject, it is the antarctic continent. I remember I was much struck many years ago, in reading the account of Sir Joseph Hooker's voyage, in the *Erebus and Terror*, in the antarctic, to find that, whereas the icebergs in the north are almost invariably jagged and peaked in their forms, and excessively irregular, almost all the icebergs in the antarctic ocean were perfectly horizontal, vast tablelands of ice floating in the ocean. We all know how it is that the icebergs in the north assume that form; they are born, or "calved," by falling masses from ice-sheets—glaciers, in short—which flow into the sea from the vast continent of Greenland. It appears to me that the flat tops of the antarctic icebergs indicate conditions under which no such

disruptive movements take place as account for the form of the northern bergs. We may probably have there a very considerable continent covered with a true ice-sheet, and the question is, What is the cause of motion? Does it move horizontally without any thrust from high mountains; or is it formed gradually by the excess of falling snow over the powers of melting, until at last the power of flotation lifts it up, and carries it along the ocean? All these are questions on which the exploration would throw the greatest light. It would reflect also on many problems at our own doors, and I cannot adequately express the interest I feel in this matter. With regard to the appeal made to our fellow-citizens and fellow-subjects and countrymen in another part of the globe, I have no doubt of its success. We need not appeal to the colonists on merely utilitarian grounds. It is acknowledged that the very soul of science lies in the divine curiosity which makes us seek the explanation of all the phenomena of the globe. I have no doubt whatever that when they see exertion made in this country, they will think it due to their own reputation and credit to give us their hearty co-operation and help.

The PRESIDENT: After what His Grace has said, I think no one in this room has any further doubt as to the interest which attaches to the exploration of the antarctic region, but I am sure this meeting will like to hear a few words from our old Vice-President, Sir Joseph Hooker, who accompanied that famous expedition under Sir James Ross. I believe he is now the sole survivor.

Sir JOSEPH HOOKER: I feel it to be a great privilege to be allowed to address this meeting, both because I have myself visited three of the colonies of which there are here present the representatives, and because of my having, in my connection with Kew, so long co-operated with the Australian colonies in their endeavour to add to their vegetable resources.

Interested as I naturally am in antarctic exploration, it has always appeared to me remarkable that never since Ross's great discoveries, now sixty years ago, have the scientific societies of Australia, of most of which I have the honour of being a Fellow, made a serious joint effort to send a vessel, on however limited a scale, to explore that vast region extending all round the globe for nearly 1500 miles from the south pole, which lies as it were at their feet, and which has hitherto been penetrated to any distance beyond the antarctic circle on two meridians only.

To the eloquent tribute paid to science by the Duke of Argyll, and his lucid statement of the results to be obtained by an expedition to what he has rightly indicated as by far the largest hitherto unexplored area on the surface of the Earth, I have nothing to add. If, however, I were asked what I think would prove to be the most prolific subject, in a scientific point of view, to be investigated by such an expedition, I would instance hydrography, including the natural history of the sea-bottom, geology, meteorology, and, above all, magnetism; but there is, further, a vast field for discovery in all departments of zoology and

botany, and I would conclude by expressing my passionate interest in the objects that have called us here together, and my ardent hope that antarctic exploration will be pursued by the Australian colonies with zeal and efficiency.

The PRESIDENT: I would now ask Prof. Rücker, a prominent member of the Royal Society, to address to the meeting a few remarks on the subject of the results from an antarctic expedition with regard to terrestrial magnetism.

Prof. RÜCKER: I don't think it will take more than a few minutes to place you in possession of the main facts which lead magneticians to desire that this expedition should be despatched, as at present we are in a very early stage of knowledge with regard to terrestrial magnetism—in the same state in which astronomy was before Kepler and Newton. We are getting together a number of facts, but have not yet found the thread which binds them together. It is necessary that observations should be taken in every part of the globe, and especially around two or three points of interest in the far north and south respectively. Such observations are of importance, as it is just possible that by means of them we may arrive, in respect of terrestrial magnetism, at the stage which astronomy has now reached, and be able to predict, for many years to come, in what direction the magnet will be pointing at any given time and place. At present, in the more civilized portion of the world, we can do this for a few years. I have drawn out a table of the change of declinations for the English channel, which has proved very accurate for a range of ten years; but in the southern regions such calculations may be many degrees out, as we have very little knowledge of the direction in which the magnet points. The map serves to illustrate this. There are three points of land which enter the southern region—America, the Cape, and Australia; two of these belong to the British Empire. At all these three points the direction of the magnet is changing very slightly indeed; during the last thirty years it has changed but half a degree at the Cape, and at Melbourne, and also to a very small amount in South America. But, curiously enough, in the intervening seas, we have every reason to believe that a change is going on rapidly, though we have little knowledge as to what it is. It is, therefore, important that these spaces should be mapped, and though no great number of steamers pass from the Cape to Australia in the far south, those that do so may occasionally go a good many miles out of their course because they do not know the magnetic variation.

The position of the south magnetic pole has never yet been accurately determined. Sir James Ross got to about 150 miles from it. But there are other points of considerable magnetic importance, namely, those at which the magnetic force attains a maximum value. There are two such in the northern hemisphere—one in Canada, one in Siberia; but there is some question as to whether there are one or two in the southern

hemisphere. If there are two, they are near together, and probably not far from the magnetic pole. It is important we should know where they are and whether they are moving. Probably, to make sure whether there is any movement going on, we should have to wait for another fifty years, after a new series of observations was made, and that is certainly a good reason for not delaying the beginning of so lengthy an inquiry. It is not a matter of the last importance to get to the magnetic pole, but it is to survey the land round it, both from the practical and the scientific standpoint. Every magnetician in the world hopes that this most interesting magnetic problem will be solved, and I sincerely trust that the Australian colonies will join with England in sending this expedition.

The PRESIDENT: I regret that Dr. John Murray is unable to be here. He has written the following letter:—

“Challenger Office, Edinburgh, July 3, 1897.

“Dear Sir CLEMENTS MARKHAM,

“I very much regret that engagements in Scotland will prevent me from taking part in the Conference on Monday.

“Could I have been present, I should have been able to add little to what I have already said with reference to the advantages, from a scientific point of view, to be derived from a complete exploration of the south polar regions.

“It is much to be regretted that the Government cannot see its way to fit out an antarctic expedition at the present time. Ever since Britain became a great sea power, learned men have been able to induce governments to dispatch a naval exploring expedition about every quarter of a century. That interval has more than elapsed since the *Challenger* expedition, and, for the sake of the navy and our intellectual progress, it may be hoped that the *Challenger* expedition will not be the last of the series.

“It would be a magnificent thing should the Home Government be led to reconsider this matter through some joint action on the part of the colonies: it would be an evidence of high intelligence as well as a marked advance in political development.

“This is a subject which should concern, not only the Australasian colonies, but all the colonies of the Empire. I am a colonial—a Canadian—and I would be much disappointed should Canada not take a part in any colonial movement in the direction here indicated. The main object of such an expedition would be to obtain a fuller knowledge of the globe on which we live, and the acquisition of new knowledge is of great interest to all progressive peoples, whatever may chance to be their geographical position on our planet.

“Yours sincerely,

“JOHN MURRAY.”

You have now heard the eloquent address of His Grace the Duke of Argyll; you have heard what Sir Joseph Hooker has said, and you have heard of the importance of the magnetic survey from the lips of Prof. Rücker. I would say to our guests connected with Australasia—and I regret that most of them are only present here in spirit—that this is our case. I now ask those present to address us a few words on their side of the question. Perhaps Sir Saul Samuel will speak.

Sir SAUL SAMUEL (New South Wales): I had no idea when I entered this room, or up to the present moment, that I should be called upon to address any observations to you, as I had fully believed that my own premier, Mr. Reid, would be present; but he doubtless, like most of the colonial premiers now in England, is detained by other pressing engagements. I have taken some interest in this question, but will not pretend to address you from a scientific point of view in any way, as I possess no scientific attainments. We know, as we have heard most learnedly to-day, of the value to science which would attach to an exploration of the antarctic ocean, but there is something more than that to interest the Australian colonies—it abounds in whales, and whaling is a commercial undertaking which can be carried out with great advantage. Many years since it was a great industry, particularly in New South Wales, and we had a large number of ships trading to the antarctic ocean whaling, and bringing back large cargoes of oil. This led to great wealth at the time, but the discovery of mineral oil ultimately destroyed or helped to destroy the industry, and now there is very little whaling, though there is still something going on. Ships are being fitted out in Tasmania and New South Wales with a view to reviving that industry. Seals also abound in these seas, and would form another branch of industry. I cannot say what my Government may be prepared to do in the matter, but I have before urged on them to endeavour to contribute in aid of the movement by this Society, and I don't altogether despair that that will yet be done. I will take an early opportunity of seeing my Premier, Mr. Reid, and talking to him about it. I am sure he is well disposed. I think that if the President and His Grace the Duke of Argyll had a personal interview with him it might have some effect. I thank you for listening to these few remarks.

Sir ANDREW CLARKE (Victoria): I must limit my remarks to calling your attention to the fact that the Government I represent felt great sympathy for this movement some years ago, and made a specific offer of support. I believe that spirit still exists, although perhaps the ability of the Government to assist is not so great now as it was then. Still I think that it would have assistance both from the Government and the community. The sentiment is still alive, and some assistance, according to their means, will be accorded. For myself, I think I can best limit myself to saying that I will take care that this matter is

placed before my Government, and attention called to the various points raised by the speakers to-day. Considering the interest taken in this matter nearly fifty years ago, with reference to magnetic observations, I think you can reckon that a fair amount of sympathy and support will be given by the colony I represent.

The PRESIDENT: We have here a member of the Legislative Council of New Zealand, who, although he cannot speak in an official position, can speak with a large knowledge of the feeling which exists in the Legislature of New Zealand. I will therefore ask the Hon. Charles Bowen to address us.

The Hon. CHARLES BOWEN (New Zealand): I am very sorry that there is not an official representative of New Zealand here to-day. I can only attribute this misfortune to the many engagements of which Sir Saul Samuel has spoken, and I hope that, notwithstanding the absence of the chief official representatives of the colonies, they will go back to the Antipodes with the determination to aid in the enterprise which is proposed by this Society. I have no hesitation in speaking of what I believe to be the interest taken in this subject by the Legislature of New Zealand. I have been for a long time a member of the Legislature of that Colony, and know something of its feeling on this matter, because I tested it not long ago, as an old member of this Society. I believe, if a vote of money for an antarctic expedition was proposed by the Government of New Zealand, it would be carried with acclamation. I must say this too in regard to the Government: the present Premier is unable, owing to previous engagements, to be here to-day; but when a deputation went to the Government only a year ago on this subject, the present Premier expressed his great interest in the matter, and said that he would correspond with the other governments of Australasia, and if they were willing to come forward, he would be very glad to make a proposal to the Legislature to co-operate with them. But he seemed to think it was rather useless for one colony to act alone. Since then, I have not heard that anything particular has been done, but I feel quite confident if, in this Jubilee time, the Premiers of the different colonies could be got together, some step might be agreed to by them to bring the question before their respective legislatures. If a vote were proposed in New Zealand, I am confident it would be carried, from what I have seen of the feeling of the Legislature. I quite concur with all that has been said by His Grace the Duke of Argyll as to the discredit that attaches to all Englishmen, more especially to those who live nearest to the south pole, from the fact that no effort has been made to discover the secrets of that great unknown area. I still hope, and indeed feel sure, that the colonies will be willing to take their fair share in the cost of exploration, if the matter is brought before them. I regret to find that, instead of the Jubilee being a good time to bring premiers together, political and other interests have made it

difficult for them to assemble; but I hope something will come of this meeting.

The PRESIDENT: I think we may feel satisfied as to the interest taken in the antarctic question throughout the Australasian colonies. I think we have heard from the Agents-General of New South Wales and Victoria such words of hope and encouragement as will make us feel that this conference has not been called together in vain, and, still more, we are glad to hear from Mr. Bowen of the feeling that he knows to exist in the Legislature of New Zealand. I therefore feel some confidence that, after the proceedings of this conference have been laid before the Premiers of Australasia, as they will be by the agents-general, a movement will arise among the governments of these colonies which will enable us next year to push the matter to completion. I am not aware of anything more we can say on this occasion. We have had stated to us in the ablest way the results to be derived from an expedition, and we have had stated to us, by our guests from Australasia, the feeling which they have on the subject.

The MARQUIS OF LOTHIAN: Before separating, I should like to ask for a vote of thanks to our President to-day, for if any of us take interest in this matter, it will be largely due to the efforts of Sir Clements Markham. I should, too, like to say one word, which I think would appeal to many people, and that is, that the work of antarctic research should be done by Englishmen. Looking at the map which hangs before me, it strikes me that almost every name in the south has been given by this country. I know that foreign countries are at this moment striving to inaugurate expeditions in order to discover what we ought to try and do ourselves. I should not like to see foreign names upon that hemisphere where all the civilized points are inhabited by our countrymen and belong to this country. Therefore, though I am not urging the work upon you from so high a level as that of science, still I think that our historical record in all parts of the world, which has been begun by Great Britain, should not allow that to fall into the hands of others. We cannot expect to do all, but should be first in the field, and I think I might appeal to some who would not be moved by scientific considerations, to help to keep up the reputation in which we have so large a share. I must ask you again to return a vote of thanks to Sir Clements Markham for so kindly presiding and inviting us here to-day.

AN EXPEDITION TO THE SOURCE OF THE NIGER.*

By Colonel J. K. TROTTER, R.A.

TAKING the interior of Sierra Leone as a whole, and dealing with the part we visited lying north of 9° N. lat., there appears to be a strip of country bounded on the north by Wellia, Saionia, Lakhata, and Buruta, on the west by the Great Skarcies, on the east by Bumban and Karena, and extending on the south-west to the coast, which is perfectly flat, and not more than from 100 to 300 feet above sea-level. The rest of the country is hilly or mountainous, and has an elevation of from 800 to 3000 feet above the sea, the least accidented part being that between the line Kalieri-Dakolofe and the Tintarba valley. South of Yana the Great and Little Skarcies rivers run side by side, at a distance from each other of from 15 to 20 miles, through a perfectly flat country, with no well-defined watershed to separate them.

Of the tribes with which we were brought into contact the principal are the Mendi from the Sherbro country, the Limba from the country north and west of Bumban, the Susu from the Great Skarcies valley and the northern boundary, and the Kuranko. I have already spoken of the last. Of the Limba we saw little. Apparently they do not take service in large numbers at Freetown as the other races do. Traders of that race, however, are found in the interior, and they seem to be fairly intelligent and pushing. They are more warlike than the other tribes.

The Mendi form the bulk of the carriers obtainable at Freetown. They are very low in the scale of civilization, pagans, and very superstitious. They have no morale nor link to bind them together; vanity, pride, and self-esteem are quite strange to them, and in corporate form they are contemptible. As labourers and carriers, however, they are very useful, and individually show great courage and endurance. They will struggle with a heavy load till they drop, and will subsist on a handful of rice a day without complaining.

The Susu are Mussulmans. They are generally employed as servants and hammock-boys, and in positions a little superior to that of labourers. They have plenty of pride and self-esteem. They look down upon the other tribes, and regard it as a dreadful insult to be called a Mendi. They are generally men of good physique, very fond of dress, and, whilst working from day to day with no clothes at all on worth mentioning, will turn out, on reaching a town, in the most gaudy raiments.

All the natives of the West Coast, in spite of their defects, which are very apparent, and which in general are those of a low order of

* Paper read at the Royal Geographical Society, December 7, 1896. Continued from p. 259. Map, p. 348.

civilization, appear to me to be tractable and to be very ready to obey the direction of the Europeans. They have their own little quarrels and jealousies, but when once communications are opened in the interior, I do not believe that the Sierra Leone Government will have any serious difficulty with them. Their best point is their light heartedness, which indeed, I think, is the bright spot of West Africa. It is a country where the worst jokes never fail to be appreciated, and where



KING OF TAMISSO.

(From a photograph by Captain Parsaga, President of the French Commission.)

one is certain of bringing down the house without having any claim to being a wit.

In considering the native question, it is important to bear in mind that the natives of Sierra Leone proper, except for those who have come there from up country to find work, are quite distinct and separate in race, tradition, and language from the natives of the interior. The Sierra Leone people are a people to themselves, and I think it is a matter of regret that some name has not been given to the

Protectorate recently added to British Colonial Empire, to distinguish it from their settlement.

The country of the interior is as yet altogether undeveloped and untried. What its producing power is no one knows. All that is known is that the natives, with the merest scratching of the soil, grow rice, cassava, guinea-corn, cotton, and native tobacco in such quantity as they require. Their method of making a farm is to cut down the bush to a height of about 3 feet, leaving the trunks and roots of the trees untouched. After the vegetation which has been cut becomes



STACKING RICE.

(From a photograph by Captain Passaga, President of the French Commission.)

dry, they set a light to it and let it burn. Cassava plants are then put into the ground, and the earth is heaped over them. Rice is now sown on the top, and the land is left to itself. With this amount of cultivation two crops are produced annually. But the amount of ground cultivated by the natives bears a very small proportion to the total area of the country; it is only an acre or two here and there. The land, however, possesses undoubtedly great natural advantages; it has an unfailing water-supply, a rich soil, and is within easy reach of good markets. What it requires is a system of communications, and the establishment of posts on the highlands of the interior. The winding paths and carrier transport are quite unsuited to commercial purposes, and the experience of our commission has shown that mules are well able to do everything required of them in West Africa. The French

officers rode their mules on all occasions; the animals had no difficulty in surmounting every obstacle and in climbing the most difficult ground, and they finished the commission in better condition than any other living thing in the camp. There is no serious difficulty to overcome in making the roads fit for wheels. This done, and with the railway system in the southern part of the Protectorate, transport would be cheap, and it would be possible to establish posts in the highlands of the interior. The question at the bottom of every undertaking in West Africa is that of health, and the one serious enemy to health, so



THE SOURCE OF THE NIGER.

(From a photograph by Colonel Frederick Cardew, C.M.G., Governor of Sierra Leone.)

far as I know, is malaria. But malaria has been overcome in more than one of our colonies, and in the interior of Sierra Leone, at a height of over 2500 feet, with a good water-supply and a hard dry surface, it is hard to believe that, when stations have been carefully selected and prepared with due regard to sanitary conditions, malaria will continue to be a serious danger.

The exploration of the interior of Sierra Leone dates from the arrival in the country of the present governor. Previous to this, it is true, some good work had been done by Mr. Garrett, Major Kenney, and others; but Colonel Cardew, who is a man of great energy, a good

topographer, and is gifted with a wonderful constitution, has taken the work in hand systematically, and will, if he remains in the country, before long have explored every corner of British territory. Geographers owe him a great deal for having found the solution to many problems which have puzzled them for years. In company with Major Grant, R.E., he has done this year a very remarkable and valuable piece of exploration. Sending up Major Grant to Kruto by a different route to that followed by the commission, he thus obtained a second traverse by another line to this place. After Major Grant had fixed the longitude of Kruto by lunar distances, and had carried the time to Tembi Kunda and back, the governor went to Tembi Kunda, and from there traced the Anglo-Liberian boundary along the meridian of $10^{\circ} 40' W.$ and down the Mano river, the course of which was quite unknown before. In another year or so the interior of Sierra Leone, instead of being an unknown land, will become one of the best-mapped parts of unsurveyed Africa.

I hope others will be able to say something about the work which was done in the way of obtaining longitudes by Captain Hill's method of photography. Mr. Tyler managed the photography alone, and much credit is due to him for what he managed to do under circumstances of some difficulty. An observer, to do work of this kind, should be free from every other duty, at any rate during the days that he is engaged on it. In our case this could not be managed, and Mr. Tyler, after a hard day's work, had to sit up all night with his camera, and to work as usual the next day. The objection to the system of photography which necessitates a camera remaining in position for many hours, that the danger of the instrument shifting must be great, does not appear to be real. The solidly built camera stood very firm, and the operation of taking the photographs appears to be simple enough. Provided that the results are sufficiently accurate, the method appears a very practical way of obtaining absolute longitudes.

NOTES ON THE CLIMATE.

The remarks made here must be regarded more as the result of irregular observations having but a limited value for trustworthiness, and as the experience of individual feelings, than as having any positive scientific importance. The observations of barometer and thermometer were taken at different hours daily; the first observation, which was made about the same hour daily, first thing in the morning (from 5.30 to 6.30 a.m.), and the second when the loads reached the halting-place (in the morning, noon, or evening). The only instruments in our possession were an aneroid barometer, and a maximum and minimum thermometer. The minimum thermometer got out of order from the first, and could not be put right; the maximum was, therefore, read twice daily as an ordinary thermometer. The instruments were carried in a case which was packed inside a tin box. The case was kept covered up as far as possible, but in spite of protection the box got very hot with exposure to the sun, and the recorded temperatures, after a march, cannot be regarded as fair shade temperatures. All the clinical thermometers carried by

the commission, which read up to 110° or 112° , and were carried in boxes, and protected as far as possible, burst between the watershed boundary and the Kaba river. In consequence of the heating of the box in which the thermometer was carried, and the absence of a current of air, an arbitrary reduction has been made from the temperatures actually recorded after a march.

Between Port Lokko and Bumban (December 16 to 25, 1895), the lowest of the early morning readings was 70° (Mapema, 5.15 a.m., December 22), the mean being 72.5° . The highest reading was at Rotata (9 a.m., December 20), 84° , and the lowest at Mapema (12.30 p.m., December 21), 81° . The weather at this stage was not excessively hot, but the atmosphere was moist and heavy, and the climate resembled that of Freetown.

Between Bumban and Kruto the lowest early reading was at Isaia (5 a.m., December 31), 58° , the highest 73.5° (Lengekoro, 5 a.m., December 30), and the mean 68° . The highest day reading was 84° (Kundembaia, December 30, 12.30 p.m.), and the lowest 68° (Isaia, 11.45 a.m., December 31). On this last day the sun was obscured by mist.

The nights on the higher ground north of Bumban were perceptibly cooler than in the first stage, and the air drier and fresher. Between Lengekoro and Kruto there was a heavy dew every morning, and generally a dense mist till the sun was some hours above the horizon. This heavy dew was only experienced at this stage of the journey, but during the months of December and January there was everywhere a considerable condensation.

During the month of January, 1896, from Kruto to Boria, the lowest early reading was 58° (Kulakoia, 7 a.m., January 27), and the highest 75° (Bali, 6 a.m., January 26), the mean being 69° . The highest day reading was 86° (Boria, 12.30 p.m., January 31), and the lowest 67° (Samaindu, 12 noon, January 27).

The weather this month was never oppressively hot; the nights were always cool or cold, and on the top of the mountains the air was fresh and bracing, and a strongish breeze was always blowing (generally *harmattan*), which had the effect of making the skin feel chilly, doubtless from evaporation. The valleys were hot and close, the trees excluding both sun and air. Their bottoms are not swampy in the sense that the expression is understood to bear in the low country, where there is frequently a depth of 3 or 4 feet of stagnant, offensive mud; but they are covered with decaying vegetation, marshy, and no doubt malarious. The difference of temperature from day to day in December, January, and the early part of February is very remarkable. A cold night is succeeded by a close one, and the pleasantest day by a very enervating one. This is probably due to the wind, and from the variation of temperature it is clear that the *harmattan*, which accompanies the coolest weather, does not blow by any means every day.

In the month of February, 1896, from Boria to Kaleri, the lowest early reading was 58° (camp north of Mount Keme, 6.30 a.m., February 14), and the highest 74° (Boria, 6 a.m., February 2; Boala Karafaisa, 6 a.m., February 20; and Kambaia, 6.30 a.m., February 25), and the mean 68° . The highest day reading was 96° (Sanafa, 5.30 p.m., February 25), and the lowest 70° (Kiridugu, 11 a.m., February 7).

The weather in the early part of the month was much the same as in January in the latter part it became hotter, and the sun was more powerful. The nights were generally cool. The *harmattan* wind, which is prevalent in January and December, disappears this month.

In March, from Kaleri to Yomaia, the lowest early reading was 63° (Kabuya, 6.30 a.m., March 19) and the highest 76° (Bibia, 6.30 a.m., March 16), the mean being 72° . The highest day reading was 95° (Yomaia, 5 p.m., March 28), and the lowest 73° (Kaleri, 10 a.m., March 10). The weather this month was sensibly

hotter, and the marching and climbing were found much more exhausting. The air also felt less dry, and for some time, near Kalieri, there was much cloud. Rain fell on one or two days.

From April 1 to 24, whilst still in high country, the lowest early reading was 70° (Kaba river, 6.30 a.m., April 4), and the highest 80° (Kaba river, 6.30 a.m., April 5), and the mean 76°. The highest day reading was 100° (Lakhata, 3 p.m., April 15), and the lowest 86° (Kaba river, 6 p.m., April 1). The weather continued to get hotter. At times it was cloudy, and a little rain fell at night. Descending to the low country, which has an elevation of not more than 400 feet above the sea, during the period between April 24 and May 5, from Balifilli to Kambia, the lowest early reading was 76° (near Wellia, 6.30 a.m., April 28), and the highest 84° (near Wellia, April 25, 6.30 a.m.), the mean being 79°. The highest day temperature was 89° (Balifilli, 3 p.m., April 24), and the lowest 82° (Kukuna, 3 p.m., May 3). We were now in the coast region, and the climate was again that of Freetown, the air being heavy and close, though the sun was not powerful, the sky being overclouded every day, and heavy rain being imminent.

The rainy season in the interior, as we learned from the French officers who had been stationed in the Western Sudan, begins earlier than on the coast, and the rainfall is less. In March, when in the neighbourhood of Kalieri, the rains appeared to be near, but as we travelled west the sky became clearer.

Rain fell on the following days, mostly in the form of thunderstorms and tornadoes, and generally after sunset.

January 22 and 23, 1896.—Camp, north of Tembi Kunda. Heavy rain at night, short duration.

February 19.—Boala Karafaia. Heavy rain at night.

February 22.—Salamaia. Heavy rain at night.

February 23.—Salamaia. Rain in morning, quantity small.

February 25.—Sanaia. Heavy rain at night.

March 4 and 7.—Camp, north of Kalieri. Heavy rain at night.

March 26.—Camp on 10th parallel. Heavy rain at night.

March 27.—Camp on 10th parallel. Little rain during day; day cloudy.

April 6 and 10.—Camp on Kaba river. Rain at night.

April 16.—Camp, north of Lakhata. Rain in afternoon.

April 17.—Camp, north of Lakhata. Heavy rain at night.

April 23.—Kankuia. Little rain at night.

April 24.—Balifilli. Little rain during day.

April 27.—Camp on Great Skarcies. Heavy rain at night.

April 28.—Camp on Great Skarcies. Very heavy rain in evening and all night.

It appears from the recorded temperatures that the high ground of the interior from 1500 to 2800 feet above the sea is much cooler, at any rate at night, than the coast region. The coolest months of the dry season are December and January. The day temperature in February is higher than in January, and it increases to about the middle of April, when the sun's declination is the same as the latitude.

As regards the comparative healthiness of the interior, without venturing to give a medical opinion, I think there can be little doubt that it is less malarious than the swampy country of the coast, and that there are certain places, notably on the plateau north of Salonia, and on the hills of the eastern boundary, in which Europeans might live with much better prospects of health than on the coast. According to the experience of the French, the posts of the Western Sudan, when first occupied, were found to be unhealthy, but after the stations have been put into order and sanitary measures have been adopted, they become healthy.

The natives of the interior are strong and healthy, and of better physique than

those of the coast. They do not suffer from fever, according to their own account, except during the rains, and then in a mild form. The disease which we found to be prevalent everywhere, in some places so much so that it might be fairly described as epidemic, was bronchitis.

ITINERARY.

Place.	Date of leaving.	Mean height of barometer.	Corresponding altitude.	Thermometer readings (Fahrenheit).	Hours of reading thermometer and barometer.	Distance marched, from last halt.	Remarks.
		Inches.	Feet.	Degrees		Miles.	
Freetown ...	1895. Dec. 16	30 00*	—	—	—	—	*At sea-level.
Lori Lokko ...	" 18	29-875	125	—	—	—	
Makanna ...	" 19	29-875	125	—	—	11	
Dofunkuyin ...	" 20	29-77	220	82	11.30 a.m.	12½	
Rotata ...	" 21	29-86	140	84	9.0 a.m.	7½	
Mapema ...	" 22	29-88	120	81	12.30 p.m.	13	
				70	5.15 a.m.		
Kalangba ...	" 23	29 77	220	83	10.45 a.m.	11½	
				73	5.40 p.m.		
Madina ...	" 24	29-85	150	83	11.15 a.m.	10½	
				73	8.30 a.m.		
Bumban ...	" 26	29-65	327	83	11.50 a.m.	11½	Halted at Bumban 25th of December.
				73½	7.0 a.m.		
				73	5.30 a.m.		
Kawana ...	" 27	29-10	825	78	10.15 a.m.	½	
				74	5.30 a.m.		
Kamange ...	" 28	29-24	700	78	10.35 a.m.	9½	
				66	5.0 a.m.		
Katimbo ...	" 29	28-55	1380	67	8.30 a.m.	5½	
		28-45	1460	73-5	5.30 a.m.		
Lengekoro ...	" 30	28-425	1500	82	4.40 p.m.	11½	
		28-4	1500	73-5	5.0 a.m.		
Kundembala ...	" 31	28-8	1110	84-5	12.30 p.m.	11½	
		28-73	1100	66	5.0 a.m.		
	1896.						
Isala ...	Jan. 1	28-75	1100	68	11.45 a.m.	8½	
		28-70	1100	58	5.0 a.m.		
Yerembo ...	" 2	28-30	1600	69	11.45 a.m.	10½	
		28-25	1630	68-5	5.0 a.m.		
Alkalla ...	" 3	28-60	1340	72	10.15 a.m.	9½	
		28-55	1360	69	5.15 a.m.		
Kilela ...	" 4	28-50	1400	74	11.0 a.m.	10½	
Kruto ...	" 7	28-725	1200	78-5	9.30 a.m.	9	Halted at Kruto 5th and 6th of January.
		28-75	1150	78	8.0 a.m.		
		28-775	1125	69	8.0 a.m.		
		28-725	1175	69	6.30 a.m.		
Nyedu ...	" 8	28 65	1350	78	11.45 a.m.	11½	
		28-58	1350	68	5.20 a.m.		
Sogurella ...	" 9	27-95	1940	70	10.15 a.m.	9½	
		27-84	2000	70	5.20 a.m.		
Kurubundo ...	" 10	28-24	1700	72	9.0 a.m.	5½	
		28-15	1730	70	5.30 a.m.		
Porpor ...	" 11	28-125	1800	80	11.0 a.m.	11½	
		28-12	1860	72	5.30 a.m.		
Buria ...	" 12	28-45	1410	73-5	9.30 a.m.	7½	
		28-35	1550	71	5.30 a.m.		
Kamindu ...	" 13	27-675	2210	74	9.15 a.m.	14	
		27-525	2300	70	5.20 a.m.		
Tembi Kunda ...	" 19	27-175	2150	78	11.0 a.m.	5½	14th, 15th, 16th, 17th, and 18th of January halted at Tembi Kunda.
		27-05	2850	69-5	6.30 a.m.		
		27-1	2800	70	7.0 a.m.		
Camp I. ...	" 21	27-275	2600	72	8.43 a.m.	3½	Halted 20th at Camp I.
		27-23	2675	70	6.30 a.m.		
Camp II. ...	" 22	27-35	2520	79	11.0 a.m.	3½	
		27-35	2520	70	6.0 a.m.		
Camp III. ...	" 24	27-30	2580	83	12.0 noon	3	Halted 23rd of January at Camp III. Tornado at night, 22nd and 23rd of January.
Bali ...	" 26	28-00	1900	76	11.45 a.m.	6	Halted 25th at Bali.
		28-05	1860	74	6.0 a.m.		
		28-00	1800	75	6.0 a.m.		
Kulakola ...	" 27	27-825	2680	79	11.45 a.m.	4	
		27-75	2020	68	7.0 a.m.		
Samaindu ...	" 29	27-90	2250	67	12.0 noon	3½	Halted 28th of January at Samaindu.
		27-80	2250	67	6.30 a.m.		

Place.	Date of leaving.	Mean height of barometer.	Corresponding altitude.	Thermometer readings (Fahrenheit).	Hours of reading thermometer and barometer.	Distance marched from last halt.	Remarks.
	1896.	Inches.	Feet.	Degrees.		Miles.	
Yaria ...	Jan. 30	28.09	1900	80	4.0 p.m.	2½	
		28.00	1900	65	6.0 a.m.		
Dandafarra ...	" 31	27.95	1900	71	9.45 a.m.	2½	
		27.90	2000	64	6.0 a.m.		
Boria ...	Feb. 2	27.65	2225	86	12.30 p.m.	4½	Halted 1st of February at Boria.
		27.65	2400	74	6.0 a.m.		
Mussadugu ...	" 4	27.65	2200	78	11.0 a.m.	4½	Halted 3rd of February at Mussadugu.
		27.625	2250	70	6.30 a.m.		
Kirimandugu ...	" 6	28.25	1850	75	10.0 a.m.	3	Halted 5th of February at Kirimandugu.
		28.15	1775	64	5.30 a.m.		
		28.225	1875	60	6.30 a.m.		
Konkekoro ...	" 7	28.25	1850	86	12.0 noon	3	
		28.25	1650	65	6.30 a.m.		
Kiridugu ...	" 8	28.25	1650	70	11.0 a.m.	2	
		28.225	1675	62	6.30 a.m.		
Bennikoro ...	" 10	28.15	1775	72	12.0 noon	4½	Halted 9th at Bennikoro
		28.125	1750	61.5	6.30 a.m.		
Farama ...	" 12	28.19	1700	80.5	11.30 a.m.	3½	Halted 11th of February at Farama.
		28.225	1675	63	6.30 a.m.		
		28.25	1650	68	6.30 a.m.		
Camp No. IV. ...	" 14	28.275	1825	79	11.0 a.m.	3	Halted 13th of February at Camp IV.
		28.15	1750	61	6.30 a.m.		
		28.20	1700	58	6.30 a.m.		
Camp No. V. ...	" 16	28.175	1750	72	10.0 a.m.	2½	Halted on 15th at Camp V.
		28.20	1700	72	8.0 a.m.		
		28.20	1700	69	6.0 a.m.		
Camp No. VI. at Old Karafala (destroyed).	" 17	28.225	1675	75	6.0 a.m.	3½	
		28.175	1725	70	6.0 a.m.		
Morünia ...	" 18	28.30	1600	76	11.0 a.m.	5	
		28.25	1650	70	6.0 a.m.		
Bonbonkoro ...	" 19	28.20	1700	86	5.0 p.m.	2½	
		28.20	1700	71	6.0 a.m.		
Boala Karafala ...	" 20	28.30	1600	87	12.0 noon	10	Tornado during night of 19th of February.
		28.275	1825	74	6.0 a.m.		
Dakolofe ...	" 22	28.45	1450	78	11.0 a.m.	4	Halted 21st at Dakolofe.
		28.40	1500	75	6.0 a.m.		
		28.35	1550	70	6.0 a.m.		
Salamala ...	" 23	28.35	1550	78	10.0 a.m.	5½	Tornadoes on night of 22nd and morning of 23rd of February.
		28.38	1500	71	6.0 a.m.		
Songola ...	" 24	28.40	1500	82	11.30 a.m.	7½	
		28.30	1600	69	6.30 a.m.		
Kambala ...	" 25	28.225	1675	90	5.0 p.m.	8½	
		28.30	1600	74	6.30 a.m.		
Sanala ...	" 26	28.175	1700	91	5.30 p.m.	8½	
		28.25	1650	71.5	6.30 a.m.		
Berea Futambu ...	" 27	28.25	1650	81	11.0 a.m.	3	
		28.20	1700	69	7.0 a.m.		
Kalleri ...	Mar. 3	28.14	1750	83	6.0 p.m.	8½	Halted at Kalleri 28th and 29th of February and 1st and 2nd of March.
		28.20	1700	72	6.0 a.m.		
		28.20	1700	70	6.30 a.m.		
		28.15	1750	71	6.30 a.m.		
		28.175	1725	72	6.0 a.m.		
		28.25	1675	75	6.0 a.m.		
Camp VII. ...	" 8	28.325	1575	75	10.0 a.m.	3	Halted 4th, 5th, 6th, 7th of March at Camp VII.
		28.25	1675	73	7.0 a.m.		
Camp VIII. ...	" 12	28.25	1650	71	7.30 a.m.	½	Halted 9th, 10th, 11th of March at Camp VIII.
		28.05	1850	84	8.0 p.m.		
Simitia ...	" 13	28.25	1650	86	3.0 p.m.	10½	
Camp IX. ...	" 17	28.15	1750	75	6.0 a.m.	2½	Halted 14th, 15th, 16th at Camp IX.
		28.15	1750	76	6.30 a.m.		
Camp X. ...	" 18	28.00	1900	73	6.30 a.m.	7	
Camp XI. ...	" 19	28.20	1700	86	6.0 a.m.	3	
		28.25	1650	63	6.30 a.m.		
Camp XII. ...	" 20	27.95	1950	95	2.30 p.m.	½	
		28.00	1900	67	6.0 a.m.		
Camp XIII. ...	" 21	28.10	1800	93	5.0 p.m.		
		28.15	1750	72	6.0 a.m.		
Camp XIV. ...	" 22	28.35	1550	94	4.0 p.m.	3½	
		28.40	1500	69	6.0 a.m.		
Camp XV. ...	" 23	27.90	2000	86	6.0 p.m.	4	
		27.95	1950	68	6.0 a.m.		
Camp XVI. ...	" 24	28.20	1700	94	5.0 p.m.	4½	
		28.20	1700	72	6.30 a.m.		
Camp XVII. ...	" 25	28.15	1750	88	11.0 a.m.	3½	
		29.10	1800	74	6.0 a.m.		

Place.	Date of leaving.	Mean height of barometer.	Corresponding altitude.	Thermometer readings (Fahrenheit).	Hours of reading thermometer and barometer.	Distance marched from last halt.	Remarks.
	1896.	Inches.	Feet.	Degrees.		Miles.	
Camp XVIII.	Mar. 26	28-20	1700	74	6.30 a.m.		
Camp XIX.	" 27	28-10	1800	90	5.0 p.m.	4	Tornado at night.
		28-27.5	1620	74.5	6.30 a.m.		
Camp XX.	" 28	28-30	1600	83	4.45 p.m.	5	
		28-30	1600	72.5	6.30 a.m.		
Camp XXI. (near Yomala).	" 29	28-45	1450	95	4.0 p.m.	5	
		28-50	1400	71	6.30 a.m.		
Camp XXII. (near Small Skarries).	Apr. 1	28-35	1850	88	11.0 a.m.	3	Halted 30th and 31st of March at Camp XXII.
		28-27.5	1625	73	6.0 a.m.		
		28-25	1650	78	6.30 a.m.		
		28-25	1650	75	6.30 a.m.		
Camp XXIII.	" 2	28-40	1500	86	9.0 p.m.	3	
		28-40	1500	74	6.30 a.m.		
Camp XXIV.	" 10	29-20	750	93	5.0 p.m.	3	Halted 3rd, 4th, 5th, 6th, 7th, 8th, and 9th of April at Camp XXIV.
		29-20	750	78	6.30 a.m.		
		29-20	750	70	6.30 a.m.		
		29-27.5	750	80	6.30 a.m.		
		29-27.5	750	78	6.30 a.m.		
		29-27.5	750	77	6.30 a.m.		
		29-27.5	750	78.5	6.30 a.m.		
		29-27.5	750	76	6.30 a.m.		
		29-27.5	750	77	6.30 a.m.		
Camp XXV.	" 11	28-90	900	78	6.30 a.m.	4	
Camp XXVI.	" 12	28-60	1350	77	6.30 a.m.	4½	
Camp XXVII.	" 13	29-00	825	78	6.30 a.m.	4½	
Camp XXVIII. (Kita-Lolo junction).	" 15	29-35	650	78.5	6.30 a.m.	5	Halted 14th at Camp XXVIII.
		29-40	600	79	6.30 a.m.		
Camp XXIX. (near Lakhara).	" 16	29-25	700	100	3.0 p.m.	13	
		29-35	650	79	6.0 a.m.		
Camp XXX.	" 18	28-65	1250	76	6.30 a.m.	1	Halted 17th at Camp XXX.
		28-65	1250	89	11.0 a.m.		
		28-65	1250	76	6.30 a.m.		
Camp XXXI.	" 21	28-30	1640	89	4.30 p.m.	†	Halted 19th and 20th at Camp XXXI.
		28-32.5	1575	72	6.30 a.m.		
		28-32.5	1575	72	6.30 a.m.		
		28-35	1550	73	6.30 a.m.		
Camp XXXII.	" 22	28-65	1250	75	6.30 a.m.	3	
Camp XXXIII.	" 23	27-10	2800	92	3.0 p.m.	7	
		27-10	2800	72	6.0 a.m.		
Kankula	" 24	27-50	2440	90	3.0 p.m.	3½	A little rain during the night of 23rd of April.
		27-57.5	2300	75	6.30 a.m.		
Camp XXXIV.	" 25	29-35	600	89	3.0 p.m.	4½	A little rain during day of 24th of April.
		29-40	560	77	6.0 a.m.		
Camp XXXV. (Banks of Great Skarries).	" 29	29-60	360	84	6.30 a.m.	9½	Halted 26th, 27th, and 28th at Camp XXXV.
		29-64	360	81	6.30 a.m.		Rain during night of 27th, and heavy rain during the whole night of 28th.
		29-55	400	76	6.30 a.m.		
Weilla	May 1	29-35	600	81	11.0 a.m.	1	Halted at Weilla 30th of April.
		29-35	600	80	6.30 a.m.		
		29-32.5	625	82	6.0 a.m.		
Fodea	" 2	29-47.5	500	86.5	5.30 p.m.	20	
		29-50	450	81	6.0 a.m.		
Kufuna	" 3	29-67.5	390	88	11.0 a.m.	9½	
		29-60	380	78	6.0 a.m.		
Kukana	" 4	29-81.5	350	62	3.0 p.m.	16	
		29-70	300	76	6.0 a.m.		
Petifu	" 5	29-75	250	86	6.0 p.m.	24	
Massama	" 5					8	At sea-level barometer read 200 feet. Possibly due to commencement of rainy season.
				Embarked for Freetown.			

Before the reading of the paper, the PRESIDENT said: I think I ought to congratulate the Society on the extraordinary enterprise of the members of its Council. It was only two years ago that one of our Vice-Presidents discovered the true sources of the Oxus. This year actually three members of the Council were visiting Spitzbergen, one has just sailed for the mouth of the Niger, and we have the pleasure of welcoming back another member of the Council, who has just

returned from exploring the sources of the Niger. I am sure we shall all listen with great interest to the paper Colonel Trotter is about to read to us.

After the reading of the paper, the following discussion took place:—

Captain HILLS: The experiments made by Colonel Trotter on the method of finding the longitude by photography were extremely interesting, for the reason that it is the first time this has been practically tried in the field. Personally, I have tried a number of experiments at home, and convinced myself that a considerable amount of accuracy can be obtained; but, of course, it is different getting results when working leisurely at home, from getting them by actual practical work in the field. The advantages of the method for field work are, that the actual man who does the work need not know very much about it, and work in the field is comparatively easy, except, of course, as Colonel Trotter says, that it often necessitates staying up all night. In this case, Lieut. Tyler had no actual experience of the work before going out. His sole instruction was obtained in about one hour, and consequently the results are very interesting, as showing what can be done under these circumstances. As regards the accuracy, it seems to be about equal to, or perhaps rather superior to, what can be got from an occultation, with this difference—that you can take these photos any night, whereas the occultation would be limited to a certain number of nights in a year. Even at Greenwich they can only be taken on about twenty nights in the year; so that, for determining longitude, the method of observing the occultation of stars by the moon is not as good a method as the photographic, which depends on photographing the moon and stars near it, and measuring the position on the photographic plate. This is practicable on any night the moon is visible, and has the advantage that you can measure the plates afterwards at leisure with a considerable amount of accuracy. At the same time, it has the disadvantage that the results are not available at the time in the field. I think, perhaps, a method could be devised by which they could be measured approximately in the field, but that is a question to be gone into. Practically, we have confined ourselves to trying what are the best results to be got from Colonel Trotter's plates, so far as they have been measured, and, though they are certainly not so good as the ones taken at home, they seem to show that you can determine the longitude within an error of a mile, or something under a minute of arc, by one single plate, which is, I think, a very satisfactory result. It is better than any other method that could be used, unless, of course, you could carry an accurate triangulation; but, next to that, it seems the best method. It is somewhat unfortunate that no attempt was made to take more than one photograph at each station. Of course, what one really wants is a good number taken at one particular spot, but still there is sufficient comparison to get accuracy. It seems to be a good practical method of getting absolute longitudes.

The PRESIDENT: Colonel Trotter has certainly given us a very interesting account of the country he has surveyed, forming a water-parting between the rivers of the coast and the Niger. He has, as it were, completed the story of that great river, which has occupied and puzzled geographers for several thousand years, since the days when the Nasamones, mentioned by Herodotus, made that remarkable journey over the deserts of Africa, and correctly ascertained the direction in which the Niger flowed. If they had lived a little later, they would have won the Gold Medal of the Royal Geographical Society, but, having lived three thousand years ago, they could not be rewarded in that way. They gave a perfectly correct idea, which was accepted down to the time of Ptolemy; but, as far as I can make out, the Arab geographers put us wrong, turning the Niger into the Atlantic, where it remained on the maps till the time of Queen Anne. I think Delisle, the predecessor of D'Anville, was the first man who ceased to make

the great river flow directly into the Atlantic. D'Anville and Rennell got the direction of the river right, and in 1830, Lander, our first Gold Medallist, discovered its mouth. We have now listened to a very charming and interesting account of the country where its sources are met with. I am sure you will all wish me to return Colonel Trotter our hearty thanks for his excellent paper, and for the interesting photographs, which we regret are so few, he has shown us this evening.

LIST OF PLACES ASTRONOMICALLY FIXED.

Name.	Lat. (N.)	Remarks.	Long (W.)	Remarks.
	0 ' "		0 ' "	
Makanna ...	8 47 55	Single meridian altitude, allowing for error of parallax		
Mapema ...	8 58 15	Ditto		
Kajangba ...	9 1 10	Mean of 2, allowing for parallax		
Madina ...	9 5 20	Single meridian altitude, allowing for parallax		
Bumban ...	9 7 15	Mean of 3, ditto	11 56 8	Longitude of Freetown assumed to be 13° 14' W.
Kawana ...	9 12 0	Mean of 2, ditto		
Kamange ...	9 17 35	Mean of F.R. and F.L. meridian altitudes		
Katimbo ...	9 21 25	Ditto		
Lengekoro ...	9 28 20	Ditto		
Kundembaia ...	9 22 55	Ditto		
Yerembo ...	9 11 25	Mean of 8 sextant and theodolite altitudes		
Alkallia ...	9 8 50	Ditto		
Kilela ...	9 10 10	Ditto		
Kruto ...	9 6 25	Mean of 4 theodolite altitudes	11 20 28.2	Longitude of Bumban assumed as above.
Nyedu ...	9 6 35	2 meridian altitudes, F.R. and F.L.		
Sogurella ...	9 11 0	Meridian altitudes with sextant and with theodolite, allowing for error of parallax		
Kurubundo ...	9 12 20	Mean of 3 meridian altitudes	11 1 50	Meridian distance from Kruto assumed to be 11° 15' 20" W.
Porpor ...	9 8 10	Ditto		
Buria ...	9 7 55	Mean of 2 meridian altitudes		
Kamindu ...	9 7 20	Mean of 3 meridian altitudes		
Tembi Kunda ...	9 5 20	Mean of 4 meridian altitudes	10 46 40	Meridian distance from Kruto assumed as above.
Bali ...	9 12 10	Mean of 2, allowing for error of parallax		
Mussadugu ...	9 18 30	Mean of 3, allowing for error of parallax	10 47 0	Meridian distance from Tembi-Kunda assumed to be 10° 46' 40".
Kiridugu ...	9 22 15	Mean of 3 (F.R. and F.L.)		
Dakolofe ...	9 41 25	Ditto		

Name.	Lat. (N.).	Remarks.	Long. (W.).	Remarks.
Songoia ...	9 45 10	1 meridian altitude with sextant	0 ' "	
Kalieri ...	9 58 0	Mean of 4 meridian altitudes		
Bibia ...	10 0 5	Mean of circum-meridian observations by French and English		
Junction of rivers, Kita and Lolo	9 52 40	Circum - meridian ; time of transit calculated by mean of results		
Kita river, at point 1500 metres north of Lakhata	9 56 0	Circum - meridian ; times as preceding		
Wellia (Wulia)	9 50 40	Circum - meridian ; time by observation	12 35 35	By meridian distance from Freetown, assumed to be 13° 14'

Positions fixed by French Commission.

Tembi Kunda ...	Lat. 9° 4' 55", circum-meridian observations of stars.	Long. 10° 47' 0"		
Source of Faliko ...	Lat. 9° 19' 21"	" "	" "	" "
Bambaireya ...	Lat. 9° 33' 12"	" "	" "	" "
Baraba ...	Lat. 9° 46' 10"	" "	" "	" "

Positions fixed by Major Grant, R.E.

Kruto, long. 11° 15' 20" (moon culminating stars).

Tembi Kunda 10° 46' 32" by transport of time from Kruto to Tembi Kunda and back.

MEMORANDUM ON THE MAP.*

The position of Bumban, where a route traverse was commenced on the journey to Tembi Kunda, has been fixed on the map by taking the latitude as found by the commission, and the longitude from Intelligence Division, War Office, map, No. 1118. Kruto has been fixed by the latitude found by the Commission (mean of four meridian altitudes), and the longitude obtained by Major Grant, R.E., from moon culminating stars. The traverse between Bumban and Kruto was made with compass, plane-table, and perambulator, and was checked by latitudes taken at each halting-place. The work thus done has been adjusted between Bumban and Kruto, which were fixed as explained.

The latitude of the British camp at Tembi Kunda was found to be 9° 5' 20" N. from four meridian altitudes of two pairs of stars. The French Commission fixed their camp, which was about a quarter of a mile south of the British camp, in 9° 4' 55" N. lat. from circum-meridian observations of stars. The Niger source, which is situated, as regards latitude, between the two camps, has been plotted as 9° 5'. The longitude obtained by Major Grant, R.E., by meridian distance from Kruto, as fixed by him, gives to Tembi Kunda a value of 10° 46' 32" W. The meridian distance obtained by the British Commission from Kruto, assuming Major

* The scale of the map has been reduced to one-half that of the original, published by the Intelligence Department, War Office. The coast-line is taken from Admiralty Chart, No. 601.

Plates 1 and 2 have not been so corrected, so it is possible that they may require a small correction, which could be applied should it be discovered that the moon's true place was observed on that night at any observatory.

Plate 4 was not a very satisfactory one, owing to the long interval (8 hours) which elapsed between the two sets of star exposures. It is impossible to believe that the camera should have remained absolutely stable during such a length of time, but, on the other hand, the measurements themselves show that the amount of misplacement, if any, did not exceed a very few seconds of arc, a result highly satisfactory as exhibiting the stability of the instrument.

It is also interesting to note that in this plate there was an error in the last exposure, which might have been due to a displacement of the camera or to some scale of exposure having been wrongly recorded. This has had no effect on the three objects the star image in question has been simply ignored in the computation, 18° 20'. Satisfactory to see how readily such an error is detected when the plate results. In triangles.

trigonometrical position. TABLE OF RESULTS OF PHOTO-LONGITUDE PLATES.

of the triangles in plate 4 to be good, that now given to the true value.

Place.	Approximate Longitude from previous Ob-	Longitude
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Falaba has been left in the position given in Intelligence Division, War Office, map, No. 1118; but if Kalieri is now correctly placed in longitude, it will probably be necessary to give Falaba a value as much east of the present position as Kalieri is east of the position given on Intelligence Division, War Office, map, No. 1118; as, although Falaba was not visited by the Commission, its position with reference to Brea Futambu, Kalieri, and Simitia appears to be very accurately given on the Intelligence Division map.

In working westwards along the 10th parallel north latitude, distances were measured with the perambulator. The longitude of the terminal point of this section of the frontier on the left bank of the Kaba, near Yomaia, was obtained from a lunar photograph (Captain Hills' method), and the result agrees very closely with the survey work. The distances surveyed each day being short (from three to four miles), any great error in the perambulator measurements is improbable, and the results confirm the position of Kalieri as fixed above.

Between the Kaba river and Wellia, latitudes by circum-meridian observations of stars were taken at the Kita-Lolo junction, at the point above Lakhata where the boundary leaves the Kita, and at Wellia. The perambulator broke down near the Kita-Lolo junction, and could not be used again. Distances were afterwards obtained by pacing. For Wellia the latitude obtained by observation has been taken, and the mean of the longitudes obtained by Major Kenney in 1891, by time observations by the Commission (meridian distance from Freetown), and from a photo-longitude plate, has been adopted. This position agrees with the survey work, which has been adjusted between the Kaba river and Wellia thus fixed.

The position of Kukuna has been taken from Intelligence Division, War Office, map, No. 1118, and the route traverse has been adjusted between Wellia and Kukuna. Distances on this section were measured by pacing, a mean being taken of the result given by the Commissioners and the three sappers. No observations were possible owing to the clouded state of the sky.

In the Samu frontier, the positions of Kiragba and the Mola river have been taken from the Intelligence Division map, and the survey work has been adjusted between these points.

A report by Captain Hills, R.E., on the photo-longitude plates is attached. For the purposes of the map the results obtained from plates 4 and 5 have been used,

Name.	Lat. (N.).	Remarks.	Long. (W.).	Remarks.
Songoia ...	9 45 10	1 meridian altitude with sextant	0 ' "	
Kalieri ...	9 58 0	Mean of 4 meridian altitudes		
Bibia ...	10 0 5	Mean of circum-meridian observations by French and English		the ved
Junction of rivers Kita and Lolo	9 52 40	Circum - meridian ; time of transit calculated by mean of results		the es focal
Kita river, at point 1500 metres north of Lakhata	9 56 0	Circum - meridian ; times as preceding		ed on the ements were
Wellia (Wulia)	9 50 40	Circum - meridian ; time by observation	12 35 35	directions, by

The results were extremely satisfactory; one only was a failure, viz. No. 3, taken at Kalieri.

The cause of the failure was that it was taken when the moon and stars were at a low altitude, and there appears to have been a considerable amount of mist or light cloud about.

The best plate was No. 5, Wellia, and as an illustration of the amount of concordance to be expected in the measurements of a good plate, I give the result of plate 5 in detail.

The longitude of the place of observation was deduced from the measurement of seven moon images on the plate. Working out the result separately for each moon image, we get the following:—

Moon.	Longitude.	Mean.
1	12 31 5	
2	33 8	
3	30 36	
4	32 36	12 31 32
5	31 0	
6	30 18	
7	32 1	

The probable error of the mean being, therefore, 11" of arc, equal to about one-fifth of a mile.

It must not, of course, be understood that it is claimed that the mean result is correct within this small limit, as there may be constant sources of error affecting all the moon images equally.

It is difficult to say exactly what are the limits of error, but I think it is not unfair to assume that the results are correct within 1' of arc (equals 1 mile).

It is unlucky that there was no opportunity of taking a series of plates at one station, the results of which could have been compared together, but it must be readily admitted that in work of this class such an opportunity would rarely occur.

The results of all the plates are given on the table annexed to this report.

Plates 4 and 5 have been corrected for the errors of the moon's predicted place, the moon having been observed that night at Greenwich.

Plates 1 and 2 have not been so corrected, so it is possible that they may require a small correction, which could be applied should it be discovered that the moon's true place was observed on that night at any observatory.

Plate 4 was not a very satisfactory one, owing to the long interval (8 hours) which elapsed between the two sets of star exposures. It is impossible to believe that the camera should have remained absolutely stable during such a length of time, but, on the other hand, the measurements themselves show that the amount of displacement, if any, did not exceed a very few seconds of arc, a result highly satisfactory as exhibiting the stability of the instrument.

It is also interesting to note that in this plate there was an error in the last star exposure, which might have been due to a displacement of the camera or to the time of exposure having been wrongly recorded. This has had no effect on the result, as the star image in question has been simply ignored in the computation, but it is satisfactory to see how readily such an error is detected when the plate is measured.

TABLE OF RESULTS OF PHOTO-LONGITUDE PLATES.

Plate.	Date.	Place.	Approximate	Longitude from	
			Longitude from	previous Observations.	
			o	'	"
1	1895, Dec. 25	Bumban	11	54 W.	11 46 9
2	1896, Feb. 3	Mussadugu	10	47	10 56 43
3	Mar. 4	Kalieri	11	16	No good
4	Mar. 29	Kaba river	11	56	11 55 57
5	April 29	Wellia	12	34	12 31 32

A JOURNEY IN SOUTH-WESTERN PATAGONIA.*

By OTTO NORDENSKJÖLD.

IN the antarctic summer 1895-96, I made an exploring expedition as leader of a party of Swedish scientific men to Tierra del Fuego, principally for the sake of comparing its natural features and history with those of North Europe. After my companions had returned, I found an opportunity of continuing my explorations in an interesting part of Southern Patagonia, with the object primarily of finding the relations between the deposits of glacial origin I had discovered the previous year in Tierra del Fuego and the great Patagonian gravel formation.† On this expedition I found an opportunity of exploring some interesting regions hitherto unknown, and of working out some contributions to the general physical geography of the territory, and of those results the following notes form a short account.

* Map, p. 464. This is a reproduction of the original sketch of Mr. Nordenskjöld, with some additions from the latest Admiralty charts.

† For the results of those researches, and for the full account of the scientific results of the whole expedition, I must refer the reader to a detailed work, which will shortly be published. A preliminary account of the results of the voyage appeared in *Die Geographische Zeitschrift*, 1896.

I spent a considerable time in a region of great actual interest, as being part of the territory presently disputed (through the boundary question) between Chile and the Argentine Republic. As may be known, the treaties of 1891 and 1893 decide that the frontier shall follow "the highest summits of the Cordilleras that form the watershed." This rather ambiguous wording of the provision has been interpreted by some of the disputants as implying that the line shall follow the continental watershed in all parts where it is to be found in the Cordillera range. Now, the mentioned territory is interesting, because the watershed undoubtedly is to the east at least of the real central Cordillera. I should be glad if my account of the structure of the Cordillera and of the orography of the country could be of any service for arriving at a better view of the question.

The principal feature in the orography of South America, from Cape Horn northwards, is the contrast between a high Pacific mountain chain and a wide Atlantic tableland. This circumstance causes the different parts of the country to wear aspects that are very dissimilar, but nowhere does the contrast appear so strongly as in Tierra del Fuego, where the summits of the Cordilleras, covered with perpetual snow, and very often also by clouds, rain, and fog, can all be clearly seen from the dry Atlantic coast. Not quite so rapid, but still very wonderful, is the transition in Patagonia; and the region I here intend to describe, lying between 50° and 52° south latitude, is in addition more interesting than any part of Tierra del Fuego, owing to the peculiar character given to parts of it by the presence of masses of basaltic rocks and lava cones in the east, and of great ice-fields in the western valleys.

To give an idea of the appearance of the country, we will begin by giving a profile of the continent a little north of 51° S. lat. This part of the country can be divided into three regions of very differing character, to which we may add two others of wide extent in the south of the continent. The whole country west of 73° W. is occupied, both islands and mainland, by the high snow-clad Cordilleras, deeply indented in all parts by numerous channels, sounds, fiords, and river valleys. At the latitude in question, Peel inlet penetrates from the mouth of the Sarmiento channel about 20 miles inland. Of this region I know by sight only a part of the channel just mentioned, where the rocks are generally granitic, and the most easterly part, on the inner side of the central portion, which is here built up of metamorphic slate. However, there exist besides, as shown by the boulders brought down by the glaciers, porphyritic rocks to a considerable extent.

This state of things is a general one in the whole southern Cordillera—on the western islands massive rocks, in the central continental Cordillera slate. The last named is *probably* the same as is broken off in $52^{\circ} 10'$ S. in the Sarmiento peninsula by Union sound, north of which no break is known in those regions. Of the interesting topography of

the country east of this chain, the accompanying sketch-map will give some idea.

The westernmost point I reached was in $50^{\circ} 50' S.$, $73^{\circ} 10' W.$ To the north and to the south, as we stand here, there is a wild range of hills with peaks upwards of 6000 feet in height, while before us is a low pass with an extensive ice-sheet, whence a big glacier descends into the valley, where it had in former times a great extent, as seen from the scratches on the mountain slopes. The valley is now filled up with the waters of a large mountain lake, with numerous "icebergs," broken off from the glacier above, floating about on its surface. The whole



VIEW FROM THE WESTERN PATAGONIAN CHANNELS.

panorama presented by the lake and the high mountains surrounding it, by the glacier with its high lofty "nunataks," and its surface cleft and distorted in a way rarely seen except in arctic regions, and by the wonderful Mount Payne in the south, is one not easily forgotten.*

The direction of the lake sets towards a narrow gorge in the south-east. From this point there opens before us, in an east-north-easterly direction, a valley about a mile in width, and shut in by steep ranges, roughly speaking 4000 feet in height, and clad on the lower slopes with dense forests of the antarctic beech. The bottom of the valley is almost flat, and through it flows the outlet of the lake, a broad river which I

* This lake I proposed to name Lake Dickson, in honour of Baron Dickson who defrayed the major part of the expenses of this as of so many other Swedish expeditions.

have called the river (Rio) Payne, its course displaying those strange meandering windings that are so characteristic of these regions. After covering a distance of not quite 7 miles, we reach another mountain lake, the whole width of the valley forming a deep water-filled depression about 3 miles in length. To get over these 10 miles on horseback was for us a hard three days' task. Sometimes we had to penetrate dense forests of shrubs, sometimes to traverse swamps where every moment our horses threatened to stick fast; while, if we tried to find our way on the hillsides higher up, we had to encounter the dense forest, and every now and then deep gorges with mountain rivulets hemmed in by steep, often perpendicular walls, and overgrown by an almost impenetrable vegetation.

The northern range is formed by slate, younger (probably Mesozoic), and less metamorphic than in the inner Cordillera. It extends as a continuous range, only sparsely broken by deep valleys, for more than 30 miles in a westerly direction. This range, the Baguales mountains, I shall describe below. On the south side of the valley there is the wild, curious Payne mountain mass. This mountain forms a steep, pointed pyramidal peak, more than 6000 feet in height, and covered in many parts with glaciers and snow. This peak is surrounded on three sides by a ring of lofty rectangular peaks with rounded summits, but with quite perpendicular walls rising to a height of thousands of feet. The rift between them and the central peak is filled with ice. As the river could not be passed on horseback at that time of the year, and we had no boat at our disposal, it became impossible to reach the mountain and explore its composition, but it looks unmistakably like an extinct volcano. As this, however, for other reasons, is rather doubtful, we can only state with certainty that it is not built up of the slates of the inner Cordilleras.

From the east end of the lake mentioned above the river Payne continues in a southerly direction, forming almost a right angle with its former course. The country it now flows through is wide and open, comparatively level, but declining gradually towards the east. The formation of the ground is of Mesozoic slate, but this is rarely visible, since it is covered by low, irregular, often sharply outlined hills, sprinkled in many cases with large stones, that elsewhere occur but rarely except among the mountains. No doubt these hills are the bottom, or perhaps the terminal, moraines left by the ice at a time of greater extent. In this territory we find two or three by no means inconsiderable lakes, and on reaching the southern border another one still larger, Lake Sarmiento. This lake consists of two parts—the proper lake in the lowland, covering an area of about 26 square miles; and its continuation to the west, a narrow channel with walls that show evident traces of ice-action, a typical fiord of the age when the Atlantic extended almost to the eastern slopes of the Cordilleras. Farther

to the west there are other lakes, true mountain lakes similar to Lake Dickson, and still further in we come upon the remains of the extensive ice-sheet that once covered the whole territory.

On the south side of Lake Sarmiento there rises, to a height of more than 3500 feet, a mountain that can be considered typical of a large number of others in the zone of transition between the Cordillera and the Pampa. At their foot I found slate, probably Mesozoic, highly contorted, and showing a strong cleavage; higher up, Tertiary rocks with only a slight dip. The clearly marked stratification sometimes gives



MOUNT PAYNE, FROM THE NORTH.

them a very peculiar shape, the, in part, almost perpendicular walls being separated by slopes of less inclination. But true table mountains of greater extent never occur, and mostly the mountains have rounded, weathered forms, except where volcanic rocks form the upper layers. Of this the most striking example is the range called the Baguales mountains, north-east of the Payne valley. There the soft Tertiary rocks have been protected by an immense sheet of basalt, and consequently there is a kind of peninsula here, jutting out from the Cordillera 30 miles into the lowlands. The influence of erosion has caused the basalt to assume the most wonderful forms, appearing sometimes as regular pyramids towering out from a broad base, sometimes as solitary pillars or high walls, occasionally occurring with comparatively low country all around.

South from Lake Sarmiento and the first-mentioned mountain occurs another lake, called in Spanish Lago Maravilla ("the marvellous lake"),

the largest in that great lake system. The exact area could not be ascertained, as I have only explored the eastern part, but will probably be about 70 square miles. It is surrounded by mountains except in the eastern corner, where an extensive lowland begins, sometimes swampy or covered with small lagoons, sometimes overgrown with rich grass. Through this tract of land a broad river runs, formed by the convergence of three streams descending from the Baguales mountains. Most interesting is the easterly one, the river Viscachas. It flows first east, then south, and after approaching the sources of the Coyle river within a distance of only a few miles, it bends west at a distance of 30 miles from



MOUNT PAYNE AND LAKE SARMIENTO.

Lake Maravilla. Its whole course is through level country, the soil consisting of slightly stratified sandy clay in which pebbles are embedded.

There exists, without doubt, a marked difference between the natural features to the east and the west of the Viscachas river, but at the same time there is a transition from one to another. Some low hills east of the river may be considered deposits left still after the erosion of the Baguales and other mountains of the intermediate zone, but they are surrounded by land similar in natural features to the Patagonian type, and that, as we proceed eastwards, soon becomes paramount. There are still sharply defined heights formed of horizontal Tertiary sandstones and conglomerates—the highest point of the so-called Latorre mountains ("Punta Alta") is about 3000 feet; but they are all table mountains, with steep slopes to the west, but a very gradual descent towards the Atlantic. The rivers and their valleys are Patagonian in their

character, sometimes running through real cañons with perpendicular walls more than 200 feet high. Moreover, not very far to the east the Patagonian pampa proper begins, its gravel-covered surface stretching for hundreds of miles. Nowhere is a single tree to be seen, and only in the valleys does a low bush now and then occur of a species of verbena, called the "black bush," and having small fleshy leaves and white strong-smelling flowers. Only in the western part are there any lakes, but, as it seems, they are shallow and always without outlet.*

The large rivers mentioned above, as well as the river Payne, all flow into the lake Maravilla, which itself has an egress to the Pacific in Last Hope inlet. The connection between the outlet of the lake and a big



SCENERY FROM BAGUALES MOUNTAINS.

river that flows out into the last-named inlet has certainly not yet been conclusively shown, but it does not seem to be in the slightest degree doubtful that such connection exists, as no other river of that size could exist in the small territory south of a line between the lake and the nearest section of the western channels, where it could otherwise find an outlet.

South of the lake down towards Last Hope inlet and Disappointment bay, we find low land and mountains of the intermediate type. The

* Also in the western, mountainous, intermediate zone lagoons occur on the lowland which are without outlet, and sometimes even contain salt water. But it is very curious that a deep fresh-water mountain lake, such as Lake Sarmiento, should be without visible outlet, unless such outlet should prove to exist in the small section not visited by me. This, however, does not seem very probable.

bay last named, the only known part of the western channels (except the Straits of Magellan) that penetrates into a region that certainly does not belong to the Cordillera proper, is situated in a latitude corresponding to that of the valley of the river Gallegos. This valley is bounded on the north by the high Latorre range. To the east it is narrow, the hills that wall it in being lower. At 71° west its width is about 6 miles, but from $71^{\circ} 20'$ west it widens to a broad open plain that may be said to continue all the way to Disappointment bay, though some parts are rather high and hilly. The boundary between country with Patagonian characters and that with intermediate crosses the river at a longitude of about $71^{\circ} 45'$ west, and from there takes a north-west



TERTIARY HILL WITH BASALTIC CONES.

direction until it reaches $51^{\circ} 30'$ south. West of this line most of the country, except the swamps, is covered with forest, the lakes are deeper, and the hills rounded, not table-shaped.

The southern limit of the Gallegos valley is a tableland 600 to 800 feet high, sometimes barren, but mostly grass-covered. Here also, in the neighbourhood of the large depressions occupied by the muddy brackish water of the "White lake" (Laguna Blanca), and from these eastwards to the straits, we find the curious, steep, lofty hills composed of boulder-clay, which I observed first in Tierra del Fuego, and which are so characteristic of the formerly glaciated territory in this region.

The above descriptions we may sum up as follows: There exists, in the space of only 50 miles, a radical difference between the high snow-covered Cordillera, consisting of folded metamorphic schists, and the dry pampa tableland of Tertiary or recent age. But between those two

regions there extends a broad zone of transition, with mountains sometimes almost as high as the higher peaks of the Cordilleras, and formed partly of younger contorted slates, partly of horizontal or slightly inclined Tertiary rocks, eruptive or sedimentary. These mountains, on the one hand, topographically form a direct continuation of the Cordillera, and on the other are separated by valleys that sometimes form extensive lowlands of a character resembling that of Patagonia, and contain rivers which mostly run to the Pacific.

As regards the origin of this state of things, which makes it almost impossible to put down on a chart any boundary-line between the "pampa" and the Cordillera, if we are to give to the latter a purely topographical definition—it seems that the isolated mountains, even the actual pampa hills such as Latorre mountains, were once joined to the central Cordillera. Rivers flowing from this to the east afterwards cut out valleys, that were considerably widened by the action of great glaciers extending far outside the mountains. Such was the origin of Disappointment bay and also of the great lakes that are limited in the east by morainic material.

Of the rivers flowing out into the Pacific, some extend far eastward from the central Cordillera right to the boundary of the Patagonian pampa proper, but they do not seem to penetrate this. The largest of them all come from mountains connected with the Cordilleras.

The actual boundaries between the different zones, even when marked by orographical features, are mostly due to climatological circumstances, especially the rainfall. The zone of transition between the wet, cloudy Cordillera and the always dry pampa is very narrow, and almost coincides with the intermediate zone described above, where isolated mountains occur, rounded or ragged, but not table-shaped.

Five years ago no single white man was living in the territory in question, except perhaps, in summer-time, some few ostrich or lion hunters, but now that is all altered. Nobody has tried, it is true, as yet to utilize the forests, here on the landside consisting of *Fagus antarctica*, or the coal and minerals, traces of which have in some parts been met with, but the open land is now largely occupied. A great part of the territory, however, cannot be made of practical use; the higher tableland is almost barren, the slopes and the hilly land in the west are often overgrown with a very annoying plant, a prickly species of an *Azorella*, forming rounded hemispherical tussocks. Sometimes the ground is swampy, and on the open pampa the vegetation is mostly very poor. But, on the other hand, there is grass in many parts, it being, especially in the river valleys, of a very rich and soft quality; indeed, comparatively speaking, the greatest part of the country is covered with grass, not very luxuriant in places, but forming an excellent pasturage for sheep. The uniform climate, too, is very well adapted for sheep, and so sheep-farming has been the principal branch of industry, cattle and

horses, however, being also sometimes kept. The coasts of the Straits of Magellan and of the Atlantic have long been occupied, but just lately many settlers have taken up their quarters in the Gallegos valley and in the region between Last Hope inlet and the lakes right away towards the dry Patagonian pampa. Until recently land could be got very cheaply, and there is still a lot of good "camp" unoccupied, but that state of things will not last long. Most of the settlers are English-speaking people, hailing from England, Scotland, the Falkland islands, or Australia. The wool is brought down to Punta Arenas, Port Gallegos, or to Last Hope Inlet, where there is a kind of harbour, to which steamers come from Punta Arenas twice or thrice in the year to bring the provisions necessary for the immediate future.

Meanwhile the original inhabitants of the country, the Patagonian or Tehuelche Indians, are being rapidly driven back towards the uninhabitable central territory. It is long since the time when they were described as a race of giants, but undoubtedly they are extremely handsome, tall fellows, a really fine people. Those still surviving are all civilized, and there is not the slightest danger for the traveller in associating with them. They often possess fine troops of horses; some of them also own cattle. Many speak Spanish, and once or twice a year they go down to Punta Arenas or to Gallegos to exchange their guanaco mantles and ostrich feathers for different kinds of provisions and implements. But the number of guanacos is diminishing day by day, the land is being absorbed and the Indians impoverished by the white traders; they are getting mixed with the whites, and so the day cannot be far off when the last Patagonian in the old sense shall have ceased to exist.

A BRITISH PROTECTORATE IN AFRICA.*

SIR HARRY JOHNSTON'S new book stands on a distinctly higher level than the great majority of books on Africa which have appeared within the past few years. It is not of mere passing interest, but is likely to long remain the standard authority on the country with which it deals, indispensable to all students of the modern development of the Dark Continent. The unusual opportunities for observation supplied by a seven years' official connection with British Central Africa, added to the author's well-known qualifications as an acute and careful observer, leave little room for doubt that the work presents a just and comprehensive view of one of the most promising recent additions to the British Empire, while the abundant and admirable illustrations, many of them from Sir Harry Johnston's own drawings, would suffice in themselves to give a vivid idea of the nature of the country described.

* 'British Central Africa: an Attempt to give Some Account of a Portion of the Territories under British Influence north of the Zambezi.' By Sir Harry H. Johnston, K.C.B. Maps and Illustrations. London: Methuen. 1897.

The author does not, however, rely solely upon the illustrations to convey a general impression of the aspect of the country, but in the opening chapter draws upon his powers of description to further contribute to the same result. With the artist's eye for the picturesque, and a keen appreciation of nature in all its varied aspects, he accomplishes his task with signal success, describing in felicitous language a series of striking scenes—from the placid river of the lowlands, with its grassy islets and fringe of palms and papyrus, to the forest gloom of the mountain slopes, through which “flit the crimson-winged turacos, the lovely genii of the African forest;” or the “Jack-and-the-beanstalk country,” reached by ascending the wall-like sides of the higher mountains, where, on the cool and bracing plateaux, “daylight is one long inexhaustible joy of living.” Here, as in the chapter specially devoted to botany, Sir Harry Johnston has much to say of the beauty of the flowers, especially on the higher grounds. Flowering plants and trees are either much more abundant, or, owing to the less dense vegetation, much more apparent than in West Africa, and there is a pretty constant succession throughout all the twelve months. For this part of Africa, the statement that singing birds, sweet-smelling flowers, and gorgeous displays of bloom are not characteristic of the tropics, does not hold good. Scenes less pleasing, but needed to complete the true picture of British Central Africa as it now is, are those in which the death-bed of the fever-stricken gold-pro prospector, or the horrors of savage war, are portrayed with dramatic vividness.

A clear account of the physical geography of the Protectorate, illustrated by useful maps, occupies the second chapter, while the next two are devoted to a concise sketch of the history of the country, both before and since the establishment of British rule, ample recognition being given to the work of all who contributed, by their patient struggle with great difficulties, to lay the foundation of existing prosperity. The mission question is one on which such conflicting opinions are expressed, that it is of much value to have the conclusions of so impartial an observer as Sir Harry Johnston stated in a chapter devoted to the subject. After some graphic and sympathetic sketches of the life and work of the missionaries as observed during frequent intercourse with them, he concludes by asking, “Who can say, with these facts before them, with the present condition of the natives in South Africa to consider, with the gradual civilization of Western Africa, that missionary work has been a failure, or anything but a success, in the Dark Continent?”

Limits of space forbid the mention of all the varied contents of the volume. Repeated reference is of course made to malarial fever, especially the deadly “black-water” variety, which the author considers the only serious drawback to British Central Africa as a field of enterprise for trader or planter. Could this demon be conjured, the

prosperity of the country would, he thinks, be almost unbounded. There are some useful hints on outfit, which, while agreeing generally with the practice dictated by experience in India and other hot countries, differ in some points in accordance with the special requirements of the climate. It will be new to many to learn that "people suffer much more from *cold* in British Central Africa than they do from *heat*." The chapter on botany, above alluded to, is followed by an equally valuable one on zoology. The concluding chapters on the natives of the Protectorate and their languages show much original research, and describe fully both the physical characters and the mental and moral traits of the various tribes. In the last chapter an attempt is made to trace the main lines of the Bantu dispersal from the site where their languages were first developed, placed by the author near the meeting-point of the Niger, Shari, and Congo basins.

THE PHLEGRÆAN FIELDS.*

By R. T. GÜNTHER, M.A., Magdalen College, Oxford.

I WAS elected to the Oxford University Geographical Studentship for 1895-6 on March 14, 1895, for the purpose of enabling me to carry out certain investigations on the physiographical features of the Phlegræan Fields, near Naples.

The objects proposed for research were—

1. The computation of the total quantity of matter erupted by each volcano and by all collectively, as an indication of the volcanic activity of the region.

Owing to the ruined condition of many of the older craters, I have been met with many preliminary difficulties. I have, therefore, devoted myself chiefly to the enumeration of the more or less recognizable craters and to their relationships.

2. The examination of the valleys on the slopes of certain of the older craters, with the ultimate intention of collecting material from which it might be possible, at some future time, to arrive at a conclusion respecting the relative ages of those crater-slopes, and of the volcanoes themselves.

A special study of the region was made during the Easter Vacation, 1895, at the Royal Geographical Society's library. I left England in order to commence work on the second of these objects on June 28. While engaged in the examination of the valley beds, I lived at a small Osteria between the monastery of Camaldoli and the village of Nazaret. I had intended to reside at the monastery itself, but the monks refused their hospitality for more than a single night to one who could not pretend that he had lost his way in the woods. My work was chiefly on the erosion curves of valleys, and in plotting out their watersheds on a map. I returned to England after the end of the first week in September, and went out to Naples during the ensuing Christmas vacation, from December 12 until January 21. I resided at Naples, and made use of the Cumana railway for reaching the more distant volcanoes.

It is with great pleasure that I take this opportunity of recording my deep sense of gratitude to the British Consul at Naples, Mr. E. Neville-Rolfe, to the monks at Camaldoli, and to the officers of the Stazione Zoologica, for the personal kindness they have severally extended to me on various occasions.

The Royal Geographical Society has still further helped me with the loan of a surveyor's level and of an Amsler's planimeter.

* For General Map (No. 1), see p. 464.

I.—THE VOLCANOES.

The Phlegræan Fields constitute but a small part of an immense area of volcanic deposits which cover all the lower stretches of country between Roccamonfina and the Sorrentine peninsula, and which extend far up the western valleys of the Apennines to a distance of some 30 miles from the coast. On the east and south these volcanic deposits are bounded by the Tertiary limestone of the Apennines and the Sorrentine chain of hills. To the west they continue for an unknown distance below the depths of the Tyrrhenian basin of the Mediterranean. The submarine volcanic deposits cannot be of less extent than those which are now subaërial, for even at Capri beds of considerable thickness have been measured. Indeed, it does not seem improbable that the submarine deposits of the bay of Naples join those of Ventotiene and the Ponza islands, and they probably extend much further.

In the vicinity of Naples, neither the tunnels that sanitary or railway engineers have driven through the hills, nor the deepest well shafts that have been sunk, have penetrated to the bottom of these deposits, or have reached any stratum of rock that is not of a volcanic origin. The well at Ponticelli was carried down 180·6 metres, through varying strata of volcanic *débris*, without reaching any other rock.

The conclusion to be drawn is, that for such a thickness of volcanic rock to have been accumulated, the volcanic fires must have been alight for a very long period of time, yielding the energy which has lifted so much matter up from below and scattered it broadcast over the surface. The original volcanoes which laid the foundations of this tract of country must have been buried over and over again by the *débris* vomited by other vents, which have in their turn been obliterated by the vast piles of ashes and lava ejected by more recent volcanoes.

Were this all, the interpretation of the more recent history of the region would be an easy matter. But the older volcanoes, in addition to suffering sepulture, have as often been partially destroyed, either by their successors or by denudation by sea or rain. By denudation, the substance of many volcanic heaps has been distributed over adjoining areas, and has often contributed to the effacement by burial of adjoining volcanic structures.

The denudation of material from one volcano and its redistribution on or around another, the formation of new volcanoes, the burial of old ones, have gone on uninterruptedly, and have produced the physiographical aspect of the country as we know it at the present day.

Some geologists tell us that most of the vast deposits of tufa which are so prominent a feature in the region, owe their present wide distribution to the action of sea-water, and that salt waves carried them to the valleys in the Apennines. Other geologists would have us believe that such a view is as unnecessary as it is absurd, and that the tufa deposits fell as dust and ashes from the air, and were somewhat compacted by rain-water. Others, again, would invoke the former existence of volcanic vents situated far from the areas where they occur to-day. At the present day all the volcanic vents which can be indubitably recognized as such are within some 5½ miles of the coast-line between Vesuvius and Cumæ.

SUBDIVISION OF VOLCANIC AREA.

The area under consideration may therefore be very naturally divided into two regions—the region of the volcanoes, and the region of the volcanic plains.

The *first region*, of volcanoes, may be defined as that in which the actual volcanic vents are situated. It is characterized by its uneven nature, its burnt soils, its crater-like hills and hollows, volcanic ridges, and trachytic rocks.

The *second region, of volcanic plains*, is that which contains no volcanic vents, but its rocks and soil are composed of volcanic *débris* ejected or denuded away from the first region and spread over the second region by water or other agency. It is characterized by its level stretches of volcanic soil, usually of the most fertile kind.

This division is one which has long been recognized by the inhabitants of the Neapolitan provinces, who speak of the second flat region of fertile plains as the *Campagna Felice*, and of the first as the *Campi Flegreæi*.

The Campi Flegreæi, or "Burning Fields," then, owe their character to the fact that within their confines the topographical features are chiefly the result of the assemblage of a number of craters of volcanic disturbance grouped in close proximity to one another. This region of volcanic vents extends over about 50 square miles, the greater part of which lie within a rectangle measuring 12 miles from east to west, 5½ from north to south. On the south the land runs out into two promontories, which limit the east and west sides of the bay of Pozzuoli. On the east is the Posillipo ridge, terminating in the island of Nisida; on the west is the Baia-Miseno promontory, extending out towards the islands of Procida and Ischia.

TOPOGRAPHICAL FEATURES DUE TO VOLCANIC ACTION.

Leaving aside all consideration of the more extensive movements of subsidence and upheaval, which probably affected more or less of the entire region of the Phlegreæan Fields, volcanic activity, as far as it has been the cause of the chief topographical features, has manifested itself locally by the ejection of rock from definite vents in one of two ways.

1. By the slow outwelling of fluid materials from the vent, resulting in the formation of lava streams, as near the Solfatara; or of heaps of lava, as in the crater of Astroni, according as the inclination of the surface of the ground was more or less inclined, and the lava more or less fluid (see p. 434).

2. By the rapid explosive discharge of matter from below, generally with the effect of enlarging the aperture of the vent, and of thus forming a volcanic "crater" surrounded by a circular heap of cast-up *débris*, scoriae, lapilli, etc., of greater or smaller diameter according to the violence of the explosion.

The first process is usually only a burying one, the second as often destroys near objects by the force of the explosions. Within the memory of man all volcanic action has been subærial, but many vulcanologists seem to think that some of the older eruptions have been submarine. The topographical features which have resulted from one or other of the above-mentioned manifestations of volcanic activity have taken the form of circular depressions in the ground (Fondi di Baia), conical heaps of ashes (Monte Nuovo), or of tufa (Campiglione) with crater-hollows in their summits, segments of tufa (Capo Miseno), ridges of tufa (Posillipo), and others.

The object of the present paper is to show how far the chief topographical features of the Phlegreæan Fields can be shown to be capable of explanation as portions of volcanic craters or of their ring walls, and to endeavour to define and localize the volcanoes of which they are supposed to have formed a part.

Before proceeding to a detailed description of those topographical features of the Phlegreæan Fields which may be explained as having once formed part of volcanic craters, it is necessary to state that the interpretation of the word "crater," which is adopted here, is that it is typically a circular cup-shaped excavation in the ground caused by a volcanic explosion, and is usually surrounded by a circular ring wall of *débris* thrown out by that explosion.

The only sure means of identifying such a crater is afforded by a knowledge of the geological structure of its walls and of the ground beneath it. In many cases,

as, for example, on the sea-bottom or on the surface of the moon, it is impossible or impracticable to obtain information concerning geological structure, and we are then compelled to resort to the configuration of the supposed crater and its walls.

In the description of volcanic craters and cones, the inner and outer slopes may be conveniently designated by the terms *crater-slopes* and *cone-slopes* respectively. A crater ring-wall will be limited by crater-slopes interiorly, and by cone-slopes exteriorly.

In the present paper, the following considerations have been found useful as indications of volcanic craters and of their position:—

1. If a hill is convex towards one side and concave towards the other, it is assumed that the crater which it formerly surrounded was situated on the concave side, and that the radius of the crater at any level is indicated by the radius of the arc formed by the horizontal projection of the horizontal curve of the crater-slope at the same level.

2. A further indication of position is afforded by the fact that in almost every case the natural crater-slope is much steeper than the corresponding cone-slope.

3. If arc-shaped hills be so situated that a curve approaching a circle can be drawn so as to pass along all their ridges, it is an indication that the hills are parts of one and the same crater wall.

4. In the Phlegræan Fields there is nothing more common than to find volcanic cones denuded on the side facing the sea (Nisida, Capo Miseno). It is therefore probable that the last vestiges of a volcanic crater ring will be on the land side.

5. When one volcanic ridge intersects another, the one which ends in the circumference of the other is likely to be the older.

6. *Ceteris paribus*, greater incompleteness, gentler slopes, more conspicuous marks of erosion and denudation are indications of greater age.

DISTRIBUTION AND ENUMERATION OF VOLCANIC CRATERS.

The volcanic hills of the Phlegræan Fields are grouped along a crescentic area of which the horns are turned to the south more or less symmetrically on either side of the old Roman road running north from Pozzuoli to Capua, now known as the Via di Campana. The two horns of the crescent coincide with the two headlands of Nisida and Capo Miseno at the eastern and western limits of the bay of Pozzuoli, the town of Pozzuoli being situated near the centre of figure of the crescent.

As will appear in the sequel, the conception of distribution over a crescentic area is a useful one, because the more recent volcanoes are arranged along the inner border, the outer border being occupied by the wrecks of older ones.

The following grouping of the chief volcanic hills and craters is necessarily quite arbitrary, but it seems convenient to adopt some classification. Formations considered to be parts of craters of demonstrable position are numbered with Arabic numerals. Formations of volcanic origin of which the craters cannot be recognized are indicated by letters.

I.—BAIA-MISENO GROUP.

1. Capo Miseno.
2. Porto Miseno.
3. Bacoli.
- 4 and 5. Fondi di Baia.
6. Baia.
 - (a) Monte Salvatichi.
 - (b) Monte di Procida.

II.—AVERNUS GROUP. (Map II.)

7. Monte Nuovo.
8. Lago d'Averno.
9. Monte Grillo, Monte Rosso.
10. Cuma.

III.

11. Campiglione.
La Starza.
(c) Monte Ruscello.
(d) Monte San Severino.
12. Montagna Spaccata.

IV.—ARCHIAGNANO GROUP. (Map IV.)

13. Cratere di Campana.
14. Solfatara.
15. Astroni.
16. Archiagnano.
17. Cigliano.
(e) Pacifico ridge.
(f) Astroni-Cigliano ridge.
(g) Crisci mound.

V.—CAMALDOLI GROUP.

18. Quarto.
19. Pianura.
20. Soccavo.

VI.—NAPLES—POSILIPO CHAIN.

21. Naples.
22. Chiaja.
23. Fuorigrotta.
24. San Strato.
25. Santa Teresa.
26. Nisida.

1. *Capo di Miseno.*

The most southerly point of the Phlegræan Fields is marked by the conspicuous square-topped hill of Miseno, which was shown to possess the geological structure of a volcanic crater by Scrope in 1825 (15, p. 435). The existing peak (Fig. 1) is the north wall of a crater, the southern wall of which has been washed away by marine erosion. The eastern and western walls, although much denuded, are indicated by the spurs from the north wall, which carry the lighthouse and the old ruined watch-tower respectively. Their cliffs fall precipitously to the sea, a feature common to all the more exposed headlands of this coast. The section of the east crater-wall exposed exhibits the turtle-back structure, so characteristic of volcanic ash-cones.

2. *Porto di Miseno.*

To the north of Capo Miseno lies the harbour of Miseno (Fig. 2), a basin somewhat constricted in the middle, of figure-of-8 shape, which opens widely to the sea between the Punta Terone and the Punta di Pennata. Separating the inner part from a shallow lagoon, the Mare Morto, is a sandy beach which is continued all round the land side except on the north, where it passes into the cliffs formed by the volcanic cone of Bacoli. The depth of the inner harbour gradually increases

towards the outer basin. On the other hand, the outer part of the harbour is for the most part enclosed by steep, rocky cliffs, and it is deepest in the middle, becoming shallower towards the sea, from which it is separated by a distinct bar traceable on the sea-bottom. The outer pool of the harbour is 59 feet ($12\frac{1}{2}$ metres) at the deepest place, but the greatest sounding on the bar is only $29\frac{1}{2}$ feet (9 metres).

The outer harbour of Misenum has, I think, every claim to be considered as a submerged crater. The greater part of its periphery can be traced; there are the cliffs below the hill of Misenum, ending in the Punta Terone on the south. There is the little eminence (Punta Saparella) with the ruins of the theatre of Misenum; there is the ridge terminating in the Punta di Pennata, in which the arrangement of strata characteristic of the cone-slope of a volcano can be clearly seen (Fig. 3); and, finally, there is the submerged bar extending across the mouth of the harbour.

Watch tower
on west wall.

North wall of crater.

Lighthouse
on east wall.



FIG. 1.—CAPO DI MISENO, FROM THE SOUTH.

On the other hand, I see no reason for accepting the view that the inner harbour is a crater. It has a greater resemblance to the neighbouring lagoon of the Mare Morto, and has probably been shut off by a sand-bar on the west of the Porto di Miseno crater, just as the Mare Morto has been shut off from the sea by the Spiaggia di Minisola.

3. *Bacoli*.

The horse-shoe-shaped hill upon which the little village of Bacoli and an old Roman reservoir—the Piscina Mirabilis—are built, exhibits every sign of being the remains of an old volcanic cone with a well-defined crater, the eastern wall of which has been removed by the action of the waves. The base of the southern wall has also suffered denudation to a slight extent, and its low cliffs partly shelter the harbour of Misenum from the north wind (Fig. 3).

4 and 5. *Fondi di Baia.*

Between Bacoli and Baia are situated two small adjacent craters, which seem to have been excavated by two series of explosive outbursts occurring simultaneously at the two ends of a cleft in the ground, or from two vents, one situated

	Monte Salvatichi.	Cuma.	Baia.	
Mare Morto.	Inner harbour.		Bacoli.	Outer harbour.
Canale di Procida.		Pta. Saparella.		Pta. Pennata.
				Pta. Terone.



FIG. 2.—PORTO DI MISENO, FROM CAPO MISENO.

in each Fondo. The *Fondi* represent a state of volcanic activity which has been paralleled by Vesuvius. Scacchi records the formation of two twin craters at the top of the mountain on February 23, 1850. The *Fondi* are situated on the con-

Pta. Saparella.	M. di Procida.	Bacoli.	Pta. Pennata.
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FIG. 3.—PORTO DI MISENO.

slopes of the Baia volcano, and must therefore be of a later date—otherwise the greater quantities of matter ejected by the latter must have filled up and obliterated, at any rate, the nearer Fondo. The crater-slopes of the *Fondi di Baia* are now cultivated with vines.





CUMA, LAKE AVERNUS, MONTE NUOVO, M. GRILLO & M. ROSSO.

6. *Baia.*

Only half of the walls of the crater in which *Baia* lies have been preserved, and even they seem to have undergone partial destruction by erosion on the west, and by the eruption of the *Fondi di Baia* on the south. The crater-slopes, however, can be traced, cradling round the bay of *Baia*, from the *Punta dell' Epitaffio* to the *Fortino di Tenaglia*, below the castle built by *Don Pedro de Toledo*.

A large portion of the bay is very shallow, and soundings have revealed the presence of shoals off the *Punta dell' Epitaffio*. In some places the submerged ruins of Roman buildings are still to be traced.

(a) *Monte Salvatichi.*(b) *Monte di Procida.*

To the west of the *Baia-Miseno* chain of craters are two massive ridges which *Breislak*, with his usual facility, interpreted as segments of the same volcanic ring.

The *Monte Salvatichi* (Fig. 2) has had its south-east extremity augmented in height by the neighbouring *Fondi di Baia*.

The *Monte di Procida* is steep towards the north-east. The slopes on the south-west side are gentle from the top of the ridge to the top of the cliffs, but then fall away precipitously to the sea. The ridge terminates abruptly to the north-west and south-east (Fig. 3). Detached from the mainland lies the small flat island rock—the *Scoglio di S. Martino*. The section of the hill shows that its height has been augmented at very various times, and that extensive denudation has gone on in the intervals. The products of the eruption of the *Procida* volcanoes seem to be interstratified with those of the mainland (*Johnstone-Lavis*).

The *Avernus* group of volcanoes are shown in Map II.

7. *Monte Nuovo.*

The most recent of the *Avernus* group of volcanoes is the well-known *Monte Nuovo*, a heap of pumices and lapilli 489 feet (149 metres) in height and $\frac{1}{4}$ mile (1 km.) in diameter, which sprang up in a few hours on September 29 and 30, 1538, on the periphery of the crater of *Lake Avernus*. The larger part of the *Lucrine* lake was filled by the *débris*, and during the seventeenth century the remainder was so "choaked up by the horrible and astonishing eruption of the new Mountain," that *Sandys* refers to it as a "little sedgy plash," and *Ray* as a "fenny meadow." Today the renaissance of oyster-culture has resulted in the uprooting of the weeds, and in the deepening of the lake; but even as late as the beginning of the present century, travellers confirm *Swinburne's* description—"a slimy bed of rushes covers the scattered pools of this once beautiful sheet of water." The *Lucrine* never seems to have been a deep lake, for, judging from the account of *Strabo*, it was too shallow for vessels even of small draught. Nor does it seem likely that *Agrippa* would have undertaken his expensive harbour-works had the *Lucrine* been sufficiently deep as an anchorage for his fleet. A sketch of part of the lake, inscribed "*Stagnv*," appears upon two Roman glass vases, together with other topographical details (6, p. 435).

8. *Avernus.*

The crater wall of *Lake Avernus* is complete, but is very low towards the south-east—a circumstance of which *Agrippa* took advantage when he placed the lake in communication with the sea by means of his ship canal. At the present day no trace of the harbour works can be seen owing to their total obliteration by the eruption of *Monte Nuovo*; but it is just within the bounds of possibility that the dip of the top of the cone of *Monte Nuovo* towards the south and east may be due to some depression in the level of the ground before the eruption, and that depression may have been along the course taken by the canal of *Agrippa*.

Being unable to discover any record of a systematic series of soundings of the

lake, and finding the depths given by various authors to vary from infinity to 250 feet by one (Phillips), and 108 feet by another,* I made a few soundings across it, and found to my great surprise that, instead of being much deeper in the centre and gradually shoaling towards its circumference, it was of a uniform depth of 34 to 35 metres over the greater part (Map III.). The lake is at present surrounded by a masonry wall, built, it is said, in 1858, just before the end of the dominion of the Bourbons.

9. *Monte Grillo and Monte Rosso.*

The wall of the Avernus crater, with the exception of the gap to the south-east, is of a fairly uniform height of over 260 feet (80 metres), but at two points it attains to heights of 380 and 318 feet (116 and 97 metres) respectively. At these two points the wall intersects a curved range of hills, known as Monte Grillo to the west (Fig. 4)

Intersection with M. Grillo



FIG. 4.—LAKE AVERNUS, FROM NORTH-EAST CORNER.

and Monte Rosso to the north, which enclose the Schiana plain. Near the middle of this range is situated the Arco Felice, beneath which the Via Cumana passes. The arch is 63 feet in height, and is said to have once supported an aqueduct.

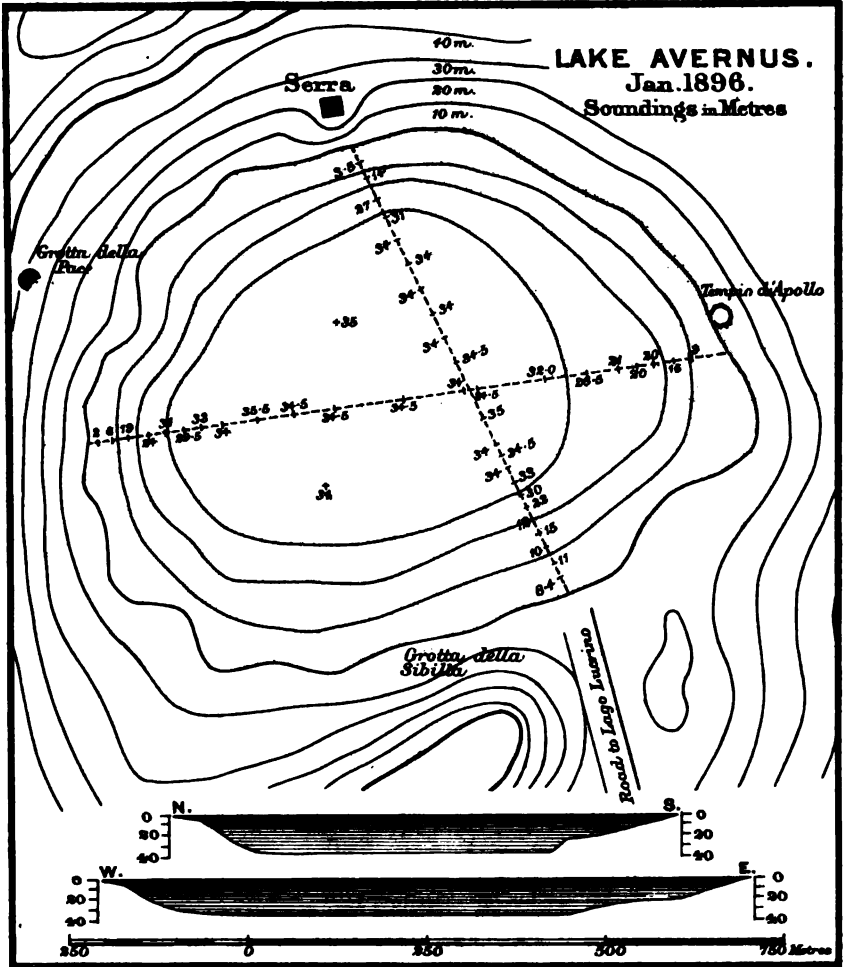
The general appearance of the Grillo-Rosso range, when viewed from a neighbouring height, is quite that of a segment of the walls of a large crater. Avernus arose in the south-east side of this Grillo-Rosso crater, just as, at a later date, Monte Nuovo sprang from the south-east of Avernus (Map II.).

10. *Cuma.*

To the west of the Grillo-Rosso cone, and rising up between the lagoons of Fusaro and Licola, is the hill which once bore the Acropolis of Cumæ. On the west and north, precipitous cliffs of trachyte (Fig. 6) supplied the citadel with a natural fortification against attack from the sea. On the south-east it is connected

* Eighteen fathoms—'Bishop Burnet's Travels.' 1686.

MAP III.



with the high land of Monte Grillo by a broad, gently sloping ridge, upon which the abundant ruins testify to the importance of the old city.

While seeking for some other trace of the crater wall, of which the hill of Cuma might be a part, I noticed that the cliffs to the south project slightly towards the sea, forming a spur which may be recognized on the contoured map to the west of the amphitheatre. At a little distance from this spur, and between it and the sea, there is a small isolated mound of tufa rising above the surface of the sandy beach. This spur and mound seem to me to be strong indications that a ridge of tufa once existed extending seawards from the cliff, but that all traces



FIG. 5.—ARCO FELICE.

of it have been washed away by the sea excepting the little mound of tufa. If this suggestion be a true one, this ridge might represent part of the southern wall of the old Cuma volcano, the cliff might mark the site of its eastern crater-slope, and the centre of the crater might lie on the perpendicular bisector of the line between the Acropolis and the mound.

11. *Campiglione.*

Occupying an almost central position in the Phlegræan Fields, the crater walls of Campiglione are the highest of those erupted from a single vent, and are among the most picturesque. The crater wall reaches an elevation of 1047 feet (319 metres) on the northern side (Monte Corvara), and 1079 feet (329 metres) on the southern (Monte Barbaro, or Monte Gauro). The sea has made extensive inroads

upon the south-western and south-eastern flanks, with the effect of considerably lowering the walls of the crater on the east and west (Fig. 7). The steepness of the southern cone-slopes of Monte Barbaro, as compared with the cone-slopes of Monte Corvara, is doubtless due to the same agency.

The cone-slopes of Monte Corvara are continuous with the crater-slopes of the western Quarto; they touch those of Monte Rosso on the west, and perhaps overlie a part of Monte Ruscello. Upon Monte Corvara is found a liberal coating of scoria and lapilli, similar to those found round the vent of the *Montagna Spaccata* volcano. On the northern side of the crater, a spur of doubtful significance traverses the crater-slope.

Acropolis.



Tufa mound.

FIG. 6.—MONTE DI CUMA, FROM THE SOUTH.

La Starza.

The east and south flanks of the Campiglione rise abruptly from a plateau, 50 to 70 metres above sea-level, upon which Monte Cigliano also stands, and which seems to owe its height to material denuded from surrounding cones, especially from that of the Campiglione, and perhaps from the *Montagna Spaccata*. This plateau terminates on the south in cliffs, known as *La Starza*, containing sufficient quantities of marine shells to prove their marine origin.

(c) *Monte Ruscello.*

Monte Ruscello is a very problematical rounded dome of tufa, in which I have hitherto been quite unable to detect any indication of crater structure. Should it really be a portion of a crater wall, it seems more likely that the remainder lies buried beneath the flanks of Monte Corvara than that it has been washed away by the western sea. It may be a complete volcanic cone, which either never had or has lost a crater situated on its summit. It is extremely unlikely that it has anything to do with Monte San Severino. The undened character of its sides seems to show that it is a far younger structure.

(d) Monte San Severino.

Monte San Severino, or Monte Gaudo, is a long ridge of tufa lying in a south-west direction tangentially to the north side of the walls of the west Quarto, to which in its morphological character it bears considerable resemblance. Like them, it slopes gently towards the north, but more steeply to the south, and, like them, it is furrowed by a series of channels of great depth in proportion to their drainage areas. The point of intersection of the Monte San Severino with the west Quarto is marked by a small rise in height to the north of the Masseria Spinelli—367 feet (112 metres) above sea-level.

It seems possible that it is the last denuded upstanding remnant of the northern segment of a crater, not unlike the west Quarto, but of older age, which was broken into by the eruption of the west Quarto, as Monte Nuovo has broken into the periphery of the Lake Avernus crater. If the Monte San Severino ridge be analogous to the north wall of the Quarto, its crater would have been situated to

M. Corvara.

M. Barbaro.



FIG. 7.—CAMPIGLIONE VOLCANO, FROM THE WEST.

the south of the ridge. The narrowness of the ridge would seem to indicate that here we have the crest of the crater wall, and that the remainder lies buried below the level of the country and the walls of other volcanoes.

12. *Montagna Spaccata.*

The occurrence of a stratum of volcanic ejectamenta, scoria, lapilli, etc., all over an area lying to the south of the Piano di Quarto, to the west of the Cratere di Campans, and over a considerable portion of the Campiglione volcano would lead one to suspect the existence of some comparatively recent subaërial volcanic vent in that region. The centre of this scoria-covered area lies near the Roman road which was cut through the *Montagna Spaccata*, from which cutting the hill derives its name. The section of the *Montagna Spaccata* disclosed shows that the hill was constructed of matter, not ejected from the Quarto, but from the south—a fact which tends to show that it is the north wall of a volcanic vent (Deecke, 4, p. 435). No trace of the southern wall is to be seen, unless the *Orisci mound* (p. 427) represents a portion of it. Its destruction was probably partially effected by the waves that denuded the eastern side of the Campiglione, and which covered the site of the vent of the crater with tufa denuded from the neighbouring volcanic cones.

13. *Cratere di Campana.*

To the north of Astroni is an exceedingly interesting series of concentric crater

rings, which are but seldom visited, owing to their being a little out of the round of the ordinary tourist. The quantity of matter erupted by the Cratere di Campana is but small compared with their neighbours. Their walls are thickly covered with chestnut woods, which often render it difficult, occasionally impossible, to obtain a clear view of the conformation of the ground. The eruptions seem to have been entirely subaërial. Lava-like flows can be seen in several places, which are thought by Deecke to be due to the partial flowing of fused hot cinder bombs ejected from the crater. The chief interest of the Cratere di Campana lies in the fact that they show very clearly how the volcanic forces at that spot gradually weakened and finally became altogether extinguished.



FIG. 8.—LA SENGA.

Three almost concentric crater walls can be made out. The outer can be most readily distinguished to the east, where it is separated from the middle crater wall by a deep trench, the Fossa Schianana or Schianata. On the north it is covered with the Maranisi woods.

The middle crater wall touches the crater-slope of the outer one, both on the north and south.

The innermost and youngest crater, or Fossa Lupara, has very steep crater-slopes on the south and east, indicative of a final explosive act before it became quiescent. On the western side the crater-slopes are more gradual, and several (three) successive steps or terraces can be traced. At the bottom lie several large blocks of trachyte, one of which measured 4 feet through.



MAP IV.



ARCHIAGNANO GROUP OF CRATERS.

In the rock on the eastern side of the Fossa Lupara, Breislak, Scacchi, and others record a narrow fissure of great depth called la Senga. Deecke (4) writes that, in 1885 and 1887, in spite of great facilities for studying the Fossa Lupara, he was unable to discover this fissure, and suggests that it had perhaps closed up, and was concealed from the eye by the vegetation. Guided by a goatherd, I had no difficulty in finding the Senga in the winter of 1896.

The Senga is a straight chasm extending across the eastern wall of the innermost crater in a radial direction running east and west (compass bearing 86°). I was able to trace it for some 50 yards, although it has become covered over in places by the surface soil and vegetation. Even where it is covered over, there are occasional pitfalls leading down into it, which might prove dangerous death-traps to any one trying to walk across them in the dark. The fissure seems to vary in width from 3 to 6 feet. Its depth is about 128 feet (39 metres). The eastern end (Fig. 8) can be easily entered to a depth of about 18 feet, but, not having a rope or assistance, I did not venture upon a further descent.

The Senga has either been caused by an earthquake or is a split due to the shrinkage of the walls of the volcano on cooling, and, as such, has been rightly compared to the cave beneath the Monti Rossi, near Nicolosi, on the slopes of Etna. If the Senga owes its origin to either of these causes, the same cause seems to have operated upon the other side of the Fossa Lupara, where I noticed two similar cavities in the crater wall, though on a smaller scale.

The next group of volcanic hills to be considered are those which seem to have sprung up around the ruins of an old crater wall, for which I propose the name of Archiagnano (Maps I. and III.).

14. *Solfatara*.

Of this group, the Solfatara is stated to have been in eruption in 1198, and at the present day its fumaroles attract the greatest amount of attention given by tourists to the volcanic phenomena of the Phlegrean Fields. The crater of the Solfatara is one of the most perfect, but the amount of matter erupted from it seems insignificant; to the north no trace of a cone is visible. At different times there have been lava-flows from its eastern side.

On the southern side of the Solfatara rises the great trachyte-capped boss of Monte Olibano, which was shown by Guiscardi to be of more recent origin than the yellow tufa of Monte Dolce. In the British Association Report of 1890, Johnston-Lavis suggests that this eruption of lava occurred at a considerable time after the sea had deposited the Starza cliffs and had partially denuded Monte Barbaro.

15. *Astroni*.

To the north of the Solfatara, and connected with it by a ridge, is the beautiful cone and crater of the Astroni. For our present purpose, the important facts to note about it are, firstly, that there is a spur running down the south-west crater-slope; secondly, that the highest points of its walls are on opposite sides of the crater at the Torre Nocera and the Torre Lupara; and, lastly, that the major axis of the elliptical crater lies across the line between these two high points.

16. *Archiagnano*.

At the foot of Astroni, cradled by hills, lies the plain which, before 1870, was partly covered by the lake of Agnano.* The eastern side of this plain is shut in by the well-preserved curved ridge of San Domenico, the northern boundary is shared with Pianura, the western is apparently replaced by the cone-slopes of Astroni. Upon the south, the walls are more irregular; their symmetry being marred by

* It is a significant fact that no mention is made by any Roman author of a lake upon the site of Agnano.

three projections, the Colles Leucogæi, or cone-slopes of the Solfatara, the northern spurs of Monte Dolce, and Monte Spina (Maps I. and IV.).

The original western wall is indicated by the two ridges, of which one is intersected by the craters of the Solfatara and Astroni, the other by those of Astroni and Pianura. The points at which these ridges intersect the Astroni crater walls have already been noticed. The Solfatara-Astroni ridge forms the Torre Nocera, and to it doubtless is due the spur upon the crater-slope in Astroni, just below the Torre Nocera (see Fig. 9). The Astroni-Pianura ridge forms the Torre Lupara, the second highest summit of the Astroni cone. Both the Nocera and Lupara ridges, as the Solfatara-Astroni and Pianura-Astroni ridges may be called, lie along the

	C. Miseno.	Ischia.	
		Monte di Procida.	
Agnano.	Colles Leucogæi.		Nocera spur. Astroni.



Masseria grande.

FIG. 9.—VIEW FROM CAMALDOLI OVER PART OF THE AGNANO PLAIN (TO THE LEFT), WITH THE WHITE COLLES LEUCOGÆI, AND THE CRATER OF ASTRONI (TO THE RIGHT). IN THE FOREGROUND IS THE PLAIN OF PIANURA.

circumference of the same circle; both are deeply furrowed by torrent beds, and to a far greater extent than the Astroni slopes. The slopes of the Nocera ridge are steeper to the east than to the west, indicating that the former are crater-slopes, the latter cone-slopes; and, finally, both lie on the site which the western crater wall of the Agnano crater, if reconstructed from its eastern and northern walls, might be expected to occupy (Map IV.).

For the crater of which these ridges—the Nocera and Lupara ridges—seem to be the surviving western walls, broken into both by Astroni and, at a probably later date, by the Solfatara, I propose the name of Archiagnano, in order to avoid confusion with any existing conceptions of the crater of Agnano having been merely coextensive with the former lake of Agnano.

If the theory stated above be the true one, the history of this interesting

group of volcanoes might have been somewhat as follows: First, the eruption of Archiagnano, with the formation of a crater wall which included the ridges of Nocera and Lupara, Monte Spina, and the hill to the west of the Masseria Grande; secondly, the shifting of the vent to the east, and the formation of the part of the crater occupied by the lake of Agnano; lastly, the eruption of Astroni and the Solfatara in the western wall.

17. *Cigliano*.

Between Astroni and Campiglione lies the extremely perfect cone and crater of Cigliano, which must be more recent than Campiglione, for otherwise it could hardly have withstood the waves which inflicted such damage on the flanks of the latter.

(e.) *Pacifico ridge*.

(f.) *Astroni-Cigliano ridge*.

(g.) *Crisi mound*.

Before leaving the Astroni group, there are three accumulations of volcanic *débris* which deserve notice, although I have been unable to account for their presence.

(1) The Pacifico ridge runs north-west from Astroni almost perpendicularly to a tangent at the point of intersection. If it originally continued further in the same line, it must have been cut across by the eruption of Archiagnano. It is covered superficially by trachytic lapilli from the Fossa Lupara eruption.

(2) The Astroni-Cigliano ridge—perhaps of no significance as an indication of a special crater wall, but merely a heap of *débris* from both craters.

(3) The Crisi mound—a small elevation of some 25 metres in height to the north of Cigliano. It may either be the summit of an old crater wall mostly buried by the *débris* erupted by other craters, or, as Deecke suggests, a portion of the southern wall of the Montagna Spaccata volcano.

18. *Quarto*.

The Camaldoli group includes the craters of *Quarto*, *Pianura*, and *Soccavo*. The hills and valleys of this group, together with those of the *Naples* volcano, are discussed in greater detail in a second paper to be published subsequently.

The most northerly part of the Phlegrean Fields is occupied by the large oval plain of the Quarto, completely surrounded by hills. It has yet to be determined whether the hills to the east and west are of the same age and originally due to the same eruption. However this may be, the Quarto is certainly not such a simple crater as has been supposed. The high eastern walls have every appearance of being crater-slopes much denuded by the torrents which have collected upon the high ground above. On the west the walls are much lower and have gentler slopes. On the north-west there is a broad, low ridge, which extends some distance into the plain. The southern walls—at any rate, in the neighbourhood of the Montagna Spaccata—seem to have been replaced by the ejecta from the latter volcano. At Monte Viticella and at Torre Poerio a similar change may be found to have taken place. Near the Campiglione, the cone-slope of Monte Corvara is continuous with the "crater-slope" (?) of that part of the Quarto.

The cone-slopes of the eastern Quarto are shared with those of the other volcanoes which have built up the Camaldoli massif.

19. *Pianura*.

Only one-half of the walls of *Pianura* are preserved. They attain their greatest elevation at Camaldoli, and are much eroded by torrents. The crater of *Pianura* is in very much the same stage of destruction as the crater of *Nisida*; their shapes are similar. There is geological evidence of the crater having been filled with a lake until tolerably recent times (Johnston-Lavis); now the surface water passes off into the adjoining *Soccavo* basin by a channel, which has been excavated at the foot of the Pignatiello spur to a depth of 45 feet below the level of the roadway.

20. *Soccavo*.

It is generally held that the Soccavo basin is the result of a volcanic eruption. If that be so, it seems to me that it cannot have contributed largely to the Camaldoli massif, because the contour-lines of the cone-slopes run concentrically with the circumference of Pianura, and not with that of Soccavo.

Lastly, there is the range of hills extending along a straight line from the Observatory hill at Capo-di-monte in a south-westerly direction as far as Nisida. From their disposition, it would seem as if the crust of the earth had given way to the volcanic forces along this line; and, further, that the foci of volcanic activity were not uniformly distributed all along the line, but were concentrated at points, two of which lay slightly to the south, and two to the north of the line. The two

Camaldoli.

Soccavo plain.



Plain of Pianura.

FIG. 10.—PIGNATIELLO SPUR BELOW CAMALDOLI.

lying to the south may be called *Naples* and *Chiaja*; the two to the north, *Fuorigrotta* and *San Strato*; and to these a fifth was added—*Nisida*.

Tunnels which have been excavated for the purpose of leading railways and sewers through the hills, have revealed masses of trachytic lava, such as are known to occur in other crater walls, e.g. Astroni, Solfatara.

21. *Naples*.

The old town of Naples lies at the foot of the semicircular range of hills, having all the appearance of a crater-slope, and extending from the Capodimonte Observatory to the hill of St. Elmo. The entire south-east half of the wall of the crater is wanting. The floor is perhaps conterminous with the slight elevation or plateau upon which the old Roman Neapolis stood. At the present day the southern margin of this plateau can be traced along a line from Sant' Agostino to the University building, where the fall is so steep as to necessitate the employment of steps as a means of placing the thoroughfares above in communication with those below.

The cone-slopes on the west are buried among the *débris* of the Camaldoli massif. In the south they become continuous with the Chiaja cone-slopes.

The course of the Vallone di Sagliocendi perhaps owes its present position to the Naples crater. The upper tributaries of this valley commence on the cone-slopes of the Pianura volcano. The valley skirts the north of the Soccavo crater, pursuing a westerly course; as soon as it reaches the spot where the cone-slopes of the Naples volcano might be supposed to be, it turns sharply to the north. Then once more it turns west, skirting the northern walls of the Naples volcano, and finally turning south it runs seawards to the east of Naples. The course of this valley certainly seems to afford some confirmatory evidence in favour of the theory that a volcano once existed where Naples lies now.

22. *Chiaja (Mergellina, Jervis, 8).*

Adjoining the bay in the hills identified above with the Naples volcano is a second, extending from the Castello dell' Ovo to the Sannazzaro spur, south of Mergellina. If this be the remains of a crater, its walls have been breached from the south, and two-thirds of its floor are submerged; the remaining third is occupied by the new western quarter of Naples between Mergellina and the Pizzofalcone ridge. On the east the cone-slopes become continuous with the cone-slopes of the Naples crater. In the angle between them, below Antignano, is a valley which discharges its waters into l'Arena, in the Soccavo plain. On the west the cone-slopes meet the crater-slopes of Fuorigrotta.

Posillipo ridge.

The sea horizon, as viewed from the Chiaja quarter of Naples, is closed in on the west by the beautiful ridge of Posillipo, extending for some $3\frac{1}{2}$ miles from the Vomero. The uniform crest of the ridge lies near its western side, immediately above the steep slope which leads down to the Fuorigrotta and Bagnoli plains below. The incline of the eastern slopes commences more gradually, but ends more abruptly in the low cliffs which fringe and are being undermined by the sea.

23. *Fuorigrotta.*

At the northern end of the Posillipo ridge, and curving away from the sweep of hills already described as the crater-slope of the Chiaja volcano, lies another concave slope, open to the west, embracing the village of Fuorigrotta, and extending from the Torre Cervati spur below the Villa Patrizi to a second spur beneath the name "Monte di Dio" on the maps. If this slope be the crater-slope of a Fuorigrotta volcano, its northern wall is very probably indicated by the rampart which divides the low-lying Fuorigrotta plain from the higher level of the plain of Soccavo. It is partly, no doubt, owing to this sudden "step" between the levels of the two plains, that the watercourses which traverse the Soccavo plain have been excavated to their present depth.

There is also an indication of the western wall of the Fuorigrotta crater in the terrace on which stands the Masseria Terracina, at the foot of the cone-slopes of the San Domenico ridge, or eastern wall of Archiagnano. If this interpretation be the true one, the Fuorigrotta crater wall would seem to be older than that of Archiagnano, but not so old as that of the Soccavo crater.

24. *San Strato.*

Between the "Monte di Dio" spur and its termination in the Coroglio, the ridge of Posillipo has undergone so much denudation that it is difficult to discover any signs of a crater, even if it ever formed part of one. The hill, too, alters its character to some extent, for, whereas the western slopes retain the steepness which marks the crater-slopes of Fuorigrotta, the south-eastern slopes become far less steep from the ridge to the tops of the sea-worn cliffs. The width of the ridge becomes somewhat greater, reaching a maximum at the Capo. All along the south-

eastern slopes, at right angles to the line of the ridge, are a number of small valleys eroded by the torrents which scour their beds in wet weather, and which have co-operated with the sea in producing that charming succession of little bays (*cale*) to which this beautiful coast owes much of its picturesqueness. At Coroglio

Grotta dei Taoni.

Soglio di Vergillo.



FIG. 11.—TUFA CLIFFS EAST OF THE CALA DI TRENTAREMI.

the ridge terminates abruptly. The cliffs extend the entire height of the ridge, and the rocks in the vicinity exhibit the marks and scars of many a battle with the sea. Several rocky islets lie below, detached from the mainland. The Gajola and the Lazzaretto vecchio rocks are inhabited; others, such as the Tavola di Mare, lie just awash with the surface of the water. The rate at which the land is being washed away might be estimated by an examination of the numerous ruins of Roman buildings still lining the shore.

From the analogy of undoubted crater walls, I am inclined to consider the western steep slope of the southern half of Posilipo as a crater-slope, the south-eastern one as a cone-slope, of a crater the centre of which lay in the Bagnoli plain, not far from the small volcanic hill of Santa Teresa.

25. *Santa Teresa.*

The Montagnella di Santa Teresa is a miniature horseshoe-shaped mound in the middle of the Bagnoli plain. Situated almost in the centre of the "crater of the San Strato volcano," it may be considered as representing the last expiring effort of volcanic activity in that region. It has been breached by the sea on the south.

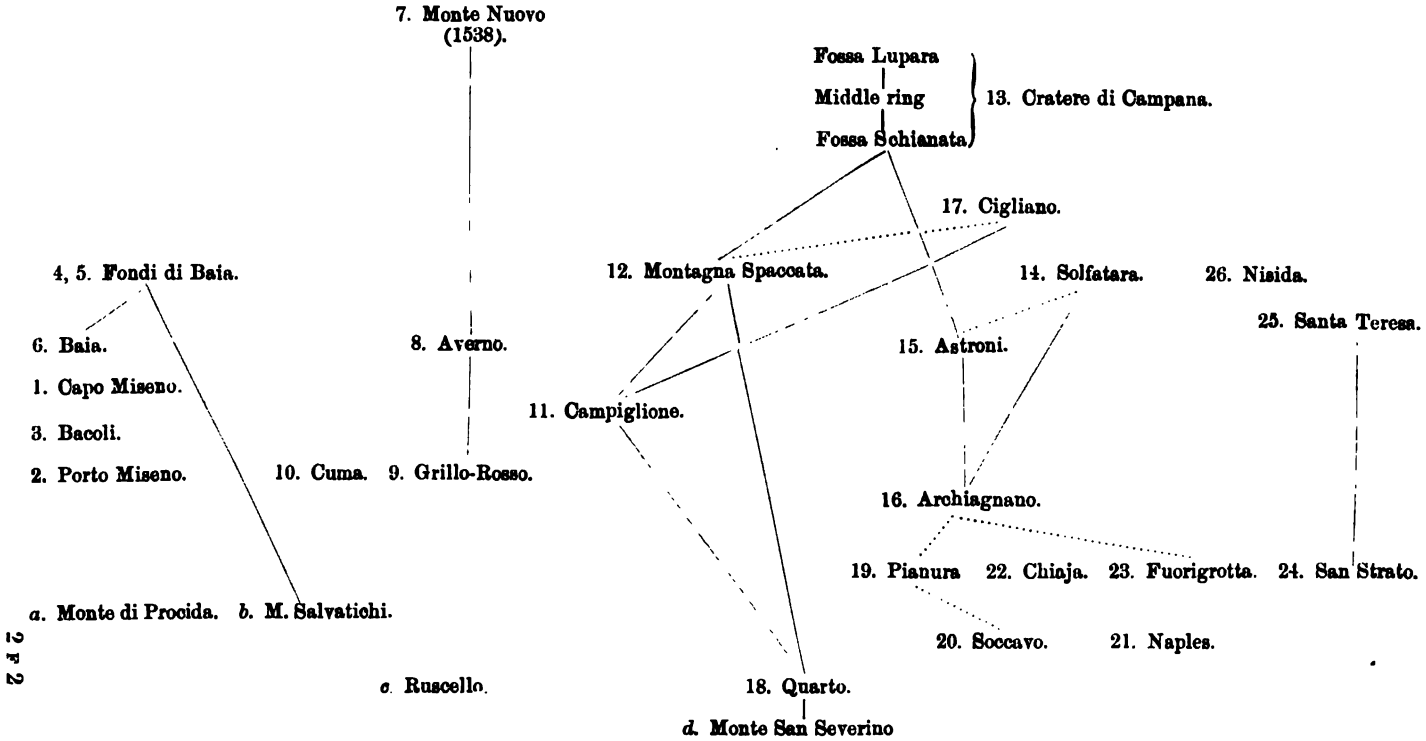
26. *Nisida.*

Lying just off the south-west end of Posilipo is the island crater of Nisida. The sea has washed away a large portion of the south-western wall, and has opened the flooded crater towards the south so as to form a natural harbour. The western crater-slope of the Porto Paone is much steeper than the eastern. The cliffs, like those of the end of Posilipo and of Capo Miseno, rise vertically from the sea. Small fragments both of eastern and western walls have become detached as two islet rocks, known as the Guglia di Levante and Guglia di Ponente respectively.

RELATIVE AGES OF VOLCANOES.

The only crater of known age is the Monte Nuovo. The others were formed in prehistoric times, and it seems almost impossible to form even a rough estimate of their absolute ages. On the other hand, there is often very considerable evidence that one volcanic structure is older than another. It may be that one does not exhibit such a weatherworn appearance as its neighbour, or that it has sprung up on the periphery of another, or, again, that its ejectamenta overlies those of a second volcano. These are taken as tests of relative age, and the following table has been constructed to exhibit the results obtained by such tests. In the

TABLE SHOWING SUPPOSED CHRONOLOGICAL ORDER OF FORMATION OF VOLCANOES OF PHLEGRÆAN FIELDS.



THE PHLEGRÆAN FIELDS.

2 P 2

table the younger structures are arranged above those which are considered to be older. The lines connect those between which it is thought that some evidence of relative age can be detected.

Conclusions.

In conclusion, it has been shown that almost all the hills in the Phlegræan fields are either the entire walls of volcanic craters or portions of walls of volcanic craters which have been, to a greater or less extent, washed away by the action of rain or the sea, or have been partially destroyed or buried by more recent volcanic eruptions.

Secondly, these volcanic craters are distributed over a crescentic area round the bay of Pozzuoli; the more recent ones are situated closer to the shore of the bay than the older ones, indicating a gradual march of volcanic vents along lines radiating towards the centre of that bay. In other words, the general effect of volcanic activity has been the accumulation of new land around the bay of Pozzuoli. Inasmuch as water seems to be a necessity for a volcanic eruption, this progression of the volcanoes seawards may stand in some relation to the channels by which water has obtained access to the fires below.

Thirdly, wherever crater rings of a larger and smaller diameter overlap, we never find a larger ring superimposed on a smaller one. The smaller ring always is superimposed on the larger. The conclusion to be drawn is, that the volcanic activity of the region has been decreasing in intensity. The same proposition is proved for a single locality by the Campana series of craters.

Lastly, considering the amount of attention that has been paid to the Phlegræan fields by geologists, mineralogists, and travellers, it is a matter of surprise that our knowledge concerning much of the region is so incomplete. Apparently the interest of the more perfect and still active manifestations of volcanic energy in the vicinity have so entirely absorbed the attention of visitors, no less than that of the residents, that they have not been able to study the less perfect, dead, and partly buried ruins of the older craters as fully as they deserve.

One subject which I should like to suggest for future investigation is the exact configuration of the sea-bottom, especially in the vicinity of the banks which rise up at several places near the coast. A series of soundings taken close together in the neighbourhood of some of these banks might reveal the existence of curved crater-like hills on the sea-bottom, very similar to those on the land. Attention has been drawn to the bar which closes the Porto Miseno, itself probably the surviving eastern wall of that crater.

The ruin-covered shoal named *Fumosa* may perhaps indicate the southern wall of a crater on the site of Lago Lucrino. The Mezzogiorno bank may be a submarine crater wall south of Capo Misenum, and the Benda Palummo banks, rising up to 23 and 27 fathoms, with a depth of 34 fathoms between them, represent a condition not unlike that of the Campiglione, were it submerged to the same depth. La Catena and many other shoals round about Procida and Ischia would be well worth a careful survey.

I have, so far as possible, reviewed the region from a purely morphographical standpoint, studying its features in their purely topographical aspect, consequently my conclusions must be regarded as suggestive rather than as final. Their ultimate proof or disproof rests with the geologist, and if they stimulate him to extend his researches, my labour will not have been in vain.

APPENDIX A.

LIST OF MINERAL SPRINGS, FUMAROLAS, AND MOFETTE.

Names of springs, baths, etc., in use in or before the sixteenth century are printed in italics.

During the fifteenth and sixteenth centuries, and even earlier, the Phlegræan Fields were celebrated for the number, variety, and excellence of their natural hydropathic establishments. If we may trust the writings of contemporary physicians, there was no ailment but had its appropriate remedial waters and baths in this favoured country. Michael, the grandfather of Savonarola, followed by Bartholomæus Taurinensis and a number of other writers, has described, and Alcadinus has sung, the medicinal virtues of the mineral springs. The height of their fame was reached in 1668, when the Spanish viceroy, Pietro Antonio d'Aragona, made the baths more accessible, and caused three tablets to be inscribed with a descriptive directory to the baths. The first of these guide-inscriptions was placed at the entrance of the Grotta di Posillipo, the second in the Piazza di Pedro di Toledo in Pozzuoli, and the third near the Sudatoria di Tritoli. For further information the curious reader was referred to the works of Sebastiano Bartolo.

LAGO FUSARO.—Fish are said to have been killed by gaseous emanations during the eruption of Vesuvius in 1834 (Daubeny).

Monterillo. Fumarole.

MISENO.—Grotta del zolfo, north of Porto Miseno. Fumarole depositing salts and sulphur.

Finocchio. Fumarole. *Balneum Feniculi* (Elysium).

BAIA.—Numerous warm springs occur along the coast between Baia and the Stufe di Nerone. During the sixteenth century the following baths were used for medicinal purposes: *Bagni di Spelunca, di Braccola* (near the Truglio), *delle Fati, del Vesovo* (= *balneum Fontis Episcopi*), *di Gibboroso, acque di Culina* (= *balneum Culmæ*), *acque del Sole e della Luna* (= *balneum Cæsaris* of Alcadinus).

STUFE DI NERONE (= *Sudatorium Trituli*, auct.).—Fumaroles and spring of hot water. When the railway tunnel was driven through the hill, many Roman cuniculi were encountered. Some were traced for 100 metres. They were probably used for collecting vapour for sudatoria (Johnstone-Lavis). Close at hand were the baths called *Salviana* (= *balneum Sylvianæ*), *di Tritoli, di S. Giorgio* (= *balneum S. Gregorii*), *del Petroleo*, and *l'acque di Pugillo*. At one place in the vicinity the temperature of the sea-water was found to be 55° C. or 131° Fahr. (Schmidt).

MONTE NUOVO.—One fumarole, "fumeta di travi di fuoco," is in the middle of the south-west slope; another is on the western side. The *bagni di Tripergole, del Arco, di Rainiero, di San Nicola, della Scrofa, di S. Lucia, di S. Maria, di S. Croce* are said to have been buried beneath the mountain.

LAGO AVERNUS.—The Sibyl's Cave, with its ancient *bagno Palombara*, or *bagno della Sibilla* and the *bagni di Succellario* and *del Ferro*, were all situated close to the lake. The Acqua Capona still rises in the temple of Apollo.

CRATERE DI CAMPANA.—Fumaroles (extinct) a few yards to the north of the Grotta di Pollicino (Deecke).

POZZUOLI.—Temple of Serapis. Acqua dell' Antro and Acqua della Macchina, warm waters containing carbonates, sulphates, and chlorides of sodium and calcium, magnesium carbonate and chloride, iron carbonate, aluminium chloride. Acqua dei Lipposi and Acqua Media are cold springs of similar composition.

Bagni Cantarelli, Fontana, del Prato (= *balneum Ciceronis*). The hot springs

of the *Bagno Ortodonico*, in the grounds of the Villa Cardito, were flowing in 1697 (Sarnelli).

SOLFATARA.—Fumaroles depositing sulphur, ammonium chloride, and arsenic sulphide. *Balneum Sulphataria seu Fori Vulcani*.

The Pisciarelli flowing from the Colles Leucogaei were once rich in alum. The annual output of alum salts was valued at 20,000 sesterces (£160) at the time of Augustus (Pliny, 18, 29). Some recent borings to a depth of 25 metres, undertaken to rediscover the old alum water, only encountered sulphureous springs. For the results of Dr. Cirillo's analysis, made in the latter half of the last century, see Hamilton, Explanation of Pl. xxi. The *Aqua Bullæ* was famed for its medicinal properties in the fifteenth century (Savonarola). It used to contain sulphate of lime, alum, iron, sulphurous acid, and sulphuretted hydrogen.

ASTRONI.—Acque degli Astruni (= *Balneum Aquæ Strumæ*, Uginolus) are said to have been warm and sulphureous.

LAGO AGRANO.—Streams of bubbles of almost pure carbonic acid gas used to rise through the water before the lake was run off in 1870 (Deville). The older authors, Savonarola, Elisio, etc., comment upon the absence of fish, and upon the abundance of frogs and serpents.

Grotta del Cane. Warm carbonic acid gas mofette.

Grotto d'Ammoniac. Carbonic acid gas mofetta.

Stufe di San Germano, or di San Giacomo (= *Balneum siccum, seu sudatorium S. Germani*). Carbonic acid gas and sulphuretted hydrogen. The gas from the different orifices differs much in composition (Deville).

BAGNOLI.—There are many warm springs between the end of Posilipo and Pozzuoli. The name Terme explains itself. Bagnoli takes its name from mineral baths containing sodium carbonate, sulphate, and chloride, as well as free carbonic acid gas.

Acqua di Subveni homini contains more sodium chloride than the waters at Bagnoli, and also chlorides of calcium and magnesium. In the sixteenth century the chief medicinal springs were the *balneum foris Cryptæ*, near Posilipo; *balneum Juncaræ*, *balneum Plagæ* (= *bagno di Bagnoli*); *balneum Petræ* and *balneum Calaturæ*, beneath Monte Olibano; *bagno di Sovieni huomini* (= *Zuppa d'Huomini*), *bagno di S. Anastasia* (= *balneum Arencæ*), and *bagno dell' Adjuutorio*.

FUORIGROTTA.—*Balneum de Tripta* (Savonarola) (= *bagno di fuori Grotte*, Capaccio).

NAPLES.—Santa Lucia (Acqua Solfurea). A sulphureous spring with carbonic acid gas.

Castello del' Ovo (Acqua ferrata di Pizzo-falcone). A ferruginous spring with large quantities of free carbonic acid gas.

Palazzo Reale. An artesian well producing water containing much carbonic acid gas, salts of iron and magnesium, and calcium carbonate.

APPENDIX B.

LIST OF TRACHYTIC ROCK MASSES AND LAVA-STREAMS.

MONTE DI PROCIDA.—*a.* At bases of two headlands, one to the north, and the other just opposite the Scoglio di S. Martino.

b. Punta di Torre Fuma.

γ. Pietre nere, or Schiavone.

MONTE NUOVO.—Lava-stream on south cone-slope.

MONTE DI CUMA.—*a.* Trachyte foundation, 20 metres thick.

b. Layer of vitreous trachyte, 1 metre thick, above a grey tuff.

CRATERE DI CAMPANA.—*a.* Trachytic mass on east of Fossa Lupara, which has been rent asunder to form the Senga.

B.—A lava-stream on north-west side of middle crater wall (Scacchi).

MONTE CORVARA.—A lava-stream is indicated on north-east slopes near the Montagna Spaccata, in a model constructed for the South Kensington Museum by Amedeo Aureli. It has not been seen by the author.

ASTRONI.—*a.* The crater is plugged by trachyte, which rises to form the two mounds known as the Rotondella and l'Imperatrice.

B. Trachytic dyke in east wall of crater.

SOLFATARA.—Trachyte appears in at least three places in the floor of the crater, as a large mass in the south wall, and also on the slopes of the Colles Leucogæsi.

MONTE OLIBANO.—Trachytic boss.

MONTE SPINA.—Vein of Trachyte on north side.

NAPLES.—*a.* Trachytic mass near S. Maria del Pianto (Roth).

B. Trachytic mass at Fontanelle, recorded by Breislak.

γ. Great thicknesses of trachyte are traversed by the tunnels of the Collettori Pluviali delle Colline and of the Ferrovia Cumana, under the Corso Vittorio Emanuele and Via Tasso.

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(To be continued.)

THE MONTHLY RECORD.

EUROPE.

The Sale of Ordnance Maps.—A parliamentary paper has lately been issued relative to the sale of Ordnance maps, which shows that by recent arrangements the facilities given to the public for obtaining maps at various towns throughout the country have been greatly increased. Mr. E. Stanford still remains the sole agent for the sale of Ordnance maps within the county of London, while for the cities of Edinburgh and Dublin Messrs. J. Menzies & Co. and Messrs. Hodges, Figgis & Co. have been appointed agents respectively. Agencies have also been instituted from January 1, 1897, in a number of other towns throughout the United Kingdom, and arrangements have been made whereby orders can be given at the head post offices of many other towns at which there is no agent. The agents throughout the country are bound to keep at the respective depôts "such a stock of the Ordnance Survey maps, with the relative area books, and of the index maps and catalogues, as may be, in the opinion of the Board of Agriculture, sufficient to meet the ordinary calls made upon them;" and it is further specified, in the case of London and Edinburgh, that "the agent shall keep at least one copy of every Ordnance Survey map (of England and Wales and Scotland respectively), whether coloured or uncoloured, which shall not have been superseded by a later edition." The selling prices are fixed by the Board, and are not to be exceeded by the agents; facilities are also to be given for the exchange of any map purchased by mistake for another, provided it be returned promptly and in good condition, and another taken. As the agents appointed already number nearly 140, the advantages to the public of the new system are at once apparent.

The Eifel Maare.—In continuation of his limnological studies in Germany (see *Journal*, vol. vii. pp. 198, 199, vol. viii. p. 634), Dr. Wilhelm Halbfass contributes to the July number of *Petermanns Mitteilungen* the results of his observations on the Eifel Maare. Geologically, these small lakes, eight in number, exclusive of a very small one which is on the point of being obliterated by the growth of reedy vegetation, are universally recognized as filling the craters of volcanoes which came to an end in the first stage of their activity. They are mostly somewhat round in shape, with an increase in depth from the margin to a point in or very near the middle. The following table gives in English measures the main results of the observations of Dr. Halbfass:—

Name.	Greatest		Circumference.	Depth in feet.		Height of surface above sea-level.	Area.	Volume, millions of cubic feet.
	Length.	Breadth.		Maximum.	Average.			
	Miles.	Miles.	Miles.			Fee.	Sq. mile.	
Laacher See	1·46	1·16	4·58	174	107·0	902	1·278	3367
Pulver Maar	0·42	0·40	1·40	243	123·0	1358	0·135	412
Meerfelder Maar	0·47	0·28	1·24	56	27·6	1097	0·093	64
Holzmaar	0·20	0·16	0·68	69	31·2	1419	0·026	20
Ulmener Maar	0·20	0·14	0·57	121	60·0	1377	0·021	31
Weinfelder Maar	0·33	0·23	0·95	167	84·3	1571	0·061	135
Gemündener Maar	0·20	0·19	0·61	125	60·7	1328	0·028	42
Schalkenmehrer Maar ...	0·36	0·31	1·10	69	37·4	1386	0·083	77

ASIA.

Ptolemy's Geography of Indo-China.—Mr. G. E. Gerini, who has for some years devoted his attention to the elucidation of Ptolemy's statements

regarding the geography of the Trans-Gangetic India—a task in which previous commentators have met with slight success—contributes a paper on the preliminary results of his researches to the July number of the *Journal of the Royal Asiatic Society*. Although these results are as yet imperfect, owing partly to the difficulties in which the writer has been placed through want of access to the complete literature of the subject, he has done enough, if his conclusions are to be relied on, to shed a new and in many ways unexpected light on the difficult question of the knowledge of the far East possessed by the ancients. The methods previously adopted have failed, Mr. Gerini thinks, through being too theoretical on the one hand and too empiric on the other. The attempt to find a formula of correction applicable alike to the better known and to the outlying parts of the world must fail, considering the greater imperfection of data necessarily existing in the case of the latter, while the method of identifying Ptolemy's places merely by a comparison with modern names is evidently faulty. Mr. Gerini's method depends on the identification, by a study of old records giving information regarding the marts and emporiums of trade on the coasts in question in Ptolemy's time, of one or more of the latter's stations, in order to supply a basis for the determination of his amount of error in the regions beyond the Ganges. The first stations thus identified were Ptolemy's *Akadra* and *Pithonobasto*, which, according to Mr. Gerini, correspond with the Bay of Ka-Dran (the present Hatien) and Panthai-Mas on the Kambojan coast of the Gulf of Siam. The formulas of correction obtained from these and other positions, when applied to Ptolemy's co-ordinates, give remarkable results, which lead the writer to the conclusion that Ptolemy's geography of the India extra-Gangem is still capable of fairly accurate interpretation, and presents perhaps fewer difficulties than the Cis-Gangetic portion. An interesting identification supplied by the method adopted is that of Ptolemy's "Stone Tower" with Khoten, while by swinging round the farther coast-line of the "Magnus Sinus" on the Lui-chau peninsula as a pivot, the writer is able to identify all its chief features with features bearing similar names on the coast of China. Mr. Gerini thinks that his researches will throw much new light on the trade relations of the ancients and the early routes of commerce in the East.

The Yakuts.*—The work under the above title, which has lately been published by the Russian Geographical Society, is a splendid addition to the geographical literature of Northern Siberia. The author, V. L. Sieroszewski, was a political exile, who was sent, in 1880, by order of the administration, to be settled at the pole of cold of the eastern continent, Verkhoyansk, a village consisting of a score of houses. There he was kept for three years, and, owing to a certain leniency on the part of the local police officer, was allowed to descend the Yana river to its mouth, there being evidently no danger of escape in those unpopulated icy deserts. In 1883 he was transferred further east, to Sredne-Kolymsk, on the Kolyma river; and in 1885 was allowed to go to the capital of those desert regions, Yakutsk. Thence he was transferred to a still remoter spot, on the Aldan river, and in 1887 to the Nama Yakut village in that same district. There he carried on agriculture up till 1892, when, the term of his twelve years' exile being over, he was allowed to settle in Irkutsk. In this town he spent eighteen months working in the library of the Siberian Geographical Society, and an Irkutsk lady, Madame Gromova, the head of a firm of traders in Yakutsk, volunteered to pay the costs of publication of the remarkable

* 'The Yakuts: An Attempt at an Ethnographical Description.' By V. L. Sieroszewski. Published by the Russian Geographical Society, under the supervision of Prof. Veselovsky, with the aid of a grant from A. I. Gromova. Vol. i. St. Petersburg: 1896. (168 illustrations, portrait of Middendorff, and map.)

ethnographical materials which V. L. Sieroszewski had collected during his peregrinations. The Russian Geographical Society at St. Petersburg undertook to edit that work; while Baron Toll, the meteorologist E. W. Stelling, and the botanists S. I. Korszinaki and J. P. Prein undertook to read over the manuscript. The result is now a handsome octavo volume, with a map and 168 excellent photographs and drawings, which were made by three Russian artists from the author's sketches. This work is a real mine of trustworthy and digested information about the nature and the inhabitants of the region. It is very well written, with an excellent sense of proportion, and with full knowledge of the excellent works of Middendorff, Maack, and other previous explorers; some parts of it, especially those which deal with the climate and the vegetation, are fine specimens of geographical literature, every page containing some little detail eminently characteristic of the nature of those dreary regions. After a rather too short geographical sketch of the country, the climate, the vegetation, and the fauna, as well as the domestic animals of the Yakuts, are described (180 pages). The remainder of the book (700 pages) is given to ethnography. By analyzing the folk-lore of the Yakuts (for which, besides the author's own notes, excellent materials are found in the little work of the great explorer of Russian folk-lore, Khudyakoff, who also lived many years as an exile in the same region and died there, his materials having been published after his death by the Siberian Geographical Society)—by analyzing that folk-lore, as well as the traditions as to the climate of their former abodes, the names of such animals as do not occur in the present abodes of the Yakuts, their calendar, and so on, the author shows that they must have come from the south, and very probably from the south-west. He then discusses their gradual spreading, and their physical features, as well as the admixture among the present Yakuts of Mongol, Manchurian, Tungus, and Russian blood. Most of this was, of course, already known, especially through Middendorff's capital work, but even this chapter contains many interesting new details. The economical foundations of Yakut life, their food, their dress, and their arts, as well as the conditions of work (wage-work, association, hiring of cattle, etc.), are described. A very interesting chapter, full of new and well-interpreted information, is then devoted to the clan organization, ancient and modern, to the present village community, to family relations, to the children, their treatment, and their games, and finally to marriage and love. The two last chapters are given to folk-lore, various recently published materials having been taken into account. The wealth of information contained in this volume appears at once from the above enumeration, and again the regret must be expressed that this work, like scores of others, which would be excellent reading for wide circles, remains unknown in Western Europe, even in abridged editions. The map which is appended to this work gives the distribution of all the present clans, while the drawings and photographs admirably illustrate the text.

A Journey in Southern Arabia.*—Although the journey described by Herr Hirsch in his recently published work was made more than three years ago, so little has been written, or is in fact known, concerning the interior of Southern Arabia, that the appearance of the book is welcome, as supplying detailed information with regard to a small portion at least of that interesting country. The principal journey made by the German traveller—in fact, the only one which took him into the interior of the country—coincided very closely with the route of the late Mr. Bent to the Upper Hadramut valley in 1894, *i. e.* just a year later, and as it was described in outline by Herr Hirsch himself in the third volume of the

* Leo Hirsch, 'Reisen in Süd-Arabien, Mahrland und Hadramut.' Leiden Brill. 1897.

Journal (p. 196), it is unnecessary to go into detail here. The book is kept within moderate compass, and forms a consecutive narrative of the traveller's experiences, containing also many details as to the physical features of the country along the route. Frequent readings of the barometer and thermometer were taken, but would have been more useful if recorded in a table at the end, than interspersed, as is the case, with other matter in the body of the book. A list of the plants collected, numbering in all over one hundred and sixty species, and including one new genus and a fair proportion of new species, is given as an appendix. It shows that, if scanty, the flora of this part of Arabia is not wanting in interest. The features of the country immediately adjoining the route are shown on a map of the scale of 1 : 800,000. It may be remarked that the latitudes in the Upper Hadramut valley differ by considerably over half a degree from those given in the sketch-map accompanying Mr. Bent's paper, although these were checked by astronomical observations with the theodolite.

Termination of the Lyonese Mission in China.—M. Brenier, the chief of the French Commercial Mission which during the past two years has traversed the western and southern provinces of China in various directions, reached Macao in June last, accompanied by Dr. Deblenne, thus bringing to a close the task entrusted to him. Owing to a rebellion which had taken place in the north-west of Kwang-si, and which the mandarins seemed powerless to cope with, the travellers had been obliged to make a long *détour* by way of Kwei-yang, the capital of the province of Kwei-chou, in order to reach Canton. Accounts of the journeys of various sections of the mission continue to appear in the *Tour du Monde*.

AFRICA.

Geographical Results of the Böttego Expedition.—The publication in the ninth number of the *Bolletino* of the Italian Geographical Society (1897) of a preliminary report by Lieuts. Vannutelli and Citeri on the geographical results of Captain Böttego's last expedition, accompanied by a sketch-map of the routes followed, enables us to add some details to those given in the last number of the *Journal*, and to gauge with more precision the value of the work accomplished, which, taken in conjunction with Captain Böttego's previous work of exploration on the upper Jub, entitles the deceased officer to a very high rank among the modern explorers of Africa. In spite of the many travellers who have sought to unravel the geography of the southern Ethiopian highlands, a number of problems still clustered round the tract of country lying north of Lake Rudolf, all of which have now been solved, in their broad outlines, by the latest Italian expedition to that region. The much-vexed question of the course of the Omo has been settled, the western shore of Lake Rudolf explored, and the general hydrographic features of the Sobat system, the last of the Nile tributaries awaiting discovery, have been defined. In addition to this, a new lake of considerable size has been discovered, apparently forming a fresh link in the lacustrine chain which stretches throughout the whole of East Africa towards the shores of the Red Sea. It appears to be this lake which, under the name Abba, or one of its variants (all of which are used generically for any large mass of water), has been so long vaguely indicated on our maps as existing in the region south of Shoa. The Italian travellers found its true name to be Pagade,* and, having entirely compassed its shores, are able to delineate it with some precision. It is described as of great beauty, and contains twelve islands, all inhabited and cultivated. Its length is about 95 miles, and from the north it receives the waters of a mountainous region, which appears to separate its

* They have, however, christened it afresh—"Regina Margherita."

basin from that of Lake Zuai. It sends a short effluent southwards into the lake Abbaya of Prince Ruspoli and Dr. Donaldson Smith (called by the Italian travellers Chiamo); but, contrary to the statement of the latter traveller, this lake is said not to have any connection with the Sagan or Galana Amara which flows into Lake Stefania. From Lake Pagade the expedition made its way to the Omo, which after all proves to be identical with the Nianam, the principal feeder of Lake Rudolf. Its valley is very narrow and enclosed by high mountain walls, a fact which accounts for Dr. Smith's inability to discover a break in the hills from his view-point in the south. The small volume of water possessed by the stream ascended by him is explained by the fact that, during the latter part of his northerly excursion, he must have been following a tributary instead of the main stream, which makes a wide bend to the south-west. The river Bass of Count Teleki is represented by a stream which loses itself in a marsh near the north-west corner of Lake Rudolf, its water only finding its way to the lake by infiltration. The western shore of the latter was followed as far as the mouth of the Tirog, the point reached by Teleki and von Hönel from the south, not a single stream apparently entering the lake during this distance. The survey of this western shore proved that the width is less than has been shown on previous maps. The Sobat basin was first reached slightly to the north of 6° N.; a southern branch, the Juba, being followed downwards for some distance across plains of rich grass. The expedition then struck across to the Upeno, the principal branch of the Sobat, crossing on the way the Shelo, which flows through a small lake. The Upeno has a breadth of over 300 yards at low water, but is shallow. It appears to be formed by the junction of the Baro and Birbir, the latter rising in the north-east, near the course of the Didessa.

Consular Reports for 1896.—Reporting on the trade of Tripoli, Mr. Dickson records a general state of stagnation, although both imports from and exports to Great Britain show a slight increase, the demands for British cloths having somewhat improved. Italian shipping, however, maintains its predominant position. The hoped-for re-opening of the caravan route to Bornu has not taken place, owing to the attitude of the Tuareg, and the hostilities between Rabah and the Emperor of Sokoto. From Harrar, Mr. Rodd calls attention to the general complaint of want of substance in the cottons, etc., supplied from England. A better quality would meet with a good sale. The Zeila route is still preferred to that from Jibuti, being shorter, easier, and more secure. The report by Mr. R. Casement on the trade of Lourenço Marques shows a considerable extension of the import trade, practically the only branch represented, and almost entirely one of transit to the Transvaal. The trade with that country *viâ* Dolagoo bay shows (in 1896) an increase of 113 per cent. (fairly well distributed over the separate items), as compared with increases of 16 and 205 per cent. respectively *viâ* Cape Colony and Natal. The large imports of food stuffs prove the disregard for agriculture due to the gold fever. Butter forms a considerable item, and might well, Mr. Casement suggests, be supplied by Ireland. England still holds the market for the better qualities of cottons and woollens, but inferior kinds are largely supplied from the continent. British shipping, except in the item of passenger traffic, still maintains a favourable position, and the important future of the port is generally recognized. The report on Zanzibar trade for 1896, by Mr. Cornish, records a falling off in the total amount as compared with 1896, due, it is thought, to the plague at Bombay and the decline in the price of cloves, the quantity exported being very much less in 1896 than in either of the two preceding years. A short crop is also feared for the present season. Great Britain takes the lead both for imports and exports, and a satisfactory increase in the import of piece goods is recorded; but here, as elsewhere, the sizing in the English cloths is complained of. The exports to British

East Africa show an increase, and Zanzibar, it is said, is becoming more and more the chief centre of commerce in East Africa. From Chinde a large increase in the local trade between the Indian traders and the natives is reported, but the shipping returns are very little different from those of the preceding year. Regular lines of steamers to this port are promised, both by the Castle Line and the *Messageries Maritimes*. Damage continues to be done by the encroachments of the river. Mr. Alfred Sharpe's report on British Central Africa records satisfactory progress in the general condition of the Protectorate. Since the successful termination of the Angoni war, peace has everywhere prevailed. The imports show a slight decrease, but the exports a considerable increase in spite of a diminution in the amount of ivory. The value of coffee exported increased by over £9000 as compared with the previous year. The unusually high level of Lake Nyasa has rendered the Shire river channel navigable all the year round, and two new steamers placed on it by the African Lakes Corporation have proved a great success. A new vessel, far larger than any at present on Nyasa, is under construction for that lake. The use of British currency has largely increased throughout the Protectorate, and rupees are now hardly seen. Native labour is very plentiful. Mr. Pickersgill, in discussing the trade of the Congo State for the past year, considers that there is no great development to record, the apparent increase in imports being not due to an extensive trade in the way of barter, but rather to the introduction of goods for the requirements of the Government, missions, etc. It may, therefore, be regarded in the light of outlay for the improvement of an estate. Ivory and indiarubber are the only paying products of the interior. The duties on these yield a considerable revenue, and there is no reason to fear a rapid exhaustion of the supply, but large capital is required to ensure success in trading ventures beyond Stanley pool.

Trigonometrical Survey of British South Africa.—We are informed by the directors of the British South Africa Company that the Administrative Council at Salisbury resolved in March last that a trigonometrical survey of the territory should be carried out in accordance with a plan suggested by Dr. Gill, Her Majesty's astronomer at the Cape. This is briefly as follows: Chains, 15 to 20 miles broad, of very accurate single triangles, would be carried across the country along certain lines, the principal being one from Tati through Bulawayo and Salisbury, and beyond the latter in the direction of Blantyre as far as circumstances should require, and another along the thirty-first meridian from Victoria to Salisbury, with north and south extensions. Loops of cheaper triangulation, beginning and ending on these chains, could include all the more important parts of Rhodesia.

Hydrography of the Sanga River, Congo Basin.—The opinion of M. Wauters that the Goko, or Ngoko, usually put down as a western tributary of the Sanga, may prove to be the principal branch of the river, has already been referred to in the *Journal* (vol. viii. p. 552). His view appears to be supported by M. Lemaitre, an agent of the *Société Belge du haut Congo*, who is well acquainted with the lower course of both branches (*Mouvement Géographique*, 1897, No. 24). He states that articles of English manufacture, some bearing the stamp of the Royal Niger Company, are seen in some numbers on the Goko, while very few comparatively are met with on the Sanga. He is therefore, like M. Wauters, inclined to identify the Goko with the Lom, crossed by Mizon in the south of Adamaoua. The Ja, seen near its source by Crampel in 1888, he considers to have a parallel course with the Goko. The Eastern Likuala is of less importance than some travellers have supposed. East of the Sanga, M. Lemaitre heard of an important trade centre named Lubi, on a river which, from the native accounts, would seem to be the upper course of the Ibenga, a tributary of the Ubangi.

The Climate of the Congo.—At a hygienic congress held early in August at Brussels, under the presidency of Dr. Kuborn, many points relating to the means of improving the health of Europeans on the Congo were discussed. While acknowledging that complete acclimatization is impossible, most of the speakers laid stress on the possibility of diminishing the death-roll of Europeans by strict attention to the rules of hygiene, the want of which is accountable for a large proportion of the deaths. In fact, a distinct improvement has already been disclosed by statistics. The examples of India, Java, and even of Belgium itself, show what may be done in time in this direction, while even now the mortality on the Congo is less than in the Cameroons, the Niger, or Cochin-China. The northern races of Europe have shown themselves no less capable of adaptation to the climate than the southern, the important factors being, not race, but temperament and good housing and nourishment. Even the negroes, though content with a vegetable diet when living at ease, require more supporting food when performing severe labour. The Congo railway, it was remarked, is likely to have a beneficial result in facilitating the procuring of supplies. It was recommended by more than one speaker that, as a general rule, two years should be the limit of continuous service on the Congo.

M. Eysseric's Journey in the Interior of the French Ivory Coast.—

Early in the present year M. Eysseric started from the French Ivory Coast on a journey of exploration in the little-known western districts in the interior of the colony. A brief outline of the journey, from which the traveller has now returned, appears in the *Comptes Rendus* of the Paris Geographical Society (1897, p. 262). M. Eysseric's plan was to ascend the western branch of the Bandama river (known as the Red Bandama), and make his way westwards to the Kavalli, which forms the boundary between French territory and Liberia. This programme he was unable to carry out completely, owing to the hostility of the natives; but he executed a survey of the Red Bandama, and returned to the coast through the mountainous district of Kami, said to be rich in gold. His survey was checked by a considerable number of astronomical observations.

AMERICA.

Climates in Davis Bay and Baffin Bay.—Mr. Ralph S. Tarr, a member of the Peary Greenland Expedition, contributes a paper to the *American Journal of Science* on some points connected with the marked difference in climate observed on the two sides of the sea separating Greenland from the American coasts. The name "Davis bay," it should be stated, is proposed for the innominate area extending from the main Atlantic to Davis straits. The author journeyed along the Labrador and Baffin Land coasts during the summer of 1896, travelling northward late in July and southward early in September, and spending the intervening period on the Greenland coast, where he reached 74° 15' N. lat. His observations are concerned with tracing the effects of prevailing winds and ocean currents in the distribution of the ice, and from these he is led to speculate on the relations of changes of level in the land to past and present glaciation. The main point it is desired to establish is that the climatic conditions of Baffin Land and Labrador are "wonderfully near those which produce glaciation." Without predicting that those regions are about to re-enter a glacial period, he considers it safe to say that if the elevation now in progress continues, the time is not far distant when valley glaciers will again appear in the Labrador peninsula, and when those of Baffin Land will increase in extent, and this would, of course, be a great step towards the re-establishment of a general ice-sheet. On the Greenland side there is distinct evidence that a subsidence of the land is going on, and that the ice-front of the Greenland glacier

is retreating; this is especially noticeable in the Upper Nugsuak peninsula. These observations—like those of Gregory in Spitsbergen—are of the greatest geological interest in explaining the details of the processes of erosive action under their most active conditions. Mr. Tarr's suggestions as to the possible balancing action of the mere weight of ice producing elevation and subsidence, and adjusting itself automatically by the variations of temperature due to changes of level, are valuable in connection with some of the recent observations in the Mississippi basin, and indicate opportunities of further investigation. But the main facts seem still the subject of considerable disagreement amongst American geologists.

Ascent of Mount St. Elias.—The ascent of Mount St. Elias has been accomplished by the Italian expedition under Prince Luigi Amadio (*ante*, p. 214). The foot of the mountain having been reached after thirty-eight days' hard travelling, during which the members of Mr. Bryant's party were met returning from an unsuccessful attempt on the mountain, the ascent was begun on July 30. A height of over 12,000 feet was reached on that day, and the ascent completed on July 31, the effects of the rarefied air being severely felt. The height of the mountain was found (by mercurial barometer) to be 18,060 feet, a result which agrees remarkably with the estimate of Prof. Ruesell. The statement of that observer that the mountain is not volcanic in origin, has been fully confirmed.

Recent Explorations in Bolivia and Peru.—Through the kindness of our honorary corresponding member, Señor Ballivian of La Paz, we have received an official report by Colonel Muños, in which that officer describes the explorations made by him, between 1893 and 1896, in North-Eastern Bolivia, mainly for the examination of the navigability of the rivers of that region. The Madidi, a western tributary of the Beni, was first ascended, but it proved impossible to advance within sight of the cordillera, the whole country, as far as the highest point reached, maintaining the character of a plain. The course was extremely sinuous, but it is always navigable for small craft. While holding that the Madidi undoubtedly rises in the eastern cordillera of the Andes, Colonel Muños says that it is not the continuation of the Tambopata, as has been usually shown on our maps, but of some other stream which rises in the sierra of Caupolicán. The Tambopata continues its northerly course to the Madre de Dios, which, says Colonel Muños, it joins in $69^{\circ} 43'$ west of Greenwich. The colonel formed one of the party sent in 1894 to complete the examination of the Madre de Dios begun by Colonel Pando in 1892 (*Journal*, vol. iii. p. 187). Although illness prevented his reaching the supposed confluence of the Inambari, discovered by the last-named officer, his inquiries led him to doubt the correctness of the identification of the stream seen with that river. The longitude given by Pando for the junction was $69^{\circ} 43'$ west (that given above for the confluence of the Tambopata), while, according to Raimondi, the Inambari bends much further to the west before taking an easterly direction. The colours of the streams from the south, noted by Señor Fiscarrald, the explorer of the Manu (*ibid.*, p. 189), and the size of the Madre de Dios above the junction, supply other arguments in the same direction. Colonel Muños also explored the Orton, which joins the Beni a little below the confluence of the Madre de Dios. Its sources do not appear to lie so far to the west as they have been placed on some maps. A land expedition was also made from Carmen, on the Madre de Dios, to the Aquiri, the result of which was to show that a narrow-gauge railway could easily be constructed between the two rivers, a work which would give a great impulse to the development of the region. Two papers, which appear in the *Boletín* of the Lima Geographical Society (vol. vi. part 3), may also be mentioned. In one of them, Dr. R. Aguilar emphasizes the importance of the discovery of the Manu, as possibly leading to the establishment of water-communication between the Department of Cuzco and the

Madre de Dios, a distance of only 3 miles separating the systems of that river and of the Ucayali, with no obstructions to the digging of a canal. The other paper describes a recent exploration by Don Pedro Portillo of the districts of Huanta and La Mar, between Ayacucho and the Apurimac. The result has been to show that a feasible route exists between that town and the head of steam-navigation on the Apurimac, the journey only occupying three days.

AUSTRALASIA.

New Exploring Expedition to German New Guinea.—An expedition has been set on foot in Germany to follow up the discoveries made in 1896 by Dr. Lauterbach and his companions. Through the courtesy of the Foreign Office, we have received the following details regarding its organization and programme, taken from the Berlin *Neueste Nachrichten*. A small stern-wheel steamer has been built, and is to be taken out at once to the mouth of the Ottilien river, the exploration of which is the main object of the proposed expedition, it being supposed that it forms the mouth of the large river (the Ramu) discovered by Dr. Lauterbach to the north of the Bismarck range. The steamer, which will be put together on arrival, will accommodate four or five Europeans and fifty natives, and carry provisions for 220 days. It is proposed also to visit and explore the Bismarck mountains, in the immediate neighbourhood of which a station will be established, and it is hoped that an easy route to the range, which probably contains gold, will be thus opened from the north. Subsequently it is intended to explore the course of the Markham river, which enters the sea at the head of Huon gulf. Should the expedition prove successful, a large area of fertile country in the interior of the Protectorate will, it is hoped, be opened up.

Funeral of the Lost Members of the Calvert Expedition.—The funeral of Mr. C. F. Wells and Mr. G. L. Jones, the lost members of the Calvert expedition, who died of thirst not far from the Joanna springs discovered by Colonel Warburton in 1873, and whose remains were discovered by Mr. L. A. Wells in June last, took place at Adelaide on July 18, amid universal manifestations of regret and sympathy. The ceremony is said to have been most impressive, and a noteworthy circumstance was the very representative gathering of members of various exploring expeditions, dating from 1844 onwards. The Start expedition of that year was represented by Dr. J. H. Browne, who was surgeon of the party, while the list of well-known expeditions, members of which were present, includes those of Stuart (1858-60), McKinlay (1865), Warburton (1873-74), Gosse (1873), Giles, and Lindsay. A full account of the ceremony appears in the *Adelaide Advertiser* for July 19. A fund is being raised in Adelaide for the benefit of the widow and children of Mr. C. F. Wells.

Examination of the Jakati River, Dutch New Guinea.—The *Tijdschrift* of the Netherlands Geographical Society (second series, vol. xiv.) contains a short account, by Dr. D. W. Horst, of an examination of the so-called Jakati river at the eastern extremity of McCluer gulf in Dutch New Guinea. According to Dr. Horst, this is not a true fresh-water river, but rather a creek widening out into an arm of the sea. The eastern extremity of McCluer gulf is strewn with islands, and between these and the mountainous north shore of the gulf a number of sandbanks, intersected by a labyrinth of channels, have been formed. Except at the foot of the mountains, the water is everywhere salt, and considerable depths were obtained by sounding. The creek was ascended as far as the town of Jakati, up to which point the ebb and flow of the tide was everywhere experienced. Dr. Horst does not, however, appear to have proved that no fresh-water river is reached by penetrating farther from the sea.

POLAR REGIONS.

Return of the Jackson-Harmsworth Expedition.—The *Windward*, with Mr. Jackson and the other members of the expedition on board, reached Gravesend on September 3, having started from Cape Flora in Franz Josef Land on August 6. Owing to the discovery that an open sea stretches to the north of the archipelago of small islands of which Franz Josef Land is found to consist, no attempt was made during the past season to reach a high northern latitude, but the time was spent in completing the survey of the islands, especially towards the west. After a comparatively mild and calm winter, during which the regular scientific observations were continued without intermission, Mr. Jackson started with Mr. Armitage, on March 16, on a sledge expedition up the British channel, the wide gulf which opens to the north of Northbrook island, on which the winter quarters were placed. In continuously bad weather the western shores of the channel were explored, and after reaching the north-east extremity of the land, the explorers turned westward and south-westward, crossing the high glaciated land behind Cape Mary Harmsworth, which proved to be the farthest land in a westerly direction. The return was made along the southern shores of the islands, a search-party consisting of Dr. Köttlitz and Messrs. Bruce and Wilson being met at Bell island on May 3. Subsequently a start was made eastward, but before Hooker island was reached the sledge broke through the thin ice off its shore, and the loss of provisions compelled a return. Before turning homewards the *Windward* steamed north-west for 50 miles through very open water, no indication of land being seen. Mr. Jackson concludes that Gillis Land does not exist in the position generally assigned to it. In addition to stores left for Andrée's possible use, a depôt had been formed on Bell island under the idea that they might be of service to the crew of the *Fram*, the news of the return of that ship not having reached Franz Josef Land until the arrival of the *Windward*. Mr. Jackson has promised to describe his experiences at an evening meeting during the coming session.

Mr. Peary and the Cape York Meteorite.—Recent telegrams announce the return of Lieut. Peary from his cruise in the Arctic. He has succeeded this time in bringing back the famous Cape York meteorite, weighing 45 tons, and supposed to be the largest in the world.

GENERAL.

The Science of Frontier Delimitation.—The report of a lecture delivered by Colonel J. K. Trotter at the Royal Artillery Institution on the above subject appears in the *Proceedings* of that Institution for May last. The class of delimitation dealt with is that relating to little-known or unexplored countries, and the lecturer's recent experience of such delimitation in West Africa enables him to speak with authority on the principal requisites for satisfactory work of the kind. At the outset, he lays stress on certain points to which regard should be paid in the preliminary stages of the work, such as the freedom from ambiguity of the international agreement fixing the boundary, and the importance of leaving as little as possible to be decided on the spot. Natural features should be followed as far as possible, it being generally found that these form fairly good dividing-lines between tribes and races. The choice of rivers greatly reduces the work of demarcation, although certain disadvantages are connected with it. Conventional lines, though often unavoidable, are very difficult to mark off. The commissioner should always be thoroughly acquainted with the whole course of negotiation which has preceded the signing of the agreement, so as to be aware of the reasons for the adoption of any particular line. A large part of the lecture naturally deals with somewhat technical details

relating to the actual work in the field. For the survey of the boundary, triangulation is recommended wherever possible, as it gives the best basis for the topographical work necessary to show the relation of the boundary to the features of the country. Special hints are given as to the demarcation of particular forms of boundary, such as a watershed, a parallel of latitude or a meridian, a straight line joining two points, or a line parallel to some given feature. The defects of such conventional lines as the latter of these are very great, and it is important that an agreement should be come to beforehand as to the manner in which the difficulties, which are sure to arise, should be met. When the work is completed, it is advisable that the frontier should be accepted by the two governments as *delimited*, even though possibly somewhat at variance with that described in the original treaty, as by this means future disputes are avoided. After the paper a discussion took place, Captain McMahon giving his experiences as delimitator of the Afghan frontier, where the work was carried out under conditions very different from those of work in West Africa; while Colonel Dalton described the work carried out in the Intelligence Department in connection with the preliminary negotiations.

The Teaching of Geography.—A leaflet has been issued by the Teachers' Guild, giving general advice with regard to the teaching of geography and the choice of books and atlases. It embodies the recommendations of a committee appointed in May last to draw up a list of important points to be considered as *considerata* in the text-books and atlases employed in the teaching of geography. The course of teaching suitable for the lower, middle, and higher forms of schools respectively is traced, and a brief statement made of the particular points to which attention should be directed, both in the teachers' and pupils' books. The leaflet should be of use, not merely as a criterion of the value of existing books, but as a guide to those engaged in the preparation of geographical text-books. Copies are to be obtained at the office of the Teachers' Guild, 74, Gower Street.

OBITUARY.

Lieut.-General Sir W. Drummond Jervois, B.E., F.R.S., G.C.M.G., C.B.

LIEUT.-GENERAL Sir W. Drummond Jervois, who died on August 17, in his 76th year, from the effects of a carriage accident, was an acknowledged authority on fortifications, and during a long connection with the War Office did much to improve the means of defence of the various British possessions throughout the world. Previous to his work in this direction he had seen service in South Africa, and during the Kaffir war of 1846-47 had been entrusted with the task of mapping the British section of Kaffraria. Later in life he had been Governor of the Strait Settlements and of New Zealand, retiring from the latter post in 1889. He had lived latterly at Merlwood, near Virginia Water. He joined our Society in 1878, and in 1893 was elected a Member of Council, resigning the office, however, in the following year.

Thomas Brumby Johnston.

Mr. Thomas B. Johnston, senior partner of the well-known firm of Messrs. W. & A. K. Johnston, died early in September at the advanced age of 84 years. Mr. Johnston was the youngest son of Andrew Johnston, of Penicuik, and brother

of Sir William Johnston and of the well-known geographer, Dr. Alexander Keith Johnston, gold medalist of our Society, the author of the great 'Physical Atlas' first published in 1848. On the death of the latter in 1871, Sir William Johnston having previously retired, Mr. Thomas Johnston became head of the geographical firm, a position which he retained till his death. He was a member of several learned societies, including (in addition to our own Society, which he joined in 1871) the Society of Antiquaries of Scotland, the Geological Society, and the Royal Society of Edinburgh. He was hon. treasurer of the Society of Antiquaries from 1860 to 1861, and was presented with a testimonial on his retirement from that office in the latter year. In 1877 he was appointed Geographer to the Queen for Scotland, a post previously held by his brother, Dr. A. K. Johnston. Mr. Johnston was the author of the 'Historical Geography of the Clans of Scotland,' published in 1872, and of several of the later additions to the maps in the 'Royal Atlas,' as well as of Library maps published by his firm. In 1843 he married a daughter of the late Thomas Ruddiman, and leaves five sons and three daughters.

Albert George Sidney Hawes.

The death has been announced of Mr. Albert Hawes, Her Majesty's Consul-General at Hawaii, who had been a member of our Society since 1885. Mr. Hawes entered the Royal Marines in 1859, but retired ten years later; and from 1871 to 1884 was in the Japanese service. In conjunction with Sir E. M. Satow, he published, in 1881, a 'Handbook for Travellers in Central and Northern Japan,' which since 1884 has been incorporated with Murray's series of handbooks. In 1885 he was appointed British consul in Nyasaland, taking part in the hostilities with the Arabs which broke out soon afterwards at the north end of Lake Nyasa. He was employed on special duty at Zanzibar in 1888-89, but in the latter year was transferred to the Pacific, which remained his sphere of action until his death.

CORRESPONDENCE.

"*Kech-Makurán.*"

WILL you allow me to offer a few remarks on Mr. Tate's interesting letter in the *Journal of the Society for August*?

Firstly, as to the region signified by the compound word "Kej-Makrán," or "Kech Makurán." I stated in a Report to the Bombay Government so far back as December, 1868:—

"In the chronicles of the conquest of Sind, at the early part of the eighth century, mention is made of this country as lying in the route of the invading army marching from the land of the Khalifa. In A.D. 1154, Al Edrisi calls it by its modern name without the variation of a single letter; and a century later, Marco Polo speaks of 'Res Macoran, a great kingdom of idolaters and Saracens.' That the modern word 'Mekran' is not found in the Greek or Latin writers who treat of the locality is explained by the assumption that it is a corruption of its ancient designation, or an Oriental name of doubtful origin. From the sixteenth century, and after the Portuguese established their authority in the Persian gulf, not only do we find more frequent mention of Mekran itself, but some of its towns or villages appear under their modern names. But all such information is confused. The maps, up to those of the present century, are not reliable, though several show

the particular tract required, and no satisfactory account of the country is really recorded before the publication of Sir Henry Pottinger's travels in 1816."

When writing the above, more than a quarter of a century ago, I referred to Major Leech's "Brief History of Kelat," contributed to the Asiatic Society's *Journal* in 1843; and in a paper read a few months later at Harrow, reverting to the same contribution, I said, "The maritime tracts between Karáchi and the Persian frontier include the country of the 'Ichthyophagoi,' and the modern name Makrán bears a strange similarity to the Persian 'Máhi-Khurán,' a literal translation of the Greek plural word." At the risk of placing myself in antagonism with high authority, I cannot but regard this acceptance of an undoubted Persian word (*i.e.* *Máhi-khorán*, or *Máicorán*, "fish-eaters") for Makrán, to be more than a mere coincidence of sound. The connection with the Greek original is almost, to my mind, convincing. *Khurán* is the present participle of the verb *khurdan*, "to eat."

Secondly, Mr. Tate thinks that General Haig's "Masakand of Istakhri" is "Naskand," to the south-east of Bampur. But, in looking back to my former reports on these matters, I find that the comparatively well known "Kasarkand," south-south-east of Bampur, was subject to such perversions of spelling that it might itself be easily confused with Masakand. "Kasarkand and Rask," I wrote, "are clearly identified in the 'Kasarfund' of Ibn Haukal (A.D. 977), the 'Kesrbund' and 'Casrbund' of Istakhri and the Nubian geographer, at perhaps an equally remote period; the 'Casrbund' of Edrisi (A.D. 1154), and the Basak of Ibn Haukal and Istakhri."

Thirdly, though not possessing data to determine any period of actual occupation by the Moghals, I venture to transcribe one or two more passages from papers which, though mainly political, contain much that is pure local history:—

"Native historians, if the term can be used for the mere tellers of tradition, make the earlier rulers of Kej to have been the Malika (or Malik) Baluchis. The town was at that remote period the capital of Mekran and the seat of government. The province extended to Mináb on the west, and Panjgúr and Kolwah on the east, all which places it comprised within its limits. Such a range explains Captain Grant's references to the eight passes into Mekran, between Mináb and Kelat. A tribe called Bulaidi dispossessed the Maliks, and were themselves reduced by the Persians, and we are then brought to the period of Nadir Shah, who made over the whole of Baluchistan, inclusive of Kelat and Mekran, to Násir Khan Brahtii." But it did not seem to me that the term "Kej Mekran" could be restricted to the province of Nasir Khan, for a century before his time we find mention by Mandelslo of "Getsche Macguerona," which must be the same compound differently spelt. If intended by Martinière (A.D. 1735) in "Kisch, petite province de Perse," it may have belonged to Persia before the days of Nádír; but the fact that many old authors and travellers would so class it does not carry much weight, for who among them has described, or attempted to describe, the actual country? The popular charts of the Indian Navy, produced during the prosperous days of that distinguished service, call the whole line of coast from Cape Jaahk to Karachi "the coast of Persia," but this circumstance may not pass as historical evidence.

Of the Miri fort in Kej, alluded to by Mr. Tate, mention is made in the instructive "Notes on Mekran," submitted to the Bombay Government in 1865 by Lieut. (now Colonel Sir Charles) Ross, Assistant Political Agent; and I venture to express a hope that those notes will not be overlooked by the present generation of writers on the interesting tracts which separate Persia from British India.

F. J. GOLDSMID.

August 4, 1897.

P.S.—Since writing the above, my attention has been accidentally recalled to Sir T. Holdich's valuable contributions on 'Ancient and Mediæval Makran,' in the Society's *Journal* for April, 1896. In this it is gratifying to find that the writer admits the continuous designation of "fish-eater" for the Makráni of to-day, as in olden times. The apparent discrepancy in the orthography (*Khurín* or *Khorán*) is a matter of local pronunciation only.

It is interesting to find, from Mr. Tate's letter published in the August number of the *Journal*, that the "*Kes Macorán*" of Marco Polo is so nearly in accordance with the local pronunciation of the present day. Yakut, who followed the usage of Arab prose authors in writing *Mukrán*, says that most Arab poets preferred *Mukkarán*, and quotes examples by officials who, like Mr. Tate, had lived and held administrative charges in the province, but he evidently considered that this form of the name was only justifiable by the exigencies of metre. It should be noted that he was very careful to ascertain the correct spelling of place-names. Is Mr. Tate absolutely certain about the local pronunciation? I merely hint a doubt, because so many English officers, from Sir Frederick Goldsmid downwards, who have visited and written about the province, adhere with one accord to Makrán, or perhaps *Mekrán*, and seem to know of no variants.

Another case in which Marco Polo proves to be more correct than his commentators is that of *Camadè*, in Karmán. This name, long since vanished from the locality, has puzzled Sir Henry Yule and others. Sir Henry thought that it might have been a mistake for Hamadí or Ahmadí. General Houtum-Schindler, according to Tomaschek, "weist auf die Analogie von Kahn-i-Medí hin;" and Tomaschek himself, venturing on a still more risky piece of conjectural emendation, says we may restore Marco's place-name "to Çamadí, or, on the analogy of Serazy (Shiráz) and Soncara (Shewánkárah), to Samadí" ('Zur Hist. Topog. von Persien,' vol. i. p. 181). Yet Marco Polo was all but accurate when he wrote *Camadè* for *Camádin*. The latter was the name of a suburb of Jiruft, the most flourishing town in Karmán during most of the middle ages, but now represented by a heap of ruins on the upper waters of the Halir river (ancient *Dívarúd*.) *Camádin* is not mentioned by the Arab geographers, and perhaps was not in existence in their time. Later, however, its importance to traders and travellers attracted considerable attention to it, and in times of barbarous warfare its wealth proved its ruin. Muhammed Ibrahim, who wrote an account (tedious enough) of the Saljuk princes of Karmán, thus describes it as it was in the year 1171 A.D., when the troops of the Saljuk Bahram Shah plundered and desolated it: "*Camádin* was a place just outside of Jiruft, inhabited by foreigners from Rúm and Hind, a station for travellers by land and sea, a treasury of the opulent, a storehouse of the merchants of the East and West" (Houtama's edition of the Persian text, p. 49). The place is mentioned several times by M. Ibrahim, who says that the battle which preceded the plundering above mentioned took place on "the plain of *Camádin*" (Sahra'e *Camádin*).

With respect to the name Kéch (or Kéj) Makrán (which is the universal pronunciation in the adjoining province of Sindh), I may mention that it was unknown to the Arab geographers of the tenth century. In their time the name of the province is found associated, not with Kiz, the capital, but with *Tiz*, the chief port of that region. El Istakhri writes, "The port of Makrán and that part of the country is *Tiz*, which is known as *Tiz Makrán*." In this he is followed nearly verbatim by Ibn Haukal, and El Mukaddasi gives the port the same name. The

coupling of names in this way is due to a mere freak of vulgar fancy, and is without any real significance. The form Kééh-Makrán came into vogue at a later period, but must have been well established when Marco Polo travelled in Eastern Persia.

M. R. HARRIS.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.	Mag. = Magazine.
Ann. = Annals, Annales, Annalen.	P. = Proceedings.
B. = Bulletin, Bollettino, Boletim.	R. = Royal.
Com. = Commerce, Commercial.	Rev. = Review, Revue, Revista.
C. Bd. = Comptes Rendus.	S. = Society, Société, Selakab.
Erdk. = Erdkunde.	Sitzb. = Sitzungsbericht.
G. = Geography, Geographic, Geografia.	T. = Transactions.
Gea. = Gesellschaft.	V. = Verein.
I. = Institute, Institution.	Verh. = Verhandlungen.
J. = Journal.	W. = Wissenschaft, and compounds.
M. = Mitteilungen.	Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 x 6½.

EUROPE.

Austria—Hungary. *M.K.K.G. Ges. Wien* 40 (1897): 167–186. **Vambéry.**

Ueber den Ursprung der Magyaren. Von H. v. Vambéry.

An examination of the light thrown on the question of the origin of the Magyars by linguistic, anthropological, and psychological facts.

Austria—Hungary. *M.K.K.G. Ges. Wien* 40 (1897): 212–246. ———

Ungarns Mühlenindustrie.

Baltic Glacier. *J. Geology* 5 (1897): 325–339. **Geikie.**

The Last Great Baltic Glacier. By James Geikie.

A re-statement of the author's reasons for holding, in opposition to Dr. Keilhack and other Prussian geologists, that the great terminal moraines of the Baltic ridge are the products of an independent glacial epoch.

Denmark—Pendulum Observations. **Zachariae.**

Oversigt K. Danske Vidensk. Selsk. Forhand. (1897): 139–184.

Relative Pendulmaalinger i København og paa Bornholm mod Tilknytning til Wien og Potsdam. Af Generalmajor Zachariae. Avec résumé en français. *With Plate.*

Europe—Races. **Ripley.**

The Racial Geography of Europe. A Sociological Study. V. The Three European Races. By Prof. William Z. Ripley. From Appleton's *Popular Science Monthly*, June, 1897, pp. 192–209. New York: D. Appleton & Co. Size 9½ x 6½. *Illustrations. Presented by the Author.*

In this paper the author endeavours to reconstruct the main types of the population of Europe, from an investigation of the geographical distribution of particular traits, and the tendencies to combination most frequently observable in them. The three racial types thus constituted are named by him the Teutonic, the Alpine (Celtic), and the Mediterranean.

France—Botanical Map. *Ann. G.* 6 (1897): 289-312. **Flahault.**
Essai d'une carte botanique et forestière de la France. Par M. Ch. Flahault.
With Map.

Describes the principles followed in the construction of a specimen sheet, embracing the district around Perpignan, of a proposed Botanical map of France on the scale of 1:200,000.

Geology. *Sitz. A. Wiss. Wien* 105 (Abth. I.) (1896): 5-40. **Mojaisovica.**
Ueber den chronologischen Umfang des Dachstein-Kalkes. Von Dr. Edmund v. Mojaisovica.

Germany—Oder. *Ann. G.* 6 (1897): 313-327. **Auerbach.**
Le régime de l'Oder. Par M. B. Auerbach.

An analysis of the most important sections, from a geographical point of view, of the voluminous work on the Oder noticed in the last volume of the *Journal* (p. 422).

Germany—Precipitation. **Bezold.**
Veröffentlichungen des Königlich Preussischen Meteorologischen Instituts.
Herausgegeben durch dessen Direktor Wilhelm von Bezold. Ergebnisse der
Niederschlags-Beobachtungen im Jahre 1894. Berlin: A. Asher & Co., 1897.
 Size 13½ × 10½, pp. xl. and 206. *Maps.*

Grecian Archipelago. *Verh. Ges. Erdk. Berlin* 24 (1897): 264-280. **Philippson.**
 Herr Dr. Alfred Philippson: *Die griechischen Inseln des Ägäischen Meeres.*
With Map.

A comprehensive sketch of the physical and economic geography of the Greek islands.

Greece—Geology. *Sitz. A. Wiss. Wien.* 105 (Abth. 1) (1896): 501-520. **Hilber.**
Geologische Reise in Nord-Griechenland und Türkisch-Epirus, 1895 (vorläufiger
Bericht). Von Vincenz Hilber.

Italy. **Millosevich.**
 Sulla opportunità che l'area delle suddivisioni del Regno venga rigorosamente
 valutata per quella province, di cui si possiede il materiale cartografico, e per
 quei comuni, che non hanno contestazioni di confini. *Relazione del prof. Ella*
Millosevich.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma,
1896. Pp. 159-164.

Italy—Alpine glaciers. *Mem. S.G. Italiana* 6 (1897): 171-192. **Marson.**
 Sui ghiacciai del massiccio del M. Disgrazia o Pizzo Bello, nota del socio prof.
 Luigi Marson. *With Maps and Illustrations.*

Italy—Apennines. *Riv. G. Italiana* 4 (1897): 102-108. **Boggero.**
 Ancora della linea di divisione tra l'Appennino Settentrionale e il Centrale del
 prof. magg. Gina Boggero. *With Map.*

A continuation of the controversy as to the boundary between the northern and central Apennines.

Italy—Apulia. **De Giorgi.**
 L'orografia delle Puglie considerata nei suoi rapporti con la Geografia, la Geologia,
 la Sismologia e la Climatologia. *Questioni relative. Relazione del prof. Cosimo*
de Giorgi.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896.
Pp. 182-192.

Italy—Benaco. *Riv. G. Italiana* 4 (1897): 23-29, 80-101. **Garbini.**
 Alcune notizie fisiche sulle acque del Benaco (Colore—Trasparenza—Temperatura).
 Nota del Dott. Adriano Garbini.

Italy—Calabria. **Cortese.**
 Sulla forma di alcune Coste della Calabria e specialmente dello Stretto di Mesina.
 Comunicazione dell'ingegnere Emilio Cortese.—Atti del II° Congresso Geografico
 Italiano, Roma, 1895. Roma, 1896. Pp. 193-199.

Italy—Cartography. **Benedictis.**
 Lo stato dei lavori che si eseguono nell'Istituto Geografico Militare per la Carta
 d'Italia, e i metodi seguiti per formarla. Conferenza del Ten. Gen. Biagio De
 Benedictis.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma,
 1896. Pp. 3-22. *Maps.*

- Italy—Early Maps.** Meri.
 Di alcune Carte d'Italia del secolo XV. in rapporto con la storia della conoscenza geografica d'Italia e con quella della Cartografia. Comunicazione del dottore Assunto Mori. Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 546-558.
- Italy—Earthquake.** *Mem. S.G. Italiana* 6 (1897): 312-330. Baratta.
 Sui terremoti della Romagna del 1781, studio del socio Mario Baratta. *With Map.*
- Italy—Geographical Divisions.** Magistria.
 Sull' opportunità di stabilire, a vantaggio della scuola e della scienza, il limite convenzionale tra Italia Continentale e Italia Peninsulare. Relazione di Luigi Filippo de Magistria.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 500-508.
- Italy—Geological Map.** Pellati.
 Sulla formazione e pubblicazione della Carta geologica del Regno. Conferenza dell' Ing. Niccolò Pellati.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 111-134. *Map.*
- Italy—Glaciers.** Porro.
 Sull' opportunità che le variazioni dei ghiacciai italiani siano sistematicamente studiate, e sulle ricerche iniziate a tale scopo. Relazione del Prof. Francesco Porro. Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 176-181.
- Italian Historical Gazetteer.** Vedova.
 Sui lavori per un glossario geografico dell' Italia del Medio-Evo. Relazione del Prof. Giuseppe Dalla Vedova.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 586-592.
- Italy—History of Cartography.** Botto.
 Del concetto fondamentale a cui potrebbe ispirarsi la Storia della Cartografia italiana. Relazione del colonnello Antonio Botto.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 593-608.
- Italy—Ischia Channel.** *Ann. Hydrographie* 25 (1897): 214-215. —
 Navigirung im Kanal von Ischia. Nach dem Bericht des deutschen Konsuls in Neapel. *With Chart.*
- Italy—Lake Maggiore.** *Mem. S.G. Italiana* 6 (1897): 331-337. Reale.
 Un cordone litoraneo presso Ispra sul Lago Maggiore, nota del dott. Carlo Reale. *With Maps.*
 On the moraines near Ispra.
- Italy—Lakes.** Vinciguerra.
 Dell' opportunità di estendere gli studi limnologici a tutti i laghi italiani e dei metodi con cui condurli. Relazione del Prof. Decio Vinciguerra. Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 205-212.
- Italy—Mountains.** Porena.
 A quali distinzioni e individuazioni sistematiche debbano sottoporsi della Geografia le montagne della Penisola Italiana, in base delle ragioni scientifiche combinate colle opportunità didattiche, e quali siano più accettabili delle loro esteriori divisioni. Relazione del professore Filippo Porena.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 464-499.
- Italy—Romagna.** Gori.
 Antichi nomi dei fiumi di Romagna. Comunicazione del prof. Fabio Gori.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 538-545.
- Italy—Sicily.** Marinelli.
 Distribuzione della popolazione della Sicilia rispetto alla distanza dal mare. Comunicazione del Dott. Olinto Marinelli.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 221-227.
- Italy—Tuscany.** *Mem. S.G. Italiana* 6 (1897): 410-435. Stefani.
 I soffioni boraciferi della Toscana, studio del socio Carlo de Stefani. *With Map and Illustrations.*
 A most interesting description of the hot springs from which boracic acid is produced on a large scale, with views of the springs and of the chemical works.

- Italy—Venetia.** *Mem. S.G. Italiana* 6 (1897): 338-341. **Pinton.**
 Tre antiche vie romane nella Venezia, nota di Toponomastica, del socio Prof. P. Pinton. *With Map.*
 On the old Roman roads in the province of Venetia.
- Italy—Vesuvius.** *Verh. Ges. Erdk. Berlin* 24 (1897): 295-297. **Ebeling.**
 Herr Dr. Max Ebeling: Vorlage des Schichten-Reliefs des Vesuv im Maasstab 1: 10,000.
 The relief-model here described was constructed by Dr. Ebeling, in conjunction with six of his pupils, as an exercise in the use of contour-maps.
- Italy—Vesuvius.** *Mem. S.G. Italiana* 6 (1897): 199-208. **Baratta.**
 Osservazioni fatte al Vesuvio il 22 marzo 1896, nota del socio Mario Baratta. *With Map and Illustrations.*
 Describes changes in the summit of Vesuvius as the result of recent eruptions.
- Lapland—Eclipse Expedition.** *M.K.K.G. Ges. Wien* 40 (1897): 247-253. **Kanitz.**
 Die russische Muonio-Expedition zur Beobachtung der Sonnenfinsterniss im August, 1896. Von F. Kanitz. *With Plate.*
 A short account of the Russian expedition up the Tornea and Muonio rivers for the observation of the solar eclipse in Lapland.
- Mediterranean—Crete.** *B.S.R.G. d'Anvers* 21 (1897): 158-192. **Ceuleneer.**
 L'île de Crète. Par M. A. de Ceuleneer. (Also in pamphlet form.)
 A sketch of the physical geography and history of the island.
- Mediterranean—Crete.** **Combes.**
 Paul Combes. L'île de Crète. Étude géographique, historique, politique et économique. Paris: Joseph André & Cie., 1897. Size 7½ × 5, pp. 132. *Map.*
Price 1s. 6d.
 A systematic description of Crete compiled from the best authorities, and containing a bibliography of the island.
- Norwegian Pilot.** **Hagerup.**
 Den Norske Loda, udgiven af Norges Geografiske Opmaalng. 2^{det} Hefte indeholdende Ryststrækningen fra Jomfruland til Kristiansand, omarbejdet efter de Hydrografiske Undersøgelser 1887-1892, ved Edv. Hagerup. Kristiania: Grøndahl & Søn, 1896. Size 9 × 6, pp. xvi. and 312.
- Russia.** *Meteorolog. Z.* 14 (1897): 170-174. **Woeikof.**
 Bemerkungen über die Temperatur russischer Flüsse und Seen. Von A. Woeikof.
- Servia.** *M.K.K. Militär-G.I.* 16, 1896 (1897): 199-221. **Truck.**
 Die erste topographische Aufnahme des Königreiches Serbien. Nach dem Werke des Kön. serb. Oberstlieutenants Joseph Simonović dargestellt, von Sigismund Truck. *With Plate.*
 Description of the methods employed in the preparation of the maps of the Servian General Staff.
- Switzerland.** **Baedeker.**
 Switzerland and the adjacent portions of Italy, Savoy, and Tyrol. Handbook for Travellers, by Karl Baedeker. With 49 Maps, 12 Plans, and 12 Panoramas. Seventeenth Edition. Leipzig: Karl Baedeker; London: Dulau & Co. 1897. Size 6½ × 4½, pp. xxx. and 484. *Price 8 marks. Presented by Messrs. Dulau & Co.*
- Switzerland.** *B.S. Neuchateloise G.* 9 (1897): 5-12. **Zobrist.**
 Les Suisses en dehors de la Suisse.
 On the distribution of Swiss emigrants in different parts of the world.
- Switzerland.**
 Rapport du Bureau Fédéral des Assurances sur les Entreprises privées en matière d'Assurances en Suisse en 1895. Berne, 1897. Size 11 × 9½, pp. cxviii. and 128.
- Turko-Grecian War.** *Blackwood's Mag.* 162 (1897): 165-180. **Callwell.**
 A Glimpse of the late War. By Major C. E. Callwell, B.A.
 Describes the battle of Domokos, as witnessed from the Greek lines.
- United Kingdom—England.** **Baddeley.**
 Thorough Guide Series. Yorkshire (Part II.) West and part of North Ridings and all parts of the country West of the N.E. Main Line, also Barnard Castle and

Teesdale. By M. J. B. Baddeley, B.A. Eighteen Maps and Plans by Bartholomew. Third Edition. London: Dulau & Co., 1897. Size $6\frac{1}{2} \times 4\frac{1}{2}$, pp. xvi. and 150. Price 3s. Presented by the Publishers.

Improved and somewhat enlarged since the last edition.

United Kingdom—England.

Graves and Evans.

The Oxford University Bicycle Club. The Roads round Oxford. An original description of the main roads and principal bye-roads within a radius of about twenty-five miles; with the mileage of longer routes. By H. Graves and A. B. Evans. With a new Map. Second Edition, enlarged. Oxford: Alden & Co. [1896]. Size $6\frac{1}{2} \times 4\frac{1}{2}$, pp. viii. and 82. Price 1s. 6d. Presented by the Publishers.

A practical guide to cycling roads near Oxford. The map in this edition is by Bartholomew.

United Kingdom—England.

Gulliver.

Dungeness Foreland. By F. P. Gulliver. From the *Geographical Journal* for May, 1897. Size $10 \times 6\frac{1}{2}$, pp. 12, sections.

United Kingdom—England, Open Lands.

Hunter.

J.R. Statistical S. 60 (1897): 360-431.

The Movements for the Inclosure and Preservation of Open Lands. By Sir Robert Hunter.

Traces the progress of the movement for the inclosure of common lands in England down to 1869, and summarizes the results of the modern counter-movement for the preservation of open spaces.

United Kingdom—Essex, Agriculture. *J.R. Statistical S. 60* (1897): 251-277. Danvers.

Agriculture in Essex during the past Fifty Years, as exemplified by the Records of one Farm, with special reference to the Prices of Corn and the Conditions of Labour. By Frederick Charles Danvers.

United Kingdom—Great Britain.

Baedeker.

Great Britain. Handbook for Travellers by K. Baedeker. With 16 Maps, 30 Plans, and a Panorama. Fourth Edition. Leipzig: K. Baedeker; London: Dulau & Co. 1897. Size $6\frac{1}{2} \times 4\frac{1}{2}$, pp. lxiv. and 556. Price 10 marks. Presented by Messrs. Dulau & Co.

Every effort appears to have been made, in the present edition of this well-known handbook, to maintain the standard of excellence reached by the series generally.

United Kingdom—Ireland.

Baddeley.

Thorough Guide Series. Ireland (Part I.) Northern Counties, including Dublin and Neighbourhood. By M. J. B. Baddeley, B.A. Twenty Maps and Plans by Bartholomew. Fourth Edition—Revised. London: Dulau & Co., 1897. Size $6\frac{1}{2} \times 4\frac{1}{2}$, pp. xvi. and 212. Price 4s. Presented by the Publishers.

This edition is revised and enlarged, the maps are clear and useful, although of different styles, and the plans of towns are particularly good.

United Kingdom—Manchester. *J.R. Agricultural S. (3) 8* (1897): 205-228. Bear.

Bear.

The Food Supply of Manchester.—I. Vegetable Produce. By William E. Bear. With Illustration.

A statement of the sources of supply of the various items of vegetable produce, and the manner of distribution to consumers.

United Kingdom—Shropshire and Cheshire.

Murray.

A Handbook for Residents and Travellers in Shropshire and Cheshire. Third Edition, revised. With Maps and Plans. London: John Murray, 1897. Size 7×5 , pp. 48, 156, and 6. Price 6s. Presented by the Publisher.

This edition has been thoroughly revised, and contains much new information respecting the parts of the country most visited by tourists and pedestrians.

ASIA.

Central Asia.

Hedin.

Lop-nor-bäckenets vandring. Af Sven Hedin. (Aftryck ur Geol. Fören. i. Stockholm Förhandl. Bd. 18. Häft 6, 1896.) Size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. [16]. Maps.

An account of recent changes in the hydrography of the Lob Nor basin.

China, Corea, Japan—Missions.*Church Miss. Intelligencer* (n.s.) 23 (1897): 525-532.

Bishop.

Missions in China, Corea, and Japan—A Traveller's Testimony. Mrs. Bishop's Speech at St. James's Hall.

Historical—Dondin.

Gummé.

Alfred Gummé. Le Dondin et les Philippines. Lettres à M. le Président de la "Société Géographique de Paris." Size 6 x 3, pp. 122. *Frontispiece and Facsimile Map.*The author of this booklet combats the theory of M. Romanet du Caillaud (*Journal*, vol. vii. p. 659) that the Dondin island of Friar Odoric represents the Philippines.**Historical.***M.K.K.G. Ges. Wien* 40 (1897): 329-419.Die topographischen Capitel des indischen Seespiegels Mohht. *With Maps.*This has already been referred to as a separate pamphlet (*ante*, p. 339).**India.***Imperial and Asiatic Quarterly Rev.* (3) 4 (1897): 1-10. Lethbridge.

India in the Sixtieth Victorian Year. By Sir Roper Lethbridge. K.O.I.K.

The writer testifies, from a close personal inspection, to the admirable working of the famine relief organization, and to the general advance made by India during the last twenty-five years.

India—Baluchistan. Quarterly J. Geolog. S. 53 (1897): 289-309.

McMahon.

Notes on some Volcanic and other Rocks, which occur near the Baluchistan-Afghan Frontier, between Chaman and Persia. By Lieut.-Gen. C. A. McMahon and Captain A. H. McMahon. *With Map and Plates.***India—Buddha's Birthplace.**

Waddell.

J. Asiatic S. Bengal 65 (Pt. I.) 1896 (1897): 275-279.

A Tibetan Guide-book to the Lost Sites of the Buddha's Birth and Death. By L. A. Waddell, M.B., etc.

This refers to the Asoka-edict pillar recently discovered in the Nepalese *tarai*, which, as the writer shows, enables us to fix the site of the birthplace of Sakya Muni.**India—Ceylon.***J. Ceylon Br. R. Asiatic S. 14* (1897): 203-222.

Lewis.

Place-Names in the Vanni. By J. P. Lewis, O.C.S.

The great majority of place-names in the Vanni district contain one or other of the numerous Tamil words for "tank," the specific title being taken from some natural object or occurrence connected with the place.

India—Ceylon.*J. Ceylon Br. R. Asiatic S. 14* (1897): 118-124, 134-154.

Modder.

Ancient Cities and Temples in the Kurunégala District: Ridí Vihárá. By F. H. Modder.

Ditto: Panduwas Nuwara. By the same.

India—History.*Imperial and Asiatic Quarterly Rev.* (3) 4 (1897): 120-151.

Sewell.

India before the English. By R. Sewell.

The writer combats the false ideas prevalent among the Hindus as to their past history.

Indo-China.*J.R. Asiatic S.* (1897): 551-577.

Gerini.

Notes on the Early Geography of Indo-China. By G. E. Gerini. Part i. Pre-historic Period: Being Researches on Ptolemy's Geography of the India extra-Gangem. *With Map and Tables.*A note is given on this paper (*ante*, p. 436).**Japan.***Trans. Asiatic S. Japan* 24 (1896): 12-40.

Clement.

Chinese Refugees of the Seventeenth Century in Mito. By Ernest W. Clement.

Biographical notices of two Chinese savants, who, as refugees from China during the Tartar invasion, helped to extend a taste for learning in Japan.

Japan—Ainu Words.*Trans. Asiatic S. Japan* 24 (1896): 41-111.

Batchelor.

Ainu Words as illustrative of Customs and Matters Pathological, Psychological, and Religious. By Rev. John Batchelor.

Japan Art.*Trans. Asiatic S. Japan* 24 (1896): 137-175.

Dooman.

The Influence of Greco-Persian Art on Japanese Arts. By Rev. Isaac Dooman.

Under the term 'Greco-Persian' influence, the author here alludes generally to the civilization which had its origin and development in Western Asia, Egypt, and Eastern Europe.

- Japan—Formosa.** *Trans. Asiatic S. Japan* 24 (1896): 112-136. Davidson.
A Review of the History of Formosa, and a Sketch of the Life of Koxinga, the First King of Formosa. By Jas. W. Davidson.
- Japan—Formosa.** *J. Tōkyō G.S.* 18 (1896): 355-384. Ishii.
A Travel in the Northern Part of the Taiwan Island (Formosa). By Y. Ishii, Rigakushi. [In Japanese.]
- Japan—Formosa.** *J. Tōkyō G.S.* 19 (1896): 317-350. Yokoyama.
On the Island of Taiwan (Formosa). By S. Yokoyama, Nōgakushi. [In Japanese.]
- Japan—Kai.** *J. Tōkyō G.S.* 18 (1896): 451-488. Jimbō.
Some Fissures in the Mountainous Land of Minami Komagōri, Province Kai. By K. Jimbō, Rigakuhakushi. [In Japanese.]

AFRICA.

- Abyssinia.** Vignéras.
Une mission française en Abyssinie. Par S. Vignéras. Paris: A. Colin & Cie., 1897. Size $7\frac{1}{2} \times 5$, pp. xiv. and 224. *Illustrations.* Price 4 fr. Presented by the Publishers.
M. Vignéras, who was attached to the French Mission sent to the court of King Menelik under M. Lagarde in November, 1896, gives here his general impressions of Abyssinia and its people, combined with the chronicle of the course of the expedition. The book is profusely illustrated from the author's photographs, and the information given cannot fail to be of value under existing circumstances.
- Algeria.** *B.S.G. et d'Archéologie d'Oran* 17 (1897): 202-242. Doutté.
Excursion dans la région forestière du Cap Bougarone. Par E. Doutté.
- Central Africa.** *B.S.R.G. d'Anvers* 21 (1897): 141-155. Kethulle.
Le pays des Niams-Niams. Par M. le lieutenant De la Kethulle.
- Eritrea and Abyssinia.** *B.S. Neuchâteloise G.* 9 (1897): 32-56. Buchs.
Voyages en Abyssinie, 1889-1875. Par Victor Buchs. *With Illustrations.*
Massawa is described in some detail, and journeys into the neighbouring parts of Eritrea at less length.
- Lagos.** *J.R. Colonial I.* 28 (1897): 468-497. Carter.
The Colony of Lagos. By Sir Gilbert T. Carter, K.C.M.G.

NORTH AMERICA.

- Discovery of America.** Dawson.
The Discovery of America by John Cabot in 1497, being extracts from the Proceedings of the Royal Society of Canada relative to a Cabot Celebration in 1897, and The Voyages of the Cabots, a paper from the Transactions of the Society in 1896, with Appendices on Kindred Subjects. By Samuel Edward Dawson, M.R.D. (Laval). (Royal Soc. Can., vol. ii. Sec. ii.) Ottawa: J. Hope & Sons, 1896. Size 10×7 , pp. xiv. and 30. *Facsimile Maps.*
Dr. Dawson's paper is an answer to objections made against a paper published by him in 1894, in which he advocated Cape Breton as the laudfall of John Cabot.
- Mexico—Geology.** *J. Geology* 5 (1897): 384-390. Bain.
A Sketch of the Geology of Mexico. By H. Foster Bain.
A résumé of a report recently published by the Geographical Institute of Mexico.
- Mexico—Lower California.** *Ymer* 17 (1897): 91-151. Eisen.
En färd till Baja California och Sonora. Af G. Eisen.
- United States—California.** *J. Geology* 5 (1897): 340-348. Walcott.
The Post-Pleistocene Elevation of the Inyo Range, and the Lake Beds of Waucobi Embayment, Inyo County, California. By Charles D. Walcott. *With Map and Illustrations.*
- United States—California—Submerged Valleys.** Davidson.
The Submerged Valleys of the Coast of California, U.S.A., and of Lower California, Mexico. By George Davidson, A.M., Ph.D., etc. *With Nine Plates. Proceedings*

of the California Academy of Sciences. Third Series. Geology. Vol. i. No. 2. San Francisco, 1897. Size 10 x 7½, pp. 71-103. *Presented by the Author.*

Nearly thirty submerged valleys are described as occurring off the coasts of Upper and Lower California. The importance of their thorough investigation is shown by the fact that vessels have been led into danger by the deep soundings obtained when running up their axes.

United States—Eleventh Census.

[Eleventh Census of the United States. 1890.] Report on the Insane, Feeble-Minded, Deaf and Dumb, and Blind, by John S. Billings, M.D. (1895, pp. x. and 756, *Diagrams*); Insurance Business, Part ii.—Life Insurance, by Charles A. Jenney (1895, pp. xii. and 478); Vital and Social Statistics, Part ii.—Vital Statistics: Cities of 100,000 population and upward, by John S. Billings, M.D. (1896, pp. viii. and 1182, *Maps and Diagrams*); Ditto. Part iv.—Statistics of Deaths, by the same (1895, pp. iv. and 1084); Crime, Pauperism, and Benevolence, Part i.—Analysis [of Statistics], by Frederick H. Wines (1896, pp. vi. and 412); Farms and Homes: Proprietorship and Indebtedness, by George K. Holmes and John S. Lord (1896, pp. x. and 646, *Maps and Diagrams*). Washington. Size 12 x 9½.

United States—Missouri. *J. School G.* 1 (1897): 110-117, 144-150. Marbut.
Missouri. By C. F. Marbut.

A sketch of the State of Missouri, showing the influence which its physical geography has had on the life of its inhabitants.

United States—South Carolina. *National G. Mag.* 8 (1897): 152-154. Glenn.
Applied Physiography in South Carolina. By L. C. Glenn.

Describes the physiographical changes resulting from the present system of farming, and their ruinous results.

United States—Virginia. Phillips.
Smithsonian Miscellaneous Collections. 1039. Virginia Cartography: a Bibliographical Description. By P. Lee Phillips. Washington: The Smithsonian Institution, 1896. Size 10 x 6½, pp. 86.

An extremely interesting piece of work, giving an account not only of the early maps of Virginia but also of those who produced them. The series begins with With's map of 1585 and comes down to 1893. The main object of the monograph is to trace the history of maps which have been torn from the volumes containing them and are in danger of being lost sight of.

CENTRAL AND SOUTH AMERICA.

Central America—Costa Rica. *National G. Mag.* 8 (1897): 143-151. Villafranca.
Costa Rica. By Señor Ricardo Villafranca. *With Illustrations.*

Central America—Rainfall. *Petermanns M.* 43 (1897): 117-119 Sapper.
Regenfall im nördlichen Mittelamerika. Von Dr. Karl Sapper. *With Maps.*

Colombia. *Mém. S.G. Italiana* 6 (1897): 436-460. Dorfo.
La repubblica di Colombia e la sua situazione economica, studio di Raniero de Dorfo.

Colombia. *Naturwiss. Wochenschrift* 12 (1897): 231-234. Regel.
Reisebriefe aus Colombia. Von Prof. Dr. Fritz Regel.

Cuba. *B.S.R. Belge G.* 21 (1897): 93-112. Du Fief.
Île de Cuba. Par J. Du Fief. *With Map.*
A systematic compilation, with references to original sources.

Interoceanic Canal. *Petermanns M.* 43 (1897): 184-137. Polakowsky.
Der Interozeanische Kanal. Von Dr. H. Polakowsky.
On the Panama and Nicaragua Canal schemes.

Jamaica. Musson and Roxburgh.
The Handbook of Jamaica for 1897. Comprising Historical, Statistical, and General Information concerning the Island. Compiled . . . by S. P. Musson and T. L. Roxburgh. London: E. Stanford, 1897. Size 9 x 6, pp. viii. and 586. *Map. Price 7s. 6d. Presented by the Publisher.*

Straits of Magellan. *National G. Mag.* 8 (1897): 129-141. **Meade.**
A Winter Voyage through the Straits of Magellan. By the late Admiral R. W. Meade. *With Map.*

The voyage here described appears to have been made in the middle of 1871.

Tierra del Fuego. *Ann. G.* 6 (1897): 347-356. **Nordenskjöld.**
L'expédition suédoise à la Terre de Feu (1895-1897). Par M. Otto Nordenskjöld. *With Plates.*

This article gives the general impressions of nature and man in South Patagonia, gained by the writer during the course of the recent Swedish expedition to that region.

Venezuela and British Guiana. *Ann. G.* 6 (1897): 369-372. **Gallois.**
La territoire contesté entre le Venezuela et la Guyane Anglaise. Par M. L. Gallois.

A brief statement of the most salient points in the British Guiana boundary question.

AUSTRALASIA AND PACIFIC ISLANDS.

German New Guinea. *Deutsche Kolonialzeitung (Beilage) (N.F.)* 10 (1897): 4, 21-24. **Tappenbeck.**

Kurze Uebersicht über den Verlauf der Kaiser-Wilhelmsland-Expedition. Von E. Tappenbeck. *With Illustrations.*

German New Guinea—Huon Gulf. *Verh. Ges. Erdk. Berlin* 24 (1897): 280-295. **Rüdiger.**

Herr Korvetten-Kapitän H. Rüdiger: Der Huon-Golf im Südosten von Kaiser Wilhelms-Land. *With Map.*

A description of the coast-features of Huon gulf, from personal knowledge acquired in the service of the German New Guinea Company.

New Caledonia. *J. Tōkyō G.S.* 19 (1896): 125-168. **Tajima.**
Notes on New Caledonia and Some Islands lying close to it. By Colonel N. Tajima. [In Japanese.]

New South Wales—Meteorology. **Russell.**
Department of Public Instruction. Meteorology of New South Wales. Results of Rain, River, and Evaporation Observations made in New South Wales, during 1895, with Maps and Diagrams. By H. C. Russell, B.A., etc. Sydney, 1896. Size 10 × 6½, pp. lxxxiv. and 200. *Price* 3s. 6d.

Queensland—Almanac and Directory. **Pugh.**
Pugh's Almanac and Queensland Directory for 1897. Brisbane: Gordon & Gotch, 1897. Size 7½ × 5, pp. 640 and 356. *Map, Plan, and Illustrations.*

A compendium of information upon Queensland, with numerous illustrations and large-scale maps.

Queensland—Mt. Peter Botte. **Le Souef.**
Ascent of Mt. Peter Botte, North Queensland. By D. Le Souef. [Read before the Field Naturalists' Club of Victoria, February 8, 1897.] [Reprinted from the *Victorian Naturalist*, March—April, 1897.] Size 9 × 5½, pp. 16. *Plate.*

POLAR REGIONS.

Arctic—Voyage of Fram. *Verh. Ges. Erdk. Berlin* 24 (1897): 249-264. **Nansen.**
Herr Dr. Fridtjof Nansen: Durch das Polargebiet. *With Map.*

Nansen Reception. *C. Rd., S.G. Paris* (1897): 121-148. ———
Réception du Dr. Fridtjof Nansen, 25 mars—1^{er} avril 1897. *With Portrait and Map.*

Polar Regions. **Prentiss.**
The Great Polar Current. Polar Papers, Old and New. By Henry Mellen Prentiss. Cambridge: Printed at the Riverside Press, 1897. Size 7½ × 5, pp. 154. *Presented by the Author.*

This will be separately noticed.

- Spitsbergen.** *Alpine J.* 18 (1797): 363-384. **Garwood.**
Across Spitsbergen with Sir Martin Conway, with an Account of the Ascent of Hornsund Tind. By Edmund J. Garwood. *With Illustrations.*
- Spitsbergen.** *B.S.G. Commerc. Bordeaux* 90 (1897): 250-264. **Voll.**
Voyage au Spitzberg. Par Nils Voll. *With Map and Illustrations.*
Account of a tourist trip.
- Spitsbergen and Norway.** **Wegener.**
Zum ewigen Eise. Eine Sommerfahrt ins nördliche Polarmeer und Begegnung mit André und Nansen. Von Georg Wegener. Zweite Auflage. Berlin: Allgemeiner Verein für Deutsche Litteratur, 1897. Size 9 x 6½, pp. xii. and 360. *Maps and Illustrations.* Price 6s. *Presented by the Author.*
An entertaining account of the trip of the *Erling Jarl* to Spitsbergen and Vadsø (for the solar eclipse) in August, 1896, together with a sketch of the plans for polar exploration associated with the names of Nansen and Andrée.
- Swedish Polar Researches.** *Ymer* 17 (1897): 153-157. **Nathorst.**
Ett önskningsmål för den svenska polar-forskningen. Af A. G. Nathorst.
The writer urges the construction of a Swedish arctic exploring vessel on somewhat similar lines to the *Fram*, and points out several pieces of exploration which might be done by such a ship.

MATHEMATICAL GEOGRAPHY.

- Barometric Altitudes.** **Benedictis.**
I progressi della livellazione barometrica. Comunicazione del Ten. Generale Biagio De Benedictis.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 149-152.
- Cartography.** *M.K.K. Militär-G.I.* 16, 1896 (1897): 131-142. **Hübl.**
Beiträge zur Technik der Kartenerzeugung. Von Arthur Freiherrn von Hübl. *With Maps.*
Shows how some of the disadvantages of photographic methods of cartography can be overcome.
- Cartography.** *Rev. Maritime* 133 (1897): 193-201, 417-434. **Lavieuville.**
Notice sur les cartes marines. Par M. G. Lavieuville.
Contains hints on the manner of using marine charts.
- Cartography.** *M.K.K. Militär-G.I.* 16, 1896 (1897): 67-98. **Rummer.**
Die Photogrammetrie im Dienste der Militär-Mappierung. Von Adolf Rummer von Rummerahof. *With Illustrations.*
- Cartography.** *M.K.K. Militär-G. I.* 16, 1896 (1897): 51-66. **Steeb.**
Terraindarstellung mit Schiefer Beleuchtung. Von Christian Ritter von Steeb. *With Maps.*
Sets forth the disadvantages of "side-lighting" in the delineation of mountainous countries.
- Cartography.** *B.S. Neuchateloise G.* 9 (1897): 159-164. **Guyou and Reclus.**
D'un Atlas à échelle uniforme proposé. Par Georges Guyou et Élisée Reclus.
Proposal for an atlas of the world on a uniform scale of 1:10,000,000. The size of each sheet is proposed to be 20 inches by 28, 38 being required to include the whole surface of the Earth. From the large atlas a pocket edition on the scale of 1:50,000,000 might be made.
- Decimal Division of Time.** *B.S.G. et d'Archéologie d'Oran* 17 (1897): 176-201. **Sarrauton.**
Conférence sur l'Heure décimale. Par H. de Sarrauton. *With Plates.* L'Heure décimale au Bureau des Longitudes. By the same.
- Geodesy.** **Zanotti-Bianco.**
Sulle misure di arco di meridiano compiute da Italiani e loro contributo all'esatta notizia della figura della Terra. Relazione dell' Ing. Ottavio Zanotti-Bianco.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 137-139.
- Geodetic datum line.** **Guarducci.**
Sulla opportunità di stabilire in Roma un caposaldo per le quote italiane. Relazione del Dottor Ing. Federico Guarducci.—Atti del II° Congresso Geografico Italiano, Roma, 1895. Roma, 1896. Pp. 140-148.

Nautical Astronomy.

Aufruf zur Umgestaltung der Nautischen Astronomie, nebst Anhang, 1896. Dorpat, 1893. Size $13\frac{1}{2} \times 10\frac{1}{2}$, pp. 30 and 10.

Tides and Wind.

Ann. Hydrographie 25 (1897): 200-207.

Der Einfluss des Windes und des Luftdruckes auf die Gezeiten.

Trigonometrisch Survey. *M.K.K. Militär-G.I.* 16, 1896 (1897): 143-198..

Weixler.

Ausgleichung trigonometrischer Messungen nach der Methode der geometrischen Orter. Von Adolf Weixler. *With Plates.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.**Meteorological Conference.**

Official, No. 127. Report of the International Meteorological Conference. Paris, 1896. Published by authority of the Meteorological Council. London: Eyre and Spottiswoode, 1897. Size $10 \times 6\frac{1}{2}$, pp. 90. *Illustrations.* Price 1s. *Presented by the Meteorological Office.*

Meteorological Hints.

Marriott.

Hints to Meteorological Observers, with Instructions for taking Observations, and Tables for their Reduction. Prepared under the direction of the Council of the Royal Meteorological Society. By William Marriott. Fourth Edition. London: E. Stanford, 1897. Size $10 \times 6\frac{1}{2}$, pp. 48. *Illustrations.* Price 1s.

Oceanography—Red Sea. *Ann. Hydrographie* 25 (1897): 165-169.

Hydrographische Forschungen im Rothen Meere (Mit einer Tiefenkarte des Golfes von Akabah).

A summary of the soundings of the *Pola*.

Oceanography—Speculation. *P.A. Nat. Sci. Philadelphia* (1897): 12-17.

Morris.

The Primeval Ocean. By Charles Morris.

Speculations on the composition, thermal and vital conditions, of the primitive ocean.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.**Anthropogeography.**

G.Z. 3 (1897): 256-267, 315-326.

Vierkandt.

Die Kulturformen und ihre geographische Verbreitung. Von Privatdozent Dr. A. Vierkandt. *With Maps.*

Environment.

Blackwood's Mag. 162 (1897): 227-235.

Robinson.

Faces and Places. By Dr. Louis Robinson.

A study of the influence of locality upon the human face.

Historical.

Columba.

La tradizione geografica dell' età romana, Relazione del Prof. Gaetano Mario Columba.—Atti del II° Congresso Italiano, Roma, 1893. Roma, 1896. Pp. 511-537.

Historical—Cabot.

Nautical Mag. 68 (1897): 534-543.

Baker.

John Cabot and the Discovery of Newfoundland. By Sir Sherston Baker, Bart.

Historical Maps.

Winsor.

Baptista Agnese and American Cartography in the Sixteenth Century. By Justin Winsor. [Reprinted from the 'Proceedings of the Massachusetts Historical Society,' May, 1897.] Cambridge: John Wilson & Son, 1897. Size $10 \times 6\frac{1}{2}$, pp. 16.

Historical Maps.

Ruge.

The Development of the Cartography of America up to the year 1570. By Dr. Sophus Ruge.—Annual Report . . . of the Smithsonian Institution . . . to July, 1894. Washington: 1896. Size $9\frac{1}{2} \times 6$, pp. 281-296. *Plates.*

Translated from *Ergänzungsheft* 106 to *Petermanns Mitteilungen* for 1892.

BIOGRAPHY.**Dickson.**

Ymer 17 (1897): 159-165.

Nathorst.

Oscar Dickson. Af A. G. Nathorst. *With Portrait.*

Elias.

Wheeler.

Obituary. Ney Elias, c.i.x. By Stephen Wheeler. From the *Geographical Journal* for July, 1897. Size $10 \times 6\frac{1}{2}$, pp. 6. *Portrait.*

Mende. *National G. Mag.* 8 (1897): 142. _____

Admiral R. W. Mende, U.S.N. *With Portrait.*

Mouat. *J. R. Statistical S. Co.* (1897): 434-437. _____

Dr. Frederic John Mouat, M.D., LL.D.

GENERAL.

Colonies—Java and the Congo. *B.S.R.G. d'Anvers* 21 (1897): 197-214. **Lecleroq.**

Le Java et le Congo au point de vue colonial. Par M. Jules Lecleroq.

The writer draws a parallel between Java and the Congo, and thence deduces the value of the latter to Belgium.

Geography. **Gebelin.**

Essai de Géographie Appliquée. Par Jacques Gebelin. Première partie: Synthèse; Premier Fascicule: Applications de la Géographie générale. (Extrait du *Bulletin de la Société de géographie commerciale de Bordeaux, année 1896.*) Bordeaux: Feret et Fils, 1896. Size 9½ × 6½, pp. 88. *Presented by the Author.*

The commencement of a treatise on applied geography, i. e. geography in relation to the immediate wants of men.

Geological Model. *Naturwissens. Wochenschrift* 13 (1897): 241-246. **Zache.**

Die Grundzüge einer Bildungsgeschichte der Erdrinde innerhalb der deutschen Grenze erläutert an der Geologischen Wand im Humboldtthain zu Berlin. Von Dr. Eduard Zache. *With Illustrations.*

The article describes a geological model at Humboldtthain in Berlin, which is constructed of the actual rocks the forms and relative positions of which it illustrates.

German Colonies. _____

Jahresbericht der Deutschen Kolonialgesellschaft, 1896. Berlin, 1897. Size 9½ × 6½, pp. 80.

Kew Observatory. _____

Description of the Kew Observatory. [From the "Record" of the Royal Society.] Size 8½ × 5½, pp. 18. *Plans.*

Kew Observatory. _____

The Kew Observatory, Old Deer Park, Richmond, Surrey. 1896. Report of the Kew Observatory Committee of the Royal Society for the Year ending December 31, 1896. [From the *Proceedings of the Royal Society, 1897.*] London: Harrison & Sons, 1897. Size 8½ × 5½, pp. 34. *Presented by the Royal Society.*

Lighthouses. _____

No. 30 [U.S.] Hydrographic Office. List of Lights of the World. Vol. i. East and West Coasts of North and South America (excepting the United States), including the West India and Pacific Islands. Corrected to October 24, 1896. Washington, 1896. Size 11½ × 9, pp. 56 and xiv. *Presented by the U.S. Hydrographic Office.*

NEW MAPS.

By J. COLES, *Map Curator, R.G.S.*

ASIA.

Central Asia. _____

Sketch-map of routes traversed by European and Asiatic Explorers beyond the British Frontier from 1865 to 1897. Scale 1: 1,000,000 or 15·8 stat. miles to an inch. London: Stanford's Geographical Establishment. 1897. *Presented by the India Office.*

This is a new edition of a map to accompany 'A Memoir on the Indian Surveys, 1875-1890,' by E. D. Black. In the present instance hill-shading has been added, and, as will be seen by the title, it purports to show all the routes followed by European and Asiatic travellers beyond the British frontier from 1865 to 1897. The map can

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however, hardly be considered to have been brought up to the date mentioned, 1897, as the very important route followed by Mr. St. George R. Littledals in 1895 does not appear, neither is the route traversed by Prince Henry of Orleans, from Tali-fu to Sadiya, shown.

AFRICA.

Western Sudan.

Meyer.

I. Die Völker des West Sudan. II. Handel und Verkehr im West-Sudan. III. Die Staatenbildungen des West-Sudan. Scale 1:10,000,000 or 157·8 stat. miles to an inch. 4 maps on 1 sheet. *Petermanns Geographische Mittheilungen*. Ergänzungsheft No. 121, "Erforschungsgeschichte und Staatenbildungen des Westsudan," von Dr. Paul Constantin Meyer. Gotha: Justus Perthes, 1897. *Presented by the Publisher.*

AMERICA.

Canada.

Department of Railways and Canals, Canada.

Map showing the Railways of Canada to accompany the annual report on Railway Statistics, 1896. Scale 1:2,750,000 or 43·4 stat. miles to an inch. Compiled by E. V. Johnson. 3 sheets. Montreal: Department of Railways and Canals, 1896. *Canadian Government Office, London.*

On this map the railways are all shown in red, each line having a number by which its name can be found in a table which is furnished. The progress made with the construction of the railways six months later than described in the annual report of railway statistics, which it accompanies, is shown on this map. In addition to Canadian railways, the lines with which they connect in the United States are given, and, for general purposes of reference, this will be found a useful map.

AUSTRALIA.

Brisbane.

Pugh.

Map of Brisbane and Suburbs, issued with 'Pugh's Almanac.' Brisbane: Gordon & Gotch, 1897. *Presented by the Publishers.*

Queensland.

Pugh.

Map of Queensland, compiled and lithographed from Official maps for 'Pugh's Almanac.' Scale 1:3,000,000 or 47·6 stat. miles to an inch. Brisbane: Gordon & Gotch, 1897. *Presented by the Publishers.*

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published at the Hydrographic Department, Admiralty, during May and June, 1897.

No.	Inches.	
2585		England:—Coastguard stations. 2s.
2586		Scotland:—Coastguard stations. 2s.
2587		Ireland:—Coastguard stations. 2s.
2886 m = 6 85		Ireland, west coast:—Killary bay. 2s. 6d.
1210 m = 6·8		Ireland, south coast:—Berehaven. 3s. 6d.
326 m = 0·54		Denmark:—Great belt. 3s.
1317 m = 0·37		Balearic islands:—Majorca and Minorca. 2s. 6d.
1710 m = 4·65		Algeria:—Bougie. 1s. 6d.
2896 m = 5·9		Newfoundland, east coast:—White and River Head bays. 1s. 6d.
2789 m = 2·37		North America:—River St. Lawrence above Quebec. Sheet xxi. Cole shoal light to Rockport. 2s.
2789 m = 2·37		North America:—River St. Lawrence above Quebec. Sheet xxii. Rockport to Burnt island light. 2s.
464 m = 1·77		North America, east coast:—Passamaquoddy bay and St. Croix river. 2s. 6d.
405 m = var.		Harbours and anchorages in the Bahama islands:—Highborne cut, Ship channel, Fleeming or Six Shilling channel (reproduction). 1s. 6d.
398 $\left\{ \begin{array}{l} m = 2·0 \\ m = 4·7 \end{array} \right.$		Harbours and anchorages in the Bahama islands:—Whale cay channel and Green Turtle cay anchorage, Great Stirrup cay (reproduction). 1s. 6d.
41 m = 0·5		India, west coast:—Delta of the Indus, Cape Monze to Kediwari mouth. 2s. 6d.

No.	Inches.	
1416 m = var.		Anchorage on the north-west coast of New Guinea:—Boni harbour, Patippi bay, Selé or Kabobolol strait. Karas island anchorage, Kaimana bay, Wardenburg group, Dubus haven, Segaar bay, Lakahia bay, Ekka island anchorage. 2s.
2874 m = 2·4		Japan:—Setozaki harbour. 1s. 6d.
2883 m = 2·8		Japan, Nipon, south coast:—Yeno Ura. 1s. 6d.
1786		Anchorage on coast of Honduras:—New plan, Hospital bight.
2110		Anchorage in south-east Alaska:—Plans added, Port Chester, Chasina anchorage.
2876		Harbours in Formosa:—New plan, Tamsui harbour.
134		Harbours and anchorages in New Hebrides:—Plans added, Picot bay, Ringdove anchorage, Vi Faka anchorage, Torrea or Vava islands.

(J. D. Potter, Agent).

Charts Cancelled.

No.		Cancelled by	No.
2585	England:—Coastguard stations.	New Chart. England:—Coastguard stations . . .	2585
2586	Scotland:—Coastguard stations.	New Chart. Scotland:—Coastguard stations . . .	2586
2587	Ireland:—Coastguard stations.	New Chart. Ireland:—Coastguard stations . . .	2587
326	Great Belt.	New Chart. Great Belt	326
1766	Plan of Bougie on this sheet.	New Chart. Bougie	1710
1717	Highborne cut.	New Chart.	
1509	Ship channel.	New Chart.	
405	Fleeming or Six Shilling channel.	Harbours and anchorages in the Bahama islands	405
398	Whale cay channel and Green Turtle cay anchorage.	New Chart. Harbours and anchorages in the Bahama islands	398
1432	Great Stirrup cay.	New Chart.	
41	Indus Tidal channels from Manora point to Kalia river.	Cape Monze to Kediwari mouth . . .	41
1416	Anchorage on north-west coast of New Guinea.	New Chart. Anchorage on the north-west coast of New Guinea	1416
996	Plan of Yeno Ura on this sheet.	New Chart. Yeno Ura	2883
2293	Plan of Altata harbour on this sheet.		
134	Plan of Segond channel on this sheet.		

Charts that have received Important Corrections.

No. 1165, Wales:—Tenby and Caldy roads. 2006, Scotland, west coast:—River Clyde from Greenock to Dumbarton. 2706, Ireland, west coast:—Ballynakill and Killary bays. 1840, Ireland, south coast:—Bantry bay, Sheet i. 2339, North Sea, general. 2182a, North sea, north part. 417, Germany:—Graa Deep. 1887, Germany:—Eider river to Blaavand point. 2842a, Baltic sea, eastern sheet. 2360, Sweden:—Falsterbö point to Kalmar sound. 2114, Baltic entrance:—The Kattegat. 2302, Gulf of Bothnia:—Tome point to Tauvö. 2365, Germany:—Rostock to Arkona light. 2364, Germany:—Lubeck bay and Femern belt. 2150, Germany:—Femern to Bornholm. 2825, Denmark:—Lüm Fiord. 2115, Denmark:—The Sound. 2229, Denmark:—Entrance to Great and Little belts. 2138, Denmark:—Approaches to the Grön sound and the Stor Strom. 213, Denmark:—Entrance to Grön sound. 790, Denmark:—Approaches to Copenhagen, etc. 2117, Germany:—Keil bay. 155, Italy, west coast:—Gulf of Spezia. 2608, France, south coast:—Approaches to Toulon. 2607, France, south coast:—Marseille to Agay road. 289, Newfoundland:—Bay of Islands, etc. 283, Newfoundland:—Codroy road to Cowhead harbour. 284, Newfoundland:—Cowhead harbour to Ste Geneviève bay, etc. 2027, Prince Edward island:—Casumpeque harbour. 678, North America:—Lakes Erie and Huron. 2895, North America, east coast:—Rockport harbour. 853, North America, east coast:—St. Andrew sound to St. John river. 2384,

Anchorage on the north coast of Cuba. 513, Venezuela:—Puerto Cabello, etc. 959, British Honduras:—Approaches to Belize. 2854, Gulf of Mexico:—Tampico harbour, approaches to Vera Cruz, Port of Vera Cruz. 522, Honduras:—Belize harbour. 1156, South America, north coast:—Nickerie river approaches. 1155, South America, north coast:—Entrances to rivers in Guiana. 506, South America, east coast:—Port of Bahia. 540, South America, east coast:—Bahia de todos os Santos. 544, South America, east coast:—Santa Catharina island and strait. 2004, Rio de la Plata:—Colonia roads. 1082, United States, west coast:—Wilmington and San Pedro harbours. 2545, Harbours on the coast of California. 585, British Columbia:—Harbours in the strait of Georgia. 1901, British Columbia:—Ogden channel, etc. 1923A, British Columbia:—Cape Caution to Port Simpson. 2453, British Columbia:—Brown and Edge passages. 1499, Alaska:—Cross sound to Kadiak island. 1500, Aleutian islands:—Siguan island to Attu island. 1863, Africa, west coast:—River Dodo to Bonny river. 1401, Mauritius:—Grand port. 164, Red sea:—Massawa channel. Port Smyth. 8p, Red sea, Sheet 4. 753, Entrance of the Persian gulf. 2760, Sumatra, west coast:—Acheh head to Tyingkok bay. 942A, Eastern archipelago, eastern portion, etc. 2577, Philippine islands:—Between St. Bernardino and Mindoro straits. 976, Philippine islands:—Manila bay. 2454, Northern portion of the island of Luzon, etc. 1263, China sea. 996, Japan:—Kii channel to Yedo. 2460, Kamohatka to Kadiak island, etc. 2432, Kamohatka:—Tumen Ula to Strelok bay, etc. 1469, Solomon islands:—Gaudalcanar and Florida islands, with a portion of Malaita island.

(*J. D. Potter, Agent.*)

United States Charts.

U. S. Hydrographic Office.

Pilot Charts of the North Atlantic Ocean for August, 1897, and North Pacific Ocean for July and August, 1897. Published at the Hydrographic Office, Washington, D.C. Presented by the U.S. Hydrographic Office.

PHOTOGRAPHS.

Chin Hills.

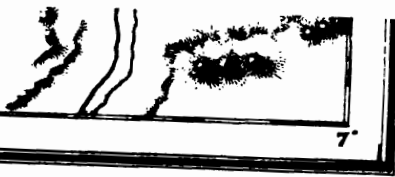
Rigby.

Thirty-nine Photographs of the Natives and Scenery of the Chin Hills, taken by Captain G. C. Rigby. 1896-97. Presented by Captain G. C. Rigby.

This series is interesting as showing the types of natives and scenery in the Chin hill country, and constitutes a valuable addition to the collection of the Society.

(1) The two last captive slaves in the Kok Dok; (2) A Mro man, Seml, North Arakan hill tracts; (3) Yindu Chin woman; (4) Chief of Dok, cane-belly Chins, Arakan Yomas; (5) Ditto; (6) Frontier stockade, Pengwah, Lemru river; (7) Yindu Chins, Myaing Mon valley; (8) Ditto; (9) A bamboo bridge built by Chins across the Lemru river; (10) Chin-paid chief "Natan;" baskets used for packing stores; (11) Interior of Mindat fort (attacked by Chins in 1895), Yawdwin Chin hills; (12) A corner of camp; (13) Humon, leader of the raid on Myaing in guard; Kok Dok Arakan Yomas; (14) A glimpse of the Arakan Yomas from the Mount Victoria range; (15) Chinbok girls; (16) Ditto; (17) Ditto; (18) Chinbok Chins, Chey valley; (19) A Chinbok valley; (20) Chinbok woman weaving; (21) A cane-belly Chin village, Mon valley; (22) On the Mon river; (23) Chinbok Chins, M'Chum village, Mon valley; (24) Gateway of a Chinbok village, Mon valley, decorated with bison skulls; (25) Chutim village (Chinbok), Chey valley; (26) Chinbok Chins, Chey valley, Yawdwin Chin hills; (27) Cane-belly Chins, Arakan Yomas; (28) Pengwah, frontier outpost on Lemru river, North Arakan hill tracts; (29) Chinbok Chins, Yawdwin Chin hills, trophy posts in background; (30) Chinbok girls, Chey valley, Yawdwin Chin hills; (31) Chutim village (Chinbok), Chey valley, Yawdwin Chin hills; (32) Chinbok police, Mindat fort, Yawdwin Chin hills; (33) Yindu Chins, Yawdwin Chin hills; (34) Officer's camp, Atet Myaing Yindu column; (35) Cane-belly Chins, Mon valley, Yawdwin Chin hills, a previously unknown tribe of Chins; (36) A cane-belly Chin woman, Chey valley, the earrings are made out of the top part of a gourd, filled with beadwork; (37) Cane-belly Chins, Mon valley; (38) Ditto; (39) No title.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.



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F.S. Weller. F.R.G.S



The Geographical Journal.

No. 5.

NOVEMBER, 1897.

Vol. X.

DISCOVERY BY BARON NORDENSKJÖLD THAT FRESH WATER WILL BE FOUND BY BORING THROUGH HARD CRYSTAL- LINE ROCK FOR 30 TO 35 METRES.

By Sir CLEMENTS R. MARKHAM, K.C.B., F.R.S.

BARON NORDENSKJÖLD'S system of boring for fresh water through the granite rocks of Sweden has now been in operation for two years, with the result that as many as forty-four wells have been made. This is not alone a question of greater or less success in finding water, but of the discovery of a new and important geological principle leading to weighty economic and hygienic results.

The difficulty that was found in obtaining good drinking-water at many of the pilot and light stations situated on rocky islets off the Swedish coasts, first induced Nordenskjöld to consider the subject. He remembered a remark of his late father, our former corresponding member, Nils Nordenskjöld, that salt water never penetrated into the Finnish mines situated on the coast and extending under the sea, although the mines were always more or less leaky—what the miners called *vattensjuka* (literally, "water-sick"). He also remembered an observation he himself made during his expeditions to Spitsbergen in 1861 and 1864. It is to be found in his 'Sketch of the Geology of Spitsbergen' (Stockholm: 1867), and is as follows:—

"The strata of the mountain limestone, which at Hinlopen strait alternate with plutonic rocks, are almost horizontal; but the tertiary beds at King's bay and Cape Staratsohin are, on the contrary, quite folded, although no eruptive rock could be discovered in the vicinity. There must consequently be some other reason for the folding which occurs in these places; and it appears to me that too much importance has been generally ascribed to the influence of eruptive masses in

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connection with the folding, upheaval, and dislocation that is almost everywhere observed on the Earth's crust. As is the case with



BOBING AT DALBYÖ.

innumerable other geological phenomena, this also very likely results

less from any violent revolution than from some almost imperceptible but nevertheless continually operating power. The upper part of the Earth's crust is, of course, subjected to periodical variations of temperature, which, at Stockholm for instance, at a depth of 70 or 80 feet rises to 0.01° C. If the Earth's crust were continuous, and the change of volume caused by these variations of temperature did not exceed the limits of elasticity of the rock, they would not exercise any disturbing influence. But as, to a greater or less degree, there are clefts and fissures in all mountains, these will widen in a lower temperature, but become narrower as soon as the temperature rises. If, however, as may often be the case, the fissures when enlarged by a lower temperature are filled up either with chemical or mechanical sediments, a powerful lateral pressure will naturally ensue when the temperature again rises and extends the rock; and thus every variation of temperature will cause a slight dislocation of the strata. When we consider that this agency is working from year to year in the same direction, and that the extensive movement of many hundred miles of the Earth's crust may only cause folds at some narrow spot where the resistance is at a minimum, it should not surprise us to find even the newest formations greatly folded, while older formations in the vicinity may be quite undisturbed."

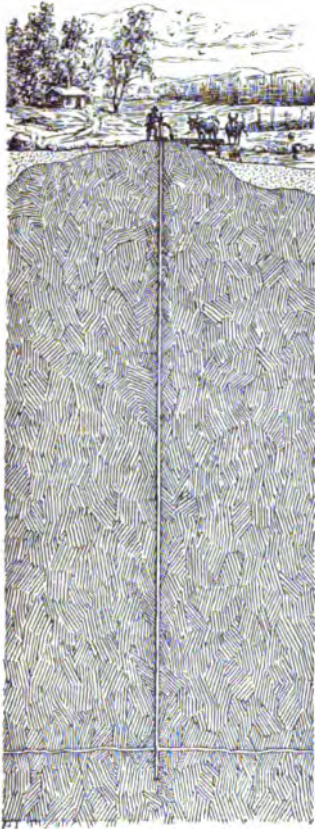
If this remark was correct, Baron Nordenskjöld argued that a horizontal crack would generally exist in all solid rocks at an insignificant depth beneath the Earth's surface. Consequently, in the Swedish rocks, he concluded that water would be found by boring to this crack. But the only places where there was any prospect of such borings being undertaken were on the out-of-the-way rocks and islets, where water was so much needed.

In order to obtain data for solving the problem, Baron Nordenskjöld had, as early as 1885, instituted inquiries respecting the saltiness of water in wells or mines near the sea-coast, and he collected some important information. He was told that several wells, in sedimentary strata, in the vicinity of the sea-coast, yielded water free from salt, notwithstanding that the springs are at a depth of 30 to 75 metres below the sea-level. As a curiosity, it may be mentioned that a well that was bored in loose sedimentary strata at Kungsbacka gave a plentiful supply of water, that rose 3 to 4 metres above the sea-level, but this water was salt.

The information thus collected, though far from conclusive, appeared to point to the fact that water obtained by boring on rocky islands should not be salt or brackish, but fresh drinking-water. Nordenskjöld, therefore, proposed to the Chief of the Pilot Stations that he should allow an attempt at boring in the given direction to be made at some suitable station. In consequence of this suggestion, the first boring, with this object, took place in 1891, on the little island of Svängen,

south of Kosterfjorden. It was abandoned, after reaching a sufficient depth, because a long crack was arrived at extending from the sea to the boring-hole. The locality had not been selected by any one conversant with the subject.

After this failure the question was allowed to rest for some years.



SPRING REACHED BY BORING THROUGH
ARCHAIC ROCK.

It was next taken up by Baron Ruuth, the General Director for Pilots, who, regardless of the unsuccessful boring at Svangen, caused a second experiment to be tried at Arkö, beyond Braviken. This time the work was superintended by men who understood it, namely, the baron's son, Gustav Nordenskjöld, the geologist Svenonius, and director Casselli. It was in May, 1894. The site selected was a flat place near the pilot station, the rock being composed of hornblende, gneiss, and diorite. The results were very satisfactory. As soon as a depth of 35 metres was reached, they came to excellent water, yielding 450 litres an hour. The boring-hole had a diameter of 64 mm. At first the water was a little yellow, owing to the clay in the cracks of the rock, the stone-dust, and oil from the boring, but it soon became perfectly clear.

Water has always been found at a depth of 30 to 35 metres, and similar borings have since been carried out successfully at forty-four different places. At first the water is mixed with the clay from the cracks, the stone-dust, and the oil from the machine, and it is some time before all dirty water is pumped away; but soon it becomes as clear as

crystal. At Stockholm it has a temperature of 6° to 7° C. (about 43° to 45° Fahr.); at Gelliavaara, 13° C., or 55° Fahr.

The boring in hard close rock would have the same results in other countries besides Scandinavia. Baron Nordenskjöld is convinced that wherever hard, close rock exists, with variations in temperature and not permeable, water will be found in the same way as in Sweden, and in the same quantity, that is, from 500 to 2000 litres per hour, with moderate pumping. Sites for such borings could be found, for example, in many parts of the north coast of Africa, in Abyssinia, in South

Africa, in Spain, and other parts of the Western Mediterranean, at the foot of Mount Sinai, in Greece and Asia Minor, and in the dry water-sheds of the cañons of Colorado. In the tropics, where there are dry and rainy seasons, such wells cannot supply water for extensive cultivation. But they will spring forth, free from all bacteria and impurities, and will suffice for household purposes, for small villages, and for gardens.

The practical importance of Baron Nordenskjöld's discovery for the geographical pioneer, and its interest from the point of view of physical geography, entitles it to the special attention of the readers of this *Journal*.

MR. FITZGERALD'S EXPEDITION TO ACONCAGUA.

By EDWARD A. FITZGERALD.

As I have now brought my expedition to the Cordilleras to a close, I take this opportunity of forwarding a few short notes upon the work done.

We arrived in Buenos Ayres on November 9, and from there proceeded to Cordoba in order to test our instruments at the observatory. Our porters and all the provisions and baggage were sent forward to Mendoza, orders being given that the men should prepare themselves for the hard work in the mountains. We reached Mendoza on December 1, and, after being somewhat delayed by the necessity of buying and hiring mules, we started for Punta de las Vacas, the last station on the Trans-Andine railway, on December 6. It was here that our work in the Cordilleras commenced.

After a journey to the head of the Vacas valley, in order to discover whether there was any possibility of ascending Aconcagua from the eastern side, and a rough survey of the valley itself, we moved higher up the main valley to the Pente del Inca. The Horocones valley, running north-west from the Inca, was at once investigated; and as we found that we could best attack Aconcagua from this valley, we made Inca the base of our operations. We worked in this valley, off and on, for five months, and it was from this point that we made our measurements for the height of Aconcagua. This we did by taking a series of levels from the Vacas railway station to the mouth of the Horocones valley.

From this junction of the two valleys we measured the elevation angles of the mountain with great care, and then made a traverse of the valley on the bar-subtense method, working with a 6-inch theodolite, and checking all our measurements twice. By this means we ascertained the exact position of the mountain with reference to our fixed point at the mouth of the Horocones valley. We also measured the altitude

of the mountain from each station of the traverse. As yet we have not worked out the altitudes given from each station; but, after working out separate altitudes given from five distinct stations, all being several miles from each other, we found that we had not got an error of over 100 feet. The result of these observations gives a trifle over 23,000 feet as the height of Aconcagua.

Our hypsometrical results led us at first to believe that the mountain was 24,000 feet, and our aneroids played us some very curious tricks. One of them, on being taken to the height of 19,000 feet, registered 12 inches and then broke. Others got quickly out of order on being taken above 17,000 feet, but after a few days in the valley became fit for use again.

From our mountain station near the Inca we took a series of observations for the latitude and longitude by circum-meridian observations with both sextant and theodolite, and also a series of lunar distances with the sextant and lunar zenith distances with our theodolites. Thus the position of Puente del Inca and of Aconcagua were clearly ascertained.

The principal instruments used in our survey work were—two 6-inch transit theodolites, one 5-inch, one 3-inch, and a 6-inch sextant, while prismatic compasses were used for rough work in climbing. A telemeter gradient-level and four-metre staff was used for the levelling from the railway. The plane-table was also much used for sketching in detail.

Numerous photographs were taken, and many ornithological and zoological specimens collected. Our photographic work was done with a full-plate camera, from which we have about three hundred results, and quarter-plate for high mountain work. Cycloramic views were taken from various trigonometrical stations and high points to the extent of some 60 yards of film. The Lee-Bridges surveying camera was also used.

Four important mountains in all were climbed by the expedition, besides various smaller peaks incidentally ascended for trigonometrical and prospecting purposes. Three of these mountains were ascended by Mr. Vines, and one by Messrs. Lightbody and Gosse. Mr. Vines ascended Aconcagua and Tupungato, and a mountain some 19,000 feet in height, adjacent to Aconcagua, unnamed. The mountain climbed by Messrs. Lightbody and Gosse was lower down in the Horocones valley, and some 17,000 feet in height.

Our work was brought to a close in the beginning of June, by the heavy winter snows falling earlier in the year than usual.

GEOGRAPHY AT THE BRITISH ASSOCIATION, TORONTO, 1897.

THE success of the meeting of the British Association in Canada is not to be gauged by the number of members in attendance, which was comparatively small. Of those present, however, a much larger proportion than usual was composed of active members who took part in the proceedings of the sections. A large number of British visitors made the journey to Canada, including several who had been present at the Montreal meeting of 1884. The authorities of McGill University, Montreal, gave a very hearty welcome to the members arriving in the Allan line steamer *Parisian*, on which most of the sectional presidents and officials travelled. This was a foretaste of receptions in many towns; and the feeling that the Dominion of Canada as a whole welcomed the Association made itself felt everywhere.

The meeting was opened in Toronto on Wednesday, August 18, by a formal afternoon reception in the Horticultural Pavilion, presided over by the mayor, and open to the public. Several speeches were made, and this innovation seemed to produce an excellent effect, by letting the townspeople feel that they had all a part in receiving the Association.

The sectional meetings were held in the fine buildings of the University of Toronto, Section E—Geography—being housed in the University library. The large reading-room was prepared at great labour and considerable expense as a lecture-room, provided with a powerful electric lantern and all possible appliances, the utmost credit being due to the Toronto committee for the successful efforts they made to provide accommodation of the most convenient possible kind.

The section was constituted as follows:—

President—J. Scott Keltie, LL.D., SEC. R.G.S.

Vice-Presidents—Rev. President Burwash; E. G. Ravenstein; Prof. A. Penck; F. C. Selous; Coutts Trotter.

Secretaries—Colonel F. Bailey, SEC. R.S.G.S.; Dr. H. R. Mill (Recorder); J. B. Tyrrell.

Committee—Prof. Marcus Baker; W. M. Beaufort; Dr. W. T. Blandford, F.R.S.; Rt. Hon. James Bryce, M.P.; Prof. W. M. Davis; Prof. R. E. Dodge; Dr. H. O. Forbes; General A. W. Greely; Otto J. Klotz; Prince Kropotkin; G. E. Lumsden; Prof. John Milne, F.R.S.; Prof. Willis L. Moore; E. Delmar Morgan; Sir G. S. Robertson, K.C.S.I.; A. Laurence Rotch; Sir John Swinburne, Bart.; J. White.

Altogether thirty-three papers and reports were presented, and the section met on five days. It was a matter of regret that the only Canadian Geographical Society, that of Quebec, was not represented at the meeting, especially as it has recently published a volume of

transactions, inaugurating, it is to be hoped, a period of renewed activity in its history. Several papers of great interest were presented by Canadians, and a special feature of the meeting was the participation of a number of the eminent geographers of the United States, and the communication of valuable reports from what may for the moment be termed the geographical departments of the Governments of Canada and the United States. The various subjects under discussion are enumerated below, and fuller details of most of the papers, with the complete text of some, will duly appear in the *Journal*.

Thursday, August 19.—The President's address, delivered at twelve o'clock so as not to clash with Dr. Dawson's address to Section C (Geology), was listened to by a large audience, who highly appreciated the series of maps shown by the electric lantern as a summary of its main features. The address is printed in the *Journal* for September, p. 308. A vote of thanks was proposed by President Burwash, and seconded by Mr. Ravenstein.

Sir G. S. Robertson gave a paper on Kafiristan and the Kafirs, which was perhaps the most popular of those read to the section, if one might judge by the large audience with which the hall was crowded.

Mr. Ravenstein presented the Sixth Report of the Committee on the Climatology of Africa, the main features of which will be recorded in the *Journal*.

Mr. Delmar Morgan described the recent work done by Russians on Novaya Zemlya, referring especially to the recent expedition of Chernysheff. The results ascertained are that the views of von Baer and other earlier explorers that Novaya Zemlya is geologically connected with the Pai-hoi are correct only as regards the southern part and Vaigats; the northern part of the southern island, including both sides of Matochkin strait, show a north-westerly strike of the strata, therefore corresponding, not with the Pai-hoi, but with the Ural. The folding process in Novaya Zemlya coincided with the Palæozoic epoch, and from that time denudation forces have been at work. In this way the system of cross-valleys has been developed and the well-known Matochkin-shar formed. The glacial period in Europe was contemporaneous with that of Novaya Zemlya. This was followed by its submergence beneath the ocean, together with vast tracts of Northern Europe, Asia, and America. This submergence reduced the extent of the glaciers in the north or mountainous region, entirely obliterating them in the south, while the formation of deltas dates from the same period. Novaya Zemlya is now undergoing a new process of glaciation, which will convert it into an icy wilderness.

A paper by Mr. Leigh Smith was communicated, in which he recalled the circumstances of his first arctic voyages, when in 1871, 1872, and 1873 he cruised round the coasts of Spitsbergen and made numerous

temperature observations, discovering the fact that the water at a considerable depth was warmer than that near the surface.

Friday, August 20.—Prof. R. E. Dodge read a suggestive paper on Scientific Géography in Schools; and the Report of the Committee on Geography Teaching in the British islands, drawn up by Mr. A. J. Herbertson, was submitted to the meeting. A short discussion on educational geography followed.

Colonel Bailey read a paper on Forestry in India, in which he sketched the growth of the present system of forest conservation as practised there, and explained the special dangers which have been successfully guarded against, concluding by pointing out the great importance of placing the forests of Canada under a similar administration.

Dr. H. R. Mill suggested a scheme for the classification of geography primarily for bibliographical purposes, the details of which will appear in the *Journal*. A lively discussion followed, in which General Greely, Prof. Davis, and others took part.

Mr. Vaughan Cornish presented a most valuable contribution on the Distribution of Detritus by the Sea, in which he treated the question of the movement of gravel and sand by water in a manner similar to his recent discussion of the movement of dry sand by wind (see *Journal*, 1897, vol. ix. p. 278). The complete paper with illustrations will shortly be published in these pages.

Prof. Milne, F.R.S., gave an account of submarine changes involving earthquakes, and insisted on the importance of establishing seismological stations in all parts of the world.

The work of the day concluded with the reading by Mr. Ravenstein of an important historical paper on the explorations from the Congo to the Cape of Good Hope between 1482 and 1488, containing the results of some recent discoveries amongst old maps which throw fresh light on the character and attainments of Martin Behaim.

Monday, August 23.—The whole of this day was devoted to papers on the North American continent, most of which we hope ultimately to publish in full. At present it is sufficient to record the authors and titles: Prof. Marcus Baker on Institutions engaged in Geographical Work in the United States; Prof. F. H. Newell on the Hydrography of the United States; Dr. T. C. Mendenhall on the Geographical Work of the United States Coast and Geodetic Survey; Prof. W. Morris Davis on the Coastal Plain of Maine; Mr. C. E. Lumsden on the Unification of Time at Sea; Mr. J. B. Tyrrell on the Barren Lands of Canada; Prof. Willis L. Moore on the Daily Weather Survey of the United States; Dr. Charles D. Walcott on the Geographical Work of the United States Geological Survey; Mr. J. White on the Topographical Work of the Canadian Geological Survey. Prof. Davis, Mr. Lumsden, Mr. Tyrrell, and Mr. White read their papers personally; the others

were kindly brought before the meeting by General Greeley and Mr. W. J. McGee, representing the National Geographic Society of Washington.

Tuesday, August 24.—The proceedings opened with a crowded joint-meeting of the sections of Geography and Economics, to hear a paper by Mr. F. C. Selous on the Economic Geography of Rhodesia. At the conclusion of the paper, Mr. James Bryce said that if he differed from Mr. Selous in reference to any of his statements he would hesitate to express his opinions, because of the much greater experience which Mr. Selous had gained in his travels up and down the country from 1872 to 1896. He thought it right to tell the audience that some years ago Mr. Selous had formed a resolution not to kill more wild animals than necessary for the safety of life. This resolution was, he thought, commendable, and he wished others would follow the example, as he regretted that the wild animals which made the African forests and plains so interesting are in danger of extinction. Mr. Selous had justly laid especial stress upon the question of health, which is of vital importance in a country, because without health it would be useless to expect British settlers to go there. He was confident that before long it would be found that at all points 3500 feet above the sea-level the European settler would be able to locate with comparative freedom from fever. He was not without hope that such advance would be made in medical science that malarial fever would be overcome by inoculation or some other means. Regarding the prospective agricultural progress, he agreed with Mr. Selous that for the present at least there is no probability of that country exporting grain, although it may be able to supply all the food required by the people, but when the country has been restocked with, he hoped, a better breed of cattle, it will become a meat-exporting country. When the gold-mines run out, as they will probably do within thirty years, a very great stimulus will have been given to progress.

Mr. J. L. Myres gave an account of his recent journey in Tripoli, in the course of which he was led to form an opinion as to the age of the ancient buildings differing from that held by Mr. Cowper.

Prince Kropotkin read a valuable paper on the Prevailing Directions of the Mountain Ranges in Asia, and Prof. Penck discussed the importance of Potamology (the science of rivers) as a branch of geography.

Mr. E. L. Corthell sent a paper on the Geographical Development of the Lower Mississippi. Mr. Otto J. Klotz gave an interesting and well-illustrated discourse on Alaska, exhibiting the photographic surveying instruments used in the survey of the boundary. Prof. H. B. Dixon, F.R.S., who had just returned from a mountaineering trip in the Selkirks, announced his ascent for the first time of Mount Lefroy and another summit which he named Mount Aberdeen.

Mr. O. H. Howarth concluded the proceedings of the day with a paper on Mexico *felix* and Mexico *deserta*, terms which he applied to the southern cool and fertile, and to the northern hot and arid, divisions of the Mexican plateau.

Wednesday, August 24.—The section met in the forenoon, when General Greely read a paper by Mr. Henry Gannett on the Material Conditions and Growth of the United States, illustrated by an extensive series of statistical maps and diagrams.

Dr. H. R. Mill, speaking on Geographical Pictures with lantern illustrations, said that, in view of the prominent place now taken by photography in the work of all travellers, it is necessary to urge the importance of taking pictures which are geographically as well as photographically "good." Such pictures must be truthful and representative, the utmost care being taken to avoid distortion, to supply some indication of scale, and to bring out the characteristic features. General views comprehending a considerable area are desirable for showing types of land-forms or sites of towns. Pictures on a larger scale are desirable for showing the detail of special features, such as varieties of architecture, means of transport, or agricultural processes related to certain geographical conditions. As far as possible, every geographical picture should show something distinctly illustrative of a natural feature or a local condition peculiar to the place where it was made, or at least characteristic of it. The handsomest house in a village, the rarest foreign tree in a park, or the prettiest view in a district, represents the sort of subject most often photographed, and they are precisely those of least geographical value.

Prof. Penok followed with a demonstration of school wall-pictures, illustrative of typical geographical features.

Prof. W. M. Davis, in a brief address, urged the importance of Geography as a subject of University Study, and outlined his method of treating geography as a means of higher educational training.

The usual votes of thanks brought to a close a meeting of great interest, during which numerous subjects had been treated of in a manner at once more scientific and more concise than has usually been the case in the section.

Many papers bearing closely on various branches of Physical Geography were read in other sections, the enumeration of which may be useful.

SECTION A, Mathematics and Physics.—Report of the Committee on Seismological Observations; Prof. A. Johnson on a Canadian and Imperial Hydrographic Survey; Mr. J. Hopkinson on Monthly and Annual Rainfalls in the British Empire, 1877–1896; Prof. Van Rijkevorsel on the Temperature of Europe; Prof. R. F. Stupart on the Climatology of Canada; Mr. F. Napier Denison on the Great Lakes as a Sensitive Barometer; Dr. J. Edkins on the Slow Refrigeration of

the Chinese Climate; Prof. Percival Lowell on Atmosphere in its Effects on Astronomical Observations.

SECTION C, *Geology*.—Mr. J. C. Branner on the Former Extension of the Appalachians across Mississippi, Louisiana, and Texas; Report of the Committee for the Investigation of a Coral Reef; Prince Kropotkin on the Asar of Finland; Dr. G. K. Gilbert on Niagara Falls; Mr. J. B. Tyrrell on the Glaciation of North Central Canada; Report of the Committee for collecting Photographs of Geological Interest; and a joint discussion with Section H on the First Traces of Man in America.

SECTION D, *Zoology*.—Prof. Herdman on the Plankton collected continuously during a Traverse of the Atlantic. On the voyage of the *Parisian*, Prof. Herdman on one occasion treated the passengers to a plankton-stew, made up of the minute crustaceans caught in fine silk nets, through which sea-water was pumped continuously, as a demonstration of the unrecognized resources available for the nourishment of shipwrecked crews.

SECTION H, *Anthropology*.—Report on the North Dravidian and Kolarian Races of Central India; Report of the Committee on the North-western Tribes of Canada; Reports of the Ethnographic Surveys of Canada and of the United Kingdom; Prof. Putnam on the Jesup Expedition to the North Pacific, and a Report on the necessity of the immediate investigation of the anthropology of Oceanic islands.

On Saturday, August 21, there was an excursion to Niagara teeming with geographical interest, and on the conclusion of the meeting the Canadian Pacific Railway Company generously provided private cars and free passages for nearly one hundred members of the Association from Toronto to Vancouver and back. The party travelled in three cars on different days, stopping for twenty-four hours at several points, and were assisted in every way possible to form an opinion of the vast agricultural and mineral resources of the Dominion. The trips included a visit to the great nickel-mines at Sudbury, the new gold-fields of the Lake of the Woods, and of the Kootenay district, the coal mines at Nanaimo, and to ranches and experimental farms in several districts. The solid character of the great transcontinental railway, its luxurious equipment, and splendid management, impressed the visitors only less than the magnificent possibilities of the country, and the energy and order of those who are engaged in its development.

THE PHLEGRÆAN FIELDS.*

By R. T. GÜNTHER, M.A., Magdalen College, Oxford.

II.—THE MORPHOGRAPHY OF THE HILLS AND VALLEYS OF CAMALDOLI.

I. INTRODUCTORY.

THE region which is the subject of the present investigation is situated to the north-west of Naples, and occupies the north-east corner of the Phlegræan Fields. The highest point is by far the most conspicuous object in all comprehensive views of the Phlegræan Fields, towering up as it does half as high again as the next highest summit. Perched upon the most elevated part of the hill is the monastery of the Camaldulensian order of Trappists, from whom the hill receives its name of Camaldoli di Napoli.

The entire region is intersected by numerous paths and mule-tracks, which have for the most part become worn deep below the level of the surface of the country, so that the views seen by the wayfarer are usually much restricted. There are good though necessarily indirect roads both from Naples, Pianura, and Marano. Much of the more level ground is devoted to the cultivation of the same crops as are grown in the plains, and vines constitute the greater part of these. About one-half of the entire surface, including most of the steeper slopes, is covered with woods. In many places the vegetation is so luxuriant that it is far from easy to make out the shape of the terrain. The woods are chiefly composed of chestnuts, which are grown as a crop, their stems being cut at more or less regular intervals. Their mode of growth reminded me very forcibly of the beech copses which clothe the Chilterns in many parts of Oxfordshire, and which are also cut when the trees have reached a certain size. The general type of the vegetation might well cause the stranger from the north to imagine himself nearer his home. Along the sides of the deep-cut paths, and wherever light can penetrate to the ground, flourishes a more lowly but not less luxuriant growth of ferns, butcher's broom, brambles, and genista. In the spring the earth is gay with cyclamens, primroses, periwinkles, and scentless violets, which are replaced later by orchids and lilies. In the moister parts at the bottom of the valleys, the humid rocks give nutriment and support to many species of mosses, ferns, and liverworts.

The shape of this tract of upland may be described as an irregular oval, the major axis of which is about $6\frac{1}{2}$ miles long, and runs east and west. From the monastery of Camaldoli, built near the extreme south-west corner of the region, the ground slopes away on all sides more or less steeply, down to about the 150 or 100 metre contour-line, below which the slopes gradually subside into the general level of the plain of tufa known as the Terra di Lavoro.

The descent is of a very different character in the different parts. Towards the north the slopes are easy and uniform. From the north-west to the north-east of the monastery the sides of the hill slope away down to the plain, in which lie the villages of Marano, Mugnano, and others, with an incline varying from about 1 in 14 to 1 in 10 to the east. But on the other sides, and especially towards the south and west on either flank of the Pignatiello spur, the descent is abrupt and irregular. It is as much as 1 in 2, or even as 1 in 1.4 in some places (Map VIII.).

The steepest slopes lead abruptly down to the oval plain of the Quarto on the west, to the circular plains of Pianura and Soccavo on the south, and to the

* Continued from p. 435. For General Map (No. 1), see p. 464. On p. 417 of the October number, line 4 from the top, 59 should be 41.

plain of Naples on the south-east. Between or away from these the other slopes are far less steep.

II. GEOLOGY OF REGION.

The broader outlines of our knowledge of the geological structure of the hill of Camaldoli have been sketched by Dr. Johnston-Lavis in his note on the ancient lake of Pianura.

The foundation of the hill consists of a volcanic rock, which is quarried at Pianura as building-stone, and which is known by the name of piperno. Upon this is a coarse breccia ("museum breccia"), composed of a miscellaneous assortment of blocks of lava, tuffa, pumice, and other materials. This underlies a great thickness of a more homogeneous, compact rock—the ordinary yellow tufa of Posilipo, which is capped by the series of beds of pozzolana and pumice forming the upper superficial layers of the hill. The existing topographic detail is sculptured in the yellow tufa and superincumbent pumice beds, and it is owing to the want of coherence of the materials of which these superficial layers are composed, that they offer but little resistance to the forces of denudation, and permit themselves to be carved into the ridges and valleys which are so marked a physical feature of the hill.

In some parts the tufa is traversed by vertical veins of a harder and less easily erosible rock. These veins seem to be of rather a local character, but where they occur they modify the process of valley-cutting, always by checking the rate of erosion, and sometimes by causing the bed to deviate from its natural course.

Their presence in the tufa at San Rocco near Capodimonte has already been remarked by Tenore, whose attention was called to them by Buckland. I have observed these veins in the northern part of the hill traversing the beds of the Vallone di Sagliscendi, Palmentello, and Fontana Maltempo. They extend like dykes in a more or less vertical plane for many yards. Their thickness varies from 3 feet to as many inches, and the same vein may vary in thickness in different parts, but is usually thickest in the middle, thinning out towards the ends until it gradually disappears altogether. Their orientation is generally within 20° of the meridian. Sometimes two may be seen close together, separated by but a few inches of ordinary coarser tufa. Their texture is firmer and more compact than that of tufa.

In order to try to discover the explanation of these veins and of their hardness, I had some thin sections cut, which show that they are composed of the same material as the tufa matrix, but in a far finer state of subdivision. A further proof of their similarity is afforded by the chemical analysis, which my friend Mr. Manley has been good enough to undertake for me.

Solubility in water.	Ordinary tufa.		Tufa of vein.	
	Per cent.	Per cent.	Per cent.	Per cent.
1. In native state	19.50	19.61	19.50	19.61
2. After being dried and ignited	3.72	3.81	3.72	3.81
Loss of weight at 100° C.	7.05	5.53	7.05	5.53
Loss of weight at red heat	8.73	10.38	8.73	10.38
SiO ₂	54.16	51.05	54.16	51.05
Fe ₂ O ₃	3.55	4.83	3.55	4.83
Al ₂ O ₃	17.36	16.86	17.36	16.86
CaO	3.84	2.31	3.84	2.31
MgO	1.20	1.41	1.20	1.41
K ₂ O	3.48	6.26	3.48	6.26
Na ₂ O (by difference)	0.63	1.37	0.63	1.37
	100.00	100.00	100.00	100.00

The analyses were made in platinum vessels throughout.

Tenore was unable to perceive the least appearance of infiltration or any line of demarcation between the tuff and the veins, and stated that their composition differed in the absence of pumice fragments and in the finer nature of their grain.

My own sections show a very sharp line of demarcation between the tuff and the vein. An examination of several of the veins has convinced me that the only probable explanation is, that they are the result of fissures in the tufa due to earthquakes, shrinkage, or some other cause. These fissures have become filled with a mud of minute fragments of tufa, washed in by rain-water from the surface or down from the sides of the fissure. The mud became consolidated and hardened to form a rocky vein compacter than the ordinary yellow coarse-grained tufa, which it traverses, by reason of the finer subdivision of the particles of which it is composed.

Cracks in the tuff are not unfrequent, and, when near the surface, often become filled with earth and fragments of sticks and leaves.

III. DISTRIBUTION AND DESCRIPTION OF CATCHMENT AREAS AND THEIR DRAINAGE CHANNELS.

A contoured map of Camaldoli (Map I.) shows that the chief slopes of the hills are of two kinds. Some slopes are like the outer surfaces of cones, others are like the inner surfaces of funnels. The former will be referred to as *cone-slopes*, the latter as *crater-slopes*, in all cases in which the evidence seems to point to their once having belonged to a volcano. The rain-water which flows over the surface of these slopes is carried off by channels, which may be conveniently referred to as *cone-valleys* and *crater-valleys* respectively.

The catchment areas may be very naturally classified according to the slopes down which their drainage channels run, and they will be referred to by the name of the basin which receives their drainage. Of the chief groups of catchment areas, four are drained by crater-valleys, one by cone-valleys; but, owing to the large size of the latter area, and also to the fact that its drainage flows towards two different points of the compass, it will be regarded as two.

The chief catchment areas are—

- | | | |
|-------------|---|------------------------|
| 1. Quarto | } | crater-drainage areas. |
| 2. Pianura | | |
| 3. Soccavo | | |
| 4. Naples | | |
| 5. Northern | } | cone-drainage areas. |
| 6. Eastern | | |

The crater-slopes face to the west and south, the cone-slopes to the north and east.

The four crater-areas drain into four crater-plains of the same name, and are separated by three short ridges or spurs from another. The Quarto-Pianura ridge is that on which the Masseria Romano stands, and is marked Olmetello Romano* on the older maps; the Pianura-Soccavo ridge is known as the Pignatiello, immediately below the monastery; and the Soccavo-Naples ridge, which is continuous with Posilipo hill, bears the village of Vomero and the fortress of San Elmo.

A noteworthy feature is that crater-valleys differ as regards their distribution from cone valleys, in that the lines of their courses tend to converge when produced

* Olmetello = elm-wood.

downwards from their source, whereas the lines of the courses of cone-valleys tend to become divergent when traced in the same direction.

CRATER-DRAINAGE.

The western drainage is conveyed by a number of channels, either into the Piano di Quarto, or else into the small plain lying immediately to the east of the Cratere di Campana, and between the craters of Astroni and Quarto. These two catchment areas are separated by the ridge of hills upon which the Torre Poerio stands, and they may be conveniently termed the Quarto and the Campana catchment areas respectively.

The Campana area is insignificant. The rain-water mostly runs straight down the very steep slopes, and streamlets do not become sufficiently large to effect land-sculpture of any very considerable relief. In this respect the area is somewhat similar to the sides of the Pignatiello. At present the Campana basin also receives the drainage of the northern slopes of Astroni, the eastern slopes of the Cratere di Campana, and from Torre Poerio. The water all sinks away through the permeable soil, but it is not improbable that, if the land-level were to become lower, a lake might be formed similar to that which once existed on the plain of Pianura.

1. *Quarto Catchment Area.*

The eastern part of the Piano di Quarto is cradled in a semicircular amphitheatre of hills—the western rampart of the Camaldoli massif—which are deeply seamed with a system of crater-valleys radiating from the eastern focus of the elliptical Piano di Quarto. The valleys, as is usually the case on steep slopes, for the most part run straight, or, if they branch, the branches tend to run parallel to one another.

At the level of the 100-metre contour-line about twenty-one main valley-beds may be distinguished. The areas drained by these are for the most part very small and of uniform length, with the exception of two. The watershed of the Quarto basin is no further than 1750 metres from the margin of the Piano di Quarto, except at the head of the two valleys, the Vallone di Pietra Spaccata (No. 13) and the Vallone Piscicelli (No. 17), both of which have come to drain larger areas than their neighbours, have cut their beds further back, and have watersheds at a distance of 3500 metres and 2250 metres respectively from the Piano di Quarto. The drainage-area of the Vallone di Spaccata is the largest of the Quarto system, and is remarkable on account of its narrowness as compared with its length. About halfway along its course, near the little chapel of Santa Maria di Pietra Spaccata, the valley scenery is very bold and striking. Vertical rocky walls fall on either side with an abruptness that justifies the name of the valley; below, the torrent bed cannot be descended without ropes, on account of a succession of waterslides and falls.

The watershed between Nos. 19 and 20 is lower near the end at which it joins the main watershed of the Quarto system than nearer the Piano di Quarto. Between these valleys is a conspicuous isolated hill known as the Cuccaro, which probably owes its origin to the valleys on either side of it having widened their beds near their source. No. 21, too, seems to be about to meet the valley on the Pianura side. At present there is only a ridge and a narrow roadway between the chasms with which these two valleys suddenly begin; but in a few years it seems likely that the land upon which the Casa di Gregorio stands will be left as an isolated peak like Monte Cuccaro.

The storm-water which runs down into the Piano di Quarto, and which cannot sink into the soil, is collected into several artificial land-drains, which unite and discharge into the underground tunnel (*Galleria*), which pierces the hills to

the west of the Quarto near the Spinelli. The other end of the tunnel opens into the Canale di Scolo. By this artificial channel the Quarto drainage is finally conveyed to the sea near the north end of the lake of Licola.

Before this underground drain was cut, the plain of the Quarto was a marsh during a great part of the year, and was probably covered by a large lake when the ground was nearer sea-level than it is at present.

2. *Pianura Catchment Area.*

The best views of the system are to be had from above the Canello or from the Pignatiello. The catchment area is a semicircular basin forming part of an almost circular crater 3 kilometres in diameter, whose centre lies about 500 metres to the south-west of the church in the middle of the village of Pianura. The walls of this crater reach their greatest altitude in the north-east at Camaldoli (Fig. 10), where their height has, perhaps, been much augmented by ejectamenta from the neighbouring crater of Soccavo. To the west the crater wall becomes lower, and finally breaks off altogether at the Canello. The southern wall is low (50 metres above the plain), but quite easily recognizable. It has been suggested that it was levelled by the removal of matter from its south side by marine erosion when the level of the Phlegræan Fields was lower. None of the valleys have encroached perceptibly on the adjacent areas, with the exception, perhaps, of No. 6.

Eleven drainage-areas are distinguished in Map V. A channel in area No. 1 is rapidly cutting its way back, and shows every sign of meeting Quarto valley No. 19, from which it is now only separated by the width of a road. Parts of No. 11 area, on the west of the Pignatiello ridge, are precipitously steep in places; the rest is overgrown with chestnut woods. The rain-water runs straight down the hillside in channels, which are very small and very numerous. Erosion appears to be going on over the entire surface, and to be removing the entire face rather than to be acting with greater effect along certain definite lines.

At the bottom of the slope is a trench into which the storm-waters flow, and by which they are conveyed out of the plain of Pianura.

The general character of the Pianura slopes is that they are much steeper in the middle than either at the top or bottom. Were a transverse section cut across the slope below the monastery, it would be seen to be markedly sigmoid \int . This is due to the fact that the upper slope is composed of loose volcanic ash of insufficient cohesive power to form a long steep slope of a stable character, whereas the precipitous middle portion is composed of compact yellow tufa. The lower concave slope is a talus slope, due to the weathering of the surfaces above.

Owing to the fact that the wall of the Pianura crater is higher to the east at Camaldoli than to the west at the Canello, the valley beds and ridges between them exhibit a marked curve from east to south in their downward course. They all trend towards the higher ground when traced upwards to their sources, involving a change of direction of almost 90° in some cases (Nos. 6 and 9).

3. *Soccavo Catchment Area.*

The Pignatiello ridge (Fig. 10) is the western watershed of the Soccavo area; the eastern watershed is formed by the high ground running from Li Cangiani to St. Elmo and the hill of Posillipo. The Soccavo catchment area, like Pianura, is regarded as the inner slope of a crater, the southern parts of which may have been washed away by the sea. It is possible that the spur of the Posillipo ridge to the north of Fuorigrotta and west of the Villa Patrizi may be a part of the southern wall of the crater of Soccavo.

The valleys which furrow the slopes above Soccavo have cut their beds very deeply into the tufa. The descent to the plain of Soccavo is very steep in places, and the valley cuttings are especially bold.

Of the Soccavo valleys, the most typical are the Vallone Castelluccio (No. 2) and Vallone Verdolino (No. 3). Both take their rise just below the monastery, and run east for some distance; then they turn at right angles to their first direction and run south. The upper portions of the valleys are V-shaped, with sloping tree-clad banks of pumice and ashes. The lower portions have been deeply cut into the solid tufa, and are Y-shaped in transverse section. The tree-clad slopes above, and the almost vertical tufa cliffs below, are well shown in Fig. 12. All the valleys discharge into a watercourse, "l'Arena," which crosses the Soccavo plain, and receives contributions from the western slopes of the Vomero and Posillipo.

A noteworthy feature of the Soccavo valleys is that those which reach the principal watershed (Orsolona-Soccavo watershed) run parallel to it from west to east, away from the Pianura crater. They then veer round to the south, and

Posillipo ridge.



FIG. 12.—VALLONE VERDOLINO, JUST BEFORE REACHING THE SOCCAVO PLAIN.

plunge straight down the steep inner wall of the Soccavo crater. In fact, they at first seem to run down an external slope of the Pianura cone, and then to be diverted into the crater-slope of Soccavo.

4. *Naples Catchment Area.*

The Neapolitan drainage area lies for the most part on a curved hillside extending, like the auditorium of a vast theatre, from the Li Cangiani St. Elmo watershed on the west to the observatory ridge below Capodimonte on the east. The sides of the hills slope gently down into the plain on which Naples is built, from a height which is never much more than 150 metres. Denudation has consequently not had as great a scope as on the other slopes which have just been described. Moreover, owing to the proximity of the Neapolitan drainage area to a large town, the natural drainage channels have been very seriously tampered with, according as the needs of agriculture or the construction of roads and buildings might require.

The chief of the drainage areas discharge their waters into the channel which

divides the city from Capodimonte. Although modern drainage has diverted much of the storm-waters from their natural course, yet it is interesting to note that the old sandy stream-bed is marked out at the present day by such street and place names as Fontanelle, l'Arenella, San Carlo all'Arena, Strada dell' Arenaccio, which indicate the position of watercourses as clearly as l'Arena does that of the stream-bed crossing the Soccavo plain.

CONE-DRAINAGE.

The system of valleys draining the north and east sides of Camaldoli differs from the other valley systems in one important respect. The northern drainage area is the convex outer surface of a cone standing on its base. The other drainage areas or crater areas are the concave inner surfaces of hollow cones standing upon their apices. The effect of this difference being to cause the lines of the beds of the southern and western valleys to tend to converge when produced downwards, and those of the northern valleys to tend to diverge when produced in the same direction.

The storm-waters from the catchment area of the cone-slopes drain partly into the bay of Naples, partly outside it, so it may be subdivided into two catchment areas of almost equal size. The more northern portion is drained by a number of valleys running northwards; the other is drained by a single valley (Vallone di Sagliscendi), which runs east for a considerable distance, but finally turns south (*cf.* p. 429).

5. Northern Catchment Area.

The northern catchment area is about three times as large as any one of the intra-crater areas, but its slopes are far less steep. The surface water runs in a more or less northerly direction along a series of valleys, which discharge on to the flat plain of the Campagna Felice. Much water sinks into the soil; the rest is carried away westwards to Patria by a system of channels, of which the Cavone Grande is the largest. Many of these land drains for storm-water have been straightened and deepened artificially,* with corresponding improvement in the sanitary condition of a district which must have been a marsh during a great part of the year.

The largest valleys, V. Palmentello and V. della Fontana Maltempo, drain a large pear-shaped area and unite to form the V. Cesinelle, which discharges its waters into the Vallone di Teresa below the villages of Chiajano and Polvica. An elevation of the bed of the Vallone Palmentello is shown in Map VII.

6. Eastern Catchment Area.

The eastern portion of the cone-slopes of Camaldoli are drained by one large valley and its tributaries. Different parts of this valley are locally known by different names, but the entire system will be referred to here by the name of its most important section—the Vallone di Sagliscendi.

The head of the valley lies close to the village of Nazaret, below which a few small V-shaped valleys run eastwards to the south of Li Guantari, and open into the deeper channel of the Vallone Orsolona, which lies to the south of the Masseria of the same name, and receives all the surface drainage south of the new carriage road from Li Cangiani to Nazaret. At the point where this road crosses, near Li

* Domenico Fontana, the architect, superintended the construction of a system of drainage channels, or *lagni*, extending from the Bocchette di Nola to the Lago di Patria. Carletti estimates the length of the *lagni* at 32 miglia (= 59·3 kilometres), and their vertical fall at 132 palmi (= 34·9 metres). The works were finished in 1612, five years after the death of Fontana.

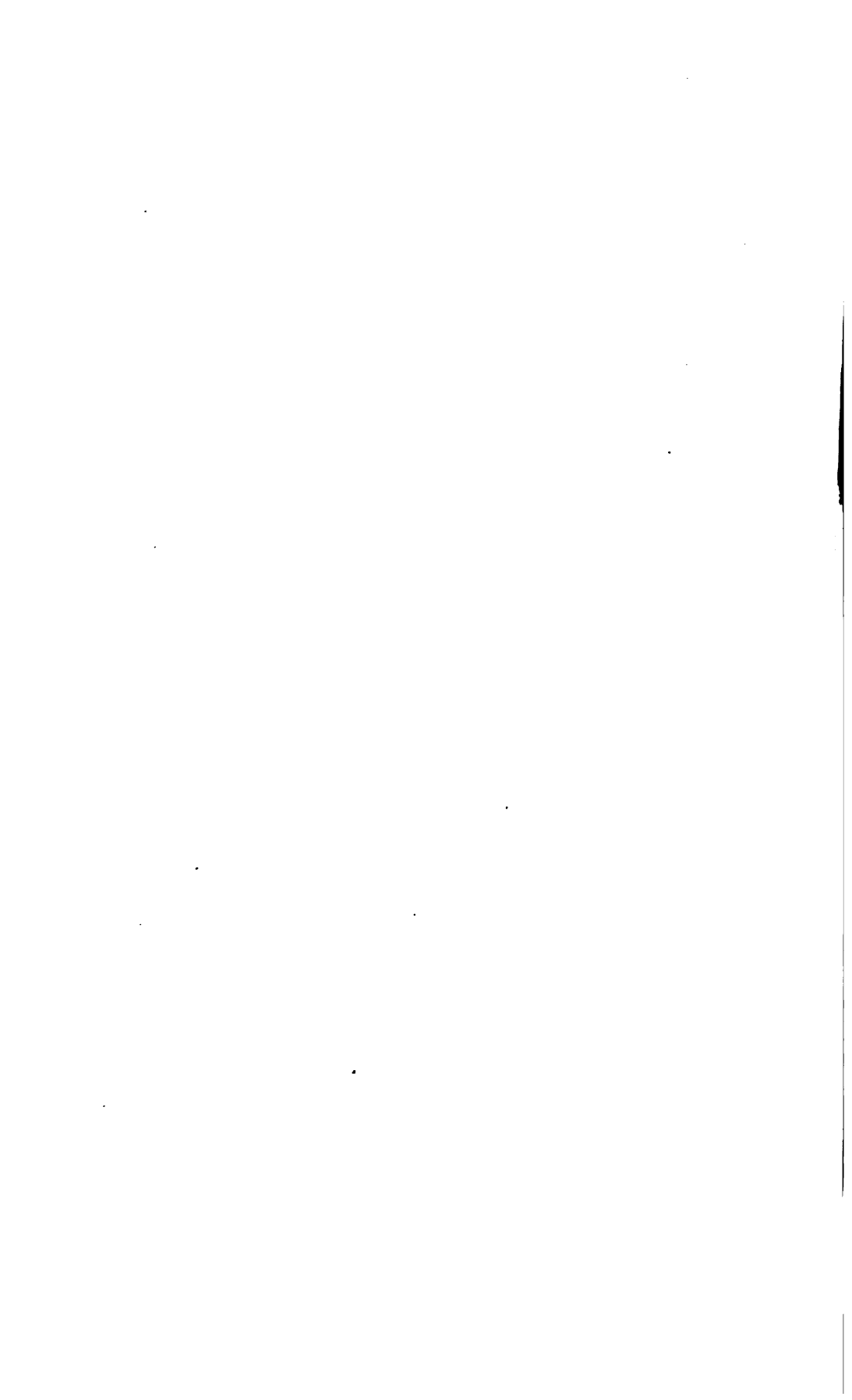
Cangiani, the valley becomes broader, more open, and less deeply cut. After making two sharp turns to the north, it plunges down into a deep canyon-like cutting in the solid tufa, which is known by the name of the Cavone delle Noce, from the nut trees which flourish in great numbers on the less precipitous upper slopes (Fig. 13). The bed has been cut to a depth of quite 40 metres, and is so narrow that in many places it is impossible for two persons to proceed abreast, and so tortuous that the view along the bottom is interrupted by a turn every few feet. The bed itself is broken by series of small vertical falls alternating with level sandy reaches of greater or less length. Occasionally the *débris* of a landslide from the side blocks the channel, and breaks the velocity of the torrents sufficiently to allow part of their load of suspended matter to be deposited above the obstruction. Some of the larger waterfalls owe their origin to transverse dykes of the harder tufa already described (p. 478), which stretch transversely across the bed, and which are not



FIG. 13.—UPPER SLOPES OF THE CAVONE DELLE NOCE.

quite so readily worn away as the softer tufa. These dykes help to support and preserve the softer tufa above. Below each is usually a depression or pocket in the soft tufa, cut by the force of the water falling vertically from above. Four of these dykes occur in a space of 800 metres, and a little further down, below a transverse wall, the bed has actually been diverted to the north by a large vertical dyke, which forms the face of a high vertical cliff on the right bank. After cutting through this, the valley becomes more V-shaped. Below the *Masseria del Principe*, the bed has been artificially widened by quarrying operations. At the upper end of the quarry are two more transverse dykes running across in a north and south direction. The lower one, which is probably the one referred to by Tenore and Daubeny in their descriptions of the hard variety of tufa, has been cut away on both sides, leaving a column standing alone just below the entrance of the valley bed into the quarry, and in a line with some enormous artificial caves, from which the tufa is being extensively quarried for building purposes.





Below the quarry the valley changes its character once more, and becomes open and V-shaped in cross-section. At the point where it is spanned by the Ponte di San Rocco it turns north, and after receiving the Vallone del Boscarello, it resumes its eastward course below the north wall of Capodimonte park as the Cavone di Miano. Finally it makes a sharp turn to the south, and soon reaches the plain near the Ponti Rossi. During the last part of its course as a deep valley it receives many tributaries, of which the Vallone Cappuccini, from the northern part of the park, is the most important (*cf.* p. 429).

GRAPHIC AND NUMERICAL REPRESENTATION OF VALLEYS AND CATCHMENT AREAS.



In order to afford a means for the comparative study of the leading features of the Camaldoli valleys and drainage areas, both by themselves and together with those on other volcanic slopes, the appended tables of measurements and diagrams were prepared from the data at my disposal. Inasmuch as many of my own surveys are not in agreement with the Italian Ordnance Surveys as represented in the 1885 map, I believe that there are considerable errors in that map, and consequently both my diagrams and measurements, which are primarily based on that map, must be taken rather as illustrating a method than as being records of the absolute facts.

The numbers in the first column refer to the catchment areas indicated by similar numbers on the map. In the delimitation of these areas, I have, so far as the larger valleys are concerned, limited the area to the region drained by the valley and its tributaries. In many cases, notably on steep hillsides, an area is drained by a multitude of small channels running more or less parallel to one another, and I have thought it best to avoid too extreme a subdivision by making the numbered catchment area fairly inclusive.

The second column gives the sizes in hectares of these arbitrarily numbered catchment areas, measured on a map by Amsler's planimeter. The areas are considered to be bounded by the limits of the adjacent areas, and by the contour-line specified at the head of each table.

In the third and fourth columns are the length and amount of fall of each valley, when straightened out and measured from the source to the contour-line specified at the head of each table.

The valleys shown in the diagrams (Map VII.) were drawn as if their beds ran in the same vertical plane from end to end without any bends. The straightened bed of each was plotted so that each part is represented at its proper height above sea-level, as indicated by the vertical scale. Above this valley-bed line was added a second, the mean bank line, whose vertical distance above the valley-bed line represents the mean height of the banks of the valley above the bed, and drawn to the same scale. In short, the upper line represents the slope of the hillsides, though not always on a regular scale; the lower line represents the bed of a straightened valley. Consequently, the area included between the two lines serves as an indication of the amount of erosion which the stream has effected. For this area I have proposed the term of *erosion area*, although *longitudinal erosion area* would probably be better, and would distinguish it from a transverse erosion area. The last column of the tables gives some of the relative dimensions of the erosion areas of the valleys, plotted and measured with Amsler's planimeter.

In practice the mean bank line was arrived at by the following process. Map VI. was produced from the ordinary contoured map (I.) by the process of "smoothing" out the hollow curves due to valley erosion. This was done by drawing lines ——— across the concavities  of each contour-line,  The result is shown in Map VI., which is supposed to represent the shape of the

hill before denudation commenced. Such a smoothed contour-map was drawn on tracing-paper and superimposed upon the ordinary contoured map. The difference of height between the smoothed contour on the tracing-paper and the lowest real



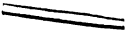
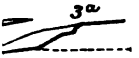
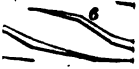
FIG. 14.—BED OF THE CAVONE DELLE NOCE.

contour-line on the ordinary map touching it was estimated and plotted in the longitudinal valley sections on Map VII. Although a difficult process to describe, it is in fact essentially that employed for finding the depth of a valley indicated in contours.

I.—QUARTO VALLEYS.

AREAS ABOVE THE 70-METRE CONTOUR-LINE.

No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	Hectares.
1	3.4	600	80	—
2	4.0	600	80	—
3	8.0	600	80	—
4	8.0	700	80	—
5	22.4	600	90	1.0
6	16.4	600	110	1.1



ces

Q₂

Piano di Quarto



ces

Piano



Univ. of California, Berkeley



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No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	Hectares.
7	10.8	600	120	0.6
8	8.8	650	130	0.4
9	14.8	750	150	0.9
10	10.0	750	150	0.7
11	8.2	800	160	0.6
12	10.2	800	160	0.8
13	75.0	3200	320	6.2
14	9.6	800	200	0.7
15	14.6	950	220	1.0
16	27.8	1250	260	2.8
17	53.6	2050	290	5.4
18	16.0	720	140	—
19	28.0	1500	210	2.2
20	34.8	1130	210	1.6
21	39.6	1200	210	2.6
424.0				

II.—PIANURA VALLEYS.

AREAS ABOVE THE 200-METRE CONTOUR-LINE.

No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	Hectares.
1	20.0	400	90	3.0
2	8.8	480	80	1.2
3a	4.8	450	80	1.1
3b	6.8	420	75	1.3
3c	10.2	520	110	1.8
4	11.0	640	160	2.4
5	2.0	280	90	0.9
6	20.8	760	170	6.3
7	4.4	480	140	2.2
8	16.8	1030	200	2.4
9	10.8	690	220	1.7
10	7.2	570	220	0.9
11	45.6	420	250	0.8
169.2				

III.—SOCCAVO VALLEYS.

AREAS ABOVE THE 150-METRE CONTOUR-LINE.

No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	Hectares.
1	40.4	500	300	—
2	13.6	1050	300	4.6
3	58.8	1600	300	—
4	5.6	330	120	0.6
5	12.4	900	160	3.1
6	1.0	00	100	—

AREAS ABOVE THE 200-METRE CONTOUR-LINE.

7a	14.4	1040	130	2.4
7b	24.4	1650	150	2.0
8	38.8	900	100	2.4
220.4				

THE PHLEGRÆAN FIELDS.

IV.—NAPLES VALLEYS.

AREAS ABOVE THE 100-METRE CONTOUR-LINE, EXCEPT 1, WHICH IS ABOVE 180 METRES.

No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	Hectares.
1	32·8	950	90	—
2	28·0	860	160	—
3	6·2	520	120	—
4	36·4	1100	170	3·3
5	30·0	1220	165	1·5
6	12·0	700	100	—
7	5·6	350	60	—
8	30·4	1450	150	2·45
9	24·8	700	90	—
10	7·2	200	50	—
	213·4			

V.—NORTHERN VALLEYS.

AREAS ABOVE THE 200-METRE CONTOUR-LINE.

No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	
1	10·8	550	20	—
2	62·4	1450	140	—
3	36·8	1475	140	—
4	17·2	500	60	—
5	24·0	1130	130	—
6	10·0	620	110	—
7	28·8	510	100	—
	AREAS ABOVE THE 180-METRE CONTOUR-LINE.			
8	46·0	1430	150	—
9	58·8	1980	170	—
10	6·0	420	30	—
11	14·0	820	70	—
12	197·0	2600	220	—
13 }	32·8	300	20	—
14 }		980	120	—
15 }		760	100	—
16	19·6	690	60	—
17	27·6	940	60	—
	616·6			

VI.—EASTERN VALLEYS (V. DI SAGLISCENDI).

AREA ABOVE THE 30-METRE CONTOUR-LINE.

No.	Drainage area.	Length.	Fall.	Erosion area.
	Hectares.	Metres.	Metres.	Hectares.
1	584·2	10,500	400	34

RELATION OF DRAINAGE AREA TO EROSION AREA.

Among other interrelations exhibited by the numbers expressing the main features of the valleys, there is one which is strikingly prominent in the tables above. It will be noticed at once that the erosion area of a valley stands in a direct and definite relation to its drainage area; in fact, that the ratio of the number expressing the erosion area to the number expressing the drainage area is a constant for the majority of the valleys belonging to the same system.

The chief causes which affect the course and structure of valleys are, the time during which the forces of denudation have been in operation, the inclination of the slope, and the nature of the rock in which the valley has been cut. In the region under consideration, the texture of the rock, apart from local variations, is on the whole uniform, and it seems probable that no part has been subjected to denuding forces longer than any other part.

The chief cause of variation, therefore, is to be sought in the varying steepness of the slopes. Hence it seems probable that the law is true that if *all other conditions, whether of age, rocks, or slopes, are similar, the drainage area of a valley is in a constant proportion to the erosion area.* The ratio of the drainage area to the erosion area may be called the *index of erosion* of the valley.

In the case of the Quarto valleys, the average index of erosion is less than the corresponding index of the Pianura valleys, but this seems to be due to the fact that the latter have on the whole a greater fall in proportion to their length. The Pianura average index of erosion is 5·2,* the Quarto index is 15·4, and the index of erosion of the Vallone di Sagliscendi is 17·2.

IV. EXPLANATION OF STRUCTURE.

It now remains to inquire into the causes to which the topographical aspect of the region owes its character, and to endeavour to ascertain how far and in what proportion such forces as are at work at the present day have contributed to produce this character.


The processes which have co-operated to produce the present configuration of Camaldoli, may, to borrow from the terminology of the biologist, though that terminology might be used more appropriately by the physical geographer, be regarded as anabolic and katabolic. The anabolic processes to which the hill owes its construction are practically dormant at the present day. The katabolic processes, on the other hand, are in full operation, and will in time effect the destruction of the hill.

The method of comparative geology teaches us that the entire mass of Camaldoli is due to a succession of volcanic outbreaks. Each eruption in turn has hurled its contribution of ashes, lapilli, and dust all around the central vent, and has thus built up a more or less circular rampart. Wherever a segment of one such rampart intersected and became superimposed upon some of the ejectamenta from an adjacent vent, a larger mound was heaped up, which, owing to its larger bulk, offered far greater resistance to the wear and tear of katabolic forces than the smaller segments compiled solely from the ejectamenta from a single vent. It is to this intersection and overlapping of the ramparts of *débris* shot out from some of the most productive volcanic vents in the Phlegræan Fields that Camaldoli owes its pre-eminence.

Its original foundations may have been laid by volcanoes of which the walls have become obscured beyond all possibility of recognition, but by far the greatest

* Excepting No. 11, which is drained by many channels.

portion is the result of the accumulation of *débris* ejected from the craters of Quarto, Pianura, Soccavo, and Naples, which, though not the only, are at any rate the most recognizable centres of volcanic activity in this part of the Phlegrean Fields.

The fact that there is a greater accumulation of ejectamenta to the northern side of these craters is partly due to their arrangement in an arc of a circle whose centre lies to the north, thus , partly, perhaps, to the erosion of the southern walls of the craters by the sea.

When the shape of this enormous volcanic mass is studied on a contoured map (VI.), on which the bends of the lines representing valleys due to denudation have been filled in as described on p. 486, it will be seen that its general configuration is by no means inconsistent with the view just given. A regular series of contour-lines will be seen descending from the highest point. Their regularity would probably have been marred had there been any comparatively recent volcanic vents further north than those mentioned.

In addition to the contributions from Quarto, Pianura, Soccavo, and Naples, no doubt others have been able to reach it from Agnano, Astroni, Fossa Lupara, and perhaps Cigliano during their more violent eruptions.

NATURE OF MATERIAL—CHARACTER OF ROCKS, ETC.

The chief geological formations traversed by the valley systems of Camaldoli have already been noticed; there still remains the consideration of those inherent qualities of soils and rocks which have hindered or favoured katabolic processes.

It has been stated that the hills are composed of a solid tufa basis or core, capped by strata of loose ashy materials. The upper layers consist of alternating beds of loose ashes, pumice, and pozzolana of the most readily erodible kind. The fragments possess no sort of coherence. Their very arrangement in layers of larger and smaller sized fragments is a source of weakness, and the individual particles are so light as to be very easy of transport by running water—many will actually float on water. Owing to this want of coherence, during the heavy winter and autumn rains landslips are of frequent occurrence. As the beds of the water-courses are being eroded, their sides are being undermined, or, at any rate, rendered less secure. Every now and again the cohesive forces are overcome, and the entire bank slides down into the bed of the stream, leaving a bare scar. With the intention of ascertaining the angle of inclination at which a bank composed of loose ashes tends to slide, I measured the inclination of several fresh scars on the sides of the Palmentello and Vajetano valleys, and found that they were all of a remarkably uniform angle. The five measured were 50°, 53°, 53°, 55°, and 57°; the average angle of slip, therefore, being between 53° and 54°.

On the other hand, the open and broken nature of a soil composed of such ashes and pumiceous fragments makes it very difficult for streams to form on the surface, owing to its great absorptive power and excellent drainage. It is only when the ash surface is much inclined or has the interstices between its particles choked by a fine tilth so that its drainage becomes impaired, that rain-water can collect and form streams running on and capable of eroding the surface.

As a result, only the very heaviest of rains produce streams on the more inclined surfaces; but when such streams do form, they wash out channels in the ash beds very readily.

The truth of this is demonstrated when the absorptive power and drainage of the surface is in any way interfered with. In many parts the natural surface is able to get rid of all the rain-water which falls upon it by imbibition. No surface

streams are formed. No drainage channels are eroded. Now, it often happens that when a road is made across such a surface, the part covered by the roadway becomes almost impervious. The rain-water collects and runs along the roadway, forming a streamlet which, striking off, runs down an adjoining slope with sufficient force to cut quite a considerable valley in a short time.

When a drainage channel has once been cut to a certain depth, a stream will flow along its bed after a less heavy shower of rain than is required to make a stream run over the surface; and the deeper a valley bed is below the level of the land, the less rainfall is required to produce a stream in it, for the reason that the good drainage of the ash beds permits the water in them to percolate freely and sink into any drainage channel in the immediate vicinity.

Underlying the ash beds is the more compact tufa. Although far inferior to the ash beds, its absorptive power when dry is very considerable, and it can also imbibe water with great rapidity.

The great porosity of dry tufa may be demonstrated by dropping a piece into water. The water on entering drives the air from the pores of the rock with such vigour as to cause it to hiss or sing like a fluid in brisk effervescence. Hard tufas do not absorb as much water as softer ones, nor do they become completely saturated as quickly. The mean of the results obtained from a number of experiments upon tufa from different localities was that soft tufa absorbed about 22 per cent. of its weight of water when immersed for an hour. Hard tufa only absorbed about 12 per cent. of its weight under the same conditions. It should be stated that no attempt had been made to use chemically dry tufa for these experiments. The blocks had only been kept in an ordinary dry place for some time, and were therefore in a somewhat similar condition to the surface of a tufa rock at the end of the dry season.

In order to form some conception of the rate at which absorption proceeds, fragments of tufa were totally immersed for a short period, and were then taken out and examined. If the surface of the rock appeared to become dry almost directly after its removal from the liquid, it showed that superficial saturation was not complete, and the fragment was immediately plunged into the water for a second period. This process was repeated until the fragment preserved a wet appearance for a couple of seconds after removal from the water. The superficial saturation point was then considered to have been reached. Fragments of about 300 grammes were found to require quite five minutes' soaking before they became superficially saturated as indicated by the above test.

From these experiments it would follow that, unless showers are of phenomenal heaviness, they must continue for a long time before clean dry tufa becomes sufficiently saturated to allow water to run over its surface, even when that surface is inclined at a considerable angle. If the surface is much broken up, the time required for superficial saturation will be greater in proportion as the area of the surface is more extensive.

Unfortunately, my observations on the spot are too incomplete to afford any data concerning the rate of surface saturation during a shower, but I have since conducted a second series of experiments bearing upon this point.

A block of dry tufa with a flat upper surface of 60 square centimetres was placed below an ordinary chemical burette arranged so as to deliver a measurable quantity of water drop by drop on to the surface of the block of tufa. The experiment was conducted so as to imitate a shower of rain, and the block was kept moving so as to prevent two consecutive drops falling on the same spot, and to ensure the even distribution of the water all over the surface. The result obtained from the experiments was, that when as much water as would correspond

to 0·5 centimetre of rain in three minutes had been allowed to fall slowly drop by drop on to the stone, the water was found to have penetrated about 1·5 centimetre below the surface. The tufa, however, continued to absorb water with diminishing avidity until an amount corresponding to 1 centimetre of rain had been delivered. At this point surface saturation became complete, and the water ran freely over the surface.

The conditions affecting the above experiments are, of course, very different to those ordinarily obtaining on the slopes of Camaldoli. The experimental block had a clean, freshly broken surface. If the rocky hillsides were in the same physical condition, it is very doubtful whether streams could ever collect on them at all. The rock faces in their natural state are generally clothed with more or less low forms of vegetation, and their pores are choked with mud and dirt to such an extent that the absorptive power of the rock is far less vigorous than in the case of the experimental block.

As compared with the superincumbent ash beds, the tufa possesses a coherence which makes it more difficult of erosion, but, on the other hand, its compactness impairs its drainage power, with the result that streams begin to form and flow over its surface after less rain has fallen. When dry it possesses a very considerable absorptive power, but its lowlying position nearer the water-level results in its generally holding a large quantity of water absorbed in its pores, and in its appetite for much more being thereby blunted.

In texture it is fairly uniform, but here and there occur local variations of sufficient importance to affect the ordinary course of valley formation. The chief of these are the dykes already noticed (p. 484), which have to some extent diverted streams and retarded the rate of corrasion. The hard inclusions in the lower reaches of the V. Piscicelli must also have a similar action.

KATABOLIC AGENTS.

The chief katabolic agents which may have helped to model Camaldoli are marine erosion, rain, frost, heat, wind, and organic nature. Of these, the five latter are all in action at the present day, but it is possible that the waves of the sea took some part in the past.

Sea.—It is possible that the eruption of the Camaldoli volcanoes and the anabolism of the Camaldoli ash and tufa heaps took place beneath the surface of a shallow sea. If this be the true history of the hill, the flanks of the emerging volcanoes must have been subjected to denuding forces of very great power. The irresistible encroachments of the waves of the sea would amply suffice, were a reason demanded for the absence of entire segments of some crater rings or for the broaching of others.

If geologists are unwilling to concede a submarine origin to Camaldoli, they are, at any rate, agreed that at no very distant date the sea covered Bagnoli, washed away the south-western flank of Monte Barbaro, and covered the cliffs of La Starza (Pozzuoli), so rich in recent marine shells. The land must, in fact, have been at least 60 metres lower than at the present, and the entire Bagnoli plain must have been submerged. If it can be proved that the level of the land was yet another 60 metres lower, the powerful waves raised by the scirocco (south-east wind), rolling over the shallows, might easily have levelled the southern walls of the craters of Pianura and Soccavo, have distributed their *débris* over the Bagnoli and Agnano plains, and have then broken against the cliffs below Camaldoli itself.

At the present day the land is high out of the water, and therefore all erosion is subaërial.

SUBAËRIAL EROSION.

Rain.—A valuable record of both the rainfall and the rate of rainfall has been kept by the monks at Camaldoli since 1887. From their records it appears that the average rainfall for the years 1888–1895 is about 981 millimetres per annum, or about 135 millimetres *more* than the rainfall down below at the R. Osservatorio di Capodimonte (Naples) during the same period.

It also appears—

1. That the most rainy months are October, November, December, and January, and that of these December has the greatest rainfall.

2. That the average rate of rainfall is twice as fast during the summer and autumn as during the winter and spring. In other words, the months during which the greatest quantity of rain falls are by no means those during which rain falls fastest.

The average rate of rainfall is about 2½ millimetres per hour of rain. The rate is greatest during September and October, when it averages above 4 millimetres per hour of rain, and least during February and March.

It follows, therefore, that the rate of rainfall in the different seasons of the year is such as to have the maximum erosive effect as far as the torrent beds are concerned.

During the dry summer months the ground becomes dried, and acquires increased absorptive powers. When the autumn thunderstorms begin to clear the air, generally about the day of the Festa di Nostra Signora di Piedigrotta (September 8), the rainfall is very fast, and consequently the water has a better chance of forming streams than if the rainfall was slower and the water more likely to be absorbed by the ground.

The surface of the ground having once become saturated, a heavy fall of rain produces most destructive effects. The watercourses are swept by torrents of liquid mud, bearing along sand and stones, which rasp away the surface of the rocky beds, as the numerous scratches on their sides and bottom testify.

On steep slopes with relatively small catchment areas, such as the two sides of the Pignatiello ridge, or the side slopes of many of the deeper valleys, the rain-water runs straight down the slope without cutting channels of any considerable depth, but heavy showers result in the general degradation of the entire face of the slope. If, however, there be a sufficiently large catchment area above the slope, to collect a sufficient head of water, as is the case with many of the Quarto areas, cf. Vallone Pietra Spaccata, etc., deep and straight furrows are cut down the slope.

If the slope be less steep, the valley beds begin to turn first to one side and then to the other. The sides become undermined at the beds, and finally slide down. The final precipitation is often brought about by a sudden heavy shower after the undermining has progressed for a certain distance.

The most striking results of erosion are to be found at the heads of many of the valleys which commence as chasms. Examples are to be found in Quarto No. 21 and Pianura No. 1, and in some of the side branches of Quarto 17, all of which are rapidly working their way backwards towards their watersheds.

Frost.—Another factor which takes part in the work of degradation of the hills of Camaldoli is frost. It might be supposed that frost was a comparatively unimportant factor in Southern Italy, especially so near the sea and at such a low altitude. Nevertheless, the thermometer at the monastery of Camaldoli registered

a temperature below $+1^{\circ}$ Centigrade on thirteen nights during the winter of 1895-6.*

At all times of the year the temperature of the air in many of the valleys, except when warmed directly by the sun's rays, is much below that of the air outside, on account of the evaporation which is continually going on. I have repeatedly noticed a difference of temperature of 5° C. between the shade temperature at the bottom of the valley and that outside it.

During many nights in the year the effect of evaporation, combined with that of radiation, is to produce a very low temperature. The result may be seen after the winter in many of the valleys the beds of which are hewn in the tufa. The superficial soil and rocks get cooled; the water held absorbed in their pores freezes, and by its expansion scales off large flakes—sometimes as much as 2 inches thick and a foot or two square—from the surface of the porous tufa.

When such flakes become dislodged, their fragments, having slid down to the bottom of the cutting, are rolled along by the next torrent, and assist in rasping away the sides and bottom of the valley bed on their way down.

Heat.—A similar cause of the destruction of rocky surfaces, according to Johnston-Lavis, is heat. When rocks loaded with moisture are exposed to the hot rays of the sun, they become heated up to a very considerable temperature, and the water contained near their surface is converted into vapour, which by its expansion produces a constant crumbling of the exposed face, and prepares the way for the more destructive action of rain or wind.

Wind.—It is probable that wind does not often play a considerable part in the moving of the surface, but there can be no doubt that occasional severe gales, sweeping along the lines of valleys, take a share in the work of the levelling of ridges composed of the looser and lighter materials.

Organic Nature.—The chief factors of inorganic nature at work at the modelling of Camaldoli to-day are almost without exception destructive or katabolic in their action. On the other hand, the action of organic life may be said to be partly katabolic, partly conservative, or in passive opposition to the katabolic forces. On the whole, vegetable life is naturally conservative, animal life naturally destructive, in its action. At the present time, the conservative action of vegetable life far outweighs the destructive action of animal life. An important exception to the general rule is afforded by man, who by civilization has become a conservative rather than a destructive force in this region.

Effect of Animals.—The banks of valleys cut in the materials which compose the upper parts of Camaldoli are often so steep and loosely combined that it needs but a small disturbance to produce quite a considerable fall. Animals are often the cause of such landslips, and goats and dogs are not the least offenders in this respect. The way in which it is possible for quite small animals to start such

			o				o
* 1895.	November 23	...	+ 0.5 C.	1896.	January 8	...	- 0.2 C.
	December 28	...	+ 0.2 C.		" 9	...	- 1.2 C.
	" 29	...	- 0.3 C.		" 10	...	- 1.3 C.
	" 30	...	- 0.7 C.		" 11	...	+ 0.5 C.
1896.	January 2	...	+ 0.5 C.		February 16	...	- 0.2 C.
	" 6	...	+ 0.3 C.		" 17	...	- 1.6 C.
	" 7	...	- 1.0 C.				

The temperatures below $+1.0^{\circ}$ C. are given, because it is certain that the minimum readings on the same nights would have been very much lower had the instruments been away from buildings.

landslips must be clear to any one who has witnessed a small lizard running up a steep bank of dry volcanic earth, and has observed even its small weight raise quite a cloud of dust and start a miniature avalanche of the larger particles of tufa and pumice.

Effect of Man.—The ash-beds can be eroded with such extraordinary ease and rapidity that mule-tracks and goat-paths may be converted into cuttings of considerable depth by a few showers. Of such deepened paths, sometimes lying many feet below the surface of the country, there are hundreds. Their origin is thoroughly well understood, and is implied in the name *cupa*, which signifies such a deeply cut path. A good illustration of one may be seen in Hamilton's 'Campi Phlegræi,' pl. xl. Road-making in this country is easier than preserving made roads from being washed away. The ease and rapidity with which channels are cut by rain-water is so great that the inhabitants incur great trouble and expense in coercing storm-torrents into other channels than the middle of the roads. It is by his efforts to regulate the drainage and to preserve his paths and fields that man becomes a conservator of the topographical features of Camaldoli.

The methods employed in country lanes are simple. A stem of a tree or a line of masonry is buried transversely or obliquely across the roadway in order to break the force of the currents of water, to divert them to one side, and to prevent them from excavating channels in the roadway itself, as well as to hold the soil above from being washed down. The method is effectual for a while, but requires constant attention, as any roadway which has been neglected for a few seasons will testify.

The traffic along these *cups* is also an important factor in their formation. The stems of chestnut trees are cut in the woods when they are some 20 feet long. The small side branches are lopped off on the spot, and the poles are tied together so as to form large bundles. Mules are employed for the purpose of carrying these bundles. Each mule carries two, one slung on each side, so that the smaller ends trail along the ground behind. Carried in this way, these large bundles act as enormous brooms which sweep the paths deeper, raising clouds of dust as they go. The banks at the sides of the paths suffer from the frequent brushings of these chestnut poles to such an extent that, wherever it is desirable to preserve them, the landowners embed large stones, which shield the soft banks to some extent.

But it is as an agriculturalist that man is, and is likely to remain, a most important factor in the preservation of the Camaldoli hillsides.

Preparation of Hillsides for the Growth of Vines.—When a steep hillside has been cleared of its natural vegetation for the purpose of viticulture, it becomes necessary to prevent the waters of torrential rains accumulating to form torrents which would sweep away the entire surface soil from the slopes. This is done by the laying out of a system of horizontal terraces traversing the face of the slope at intervals of from 4 to 5 feet. A hillside prepared in this manner looks like a gigantic flight of stairs. The steps, upon the top of each of which a single row of vines is planted, are made so as to slope inwards and catch the rain-water which runs down from the bank above. On a hillside terraced in a proper manner, it is impossible for streamlets to join and become large enough to wash away any very extensive areas of the surface soil.

These terraces for vines (*tappia-fossati*) are made by *tappiatori*. The people of Pisciunola are considered the best for the work. The best time to begin the work is at the fall of the leaf, when the ground is dry and easily handled. The *fossati* are then laid out, beginning from the bottom and breaking up the earth well (*scasso*), and then planted; but they are not beaten smooth by the mattock (*zappa*), "*cacciare la faccia e fare i colli*," till the spring rains, to avoid the frosts, which cause the

surface to scale. The men usually work in companies of ten or twelve, headed by a foreman called the *caporale*.*

Vegetation.—It has already been stated that large areas of the Camaldoli hills are thickly wooded. According to a rough estimate, at least one-half of the district under consideration is covered with woods, the greater part of which flourish on the steeper hillsides and valley banks. The chief trees are chestnuts, poplars, oaks, hazel nuts, planes, stone-pines, and some others. There are no very big or large trees. The oldest are perhaps the two or three shattered oaks in the monks' garden at Camaldoli, which have so far been spared the woodman's axe, but are severely



FIG. 15.—PATH THROUGH YOUNG CHESTNUT WOOD.
(After a photograph by Dr. D. G. Fairchild, February, 1891.)

branded by lightning. By far the greater part of the trees are chestnuts, which are largely cultivated as a crop for poles and firewood.

The method of cultivation as practised consists in the encouragement of the production of many stems from each large root. When these stems have grown to the desired size, they are cut down as close as possible to the root. From around the scars young shoots sprout, which grow into the next crop of stems. An old chestnut root may grow to a great size, and bear perhaps twenty or more stems.

* I am indebted to Mr. Neville-Rolfe for these details.

Its value is estimated by the number of stems it will bear. The crop of poles from these old roots is in many cases considered so valuable, that if such a chestnut root happens to be growing on the side of a cupa, and is in any danger of being undermined by the denudation of the bank on which it is growing, the foresters actually find it worth their while to build a masonry buttress beneath it in order to support it. Along many of the sunk wood paths leading up to Camaldoli there may be seen large trees entirely supported by high stone pillars, and only connected with the bank by a few roots running horizontally from the top of the pillar into the bank, which has retreated from them, but from which they still continue to derive nutriment.

The general effect of vegetation is conservative, inasmuch as it hinders denudation. The chestnut woods of Camaldoli are especially potent in this way, and are therefore of the highest importance as regards the preservation of the topographical aspects of the country. Chestnut trees, in virtue of their spreading roots, are especially well adapted, not only to interrupt rainwater rivulets, but also to bind the soil together, and thus prevent landslips on the steeper slopes. Another way in which chestnut trees hinder denudation is by covering the soil twice annually with hygroscopic layers of decaying vegetable matter. The inflorescences, as well as the leaves, contribute largely to the formation of mould, and vegetable mould is said to be capable of absorbing almost twice its own weight of water.

The importance of a vegetable covering to hills composed of such loose materials as the pumice beds of Camaldoli cannot be too highly estimated, and there can be no doubt but that, if the slopes of the hills were to be entirely deforested and exposed to the unrestrained action of the elements, a change would be produced which could only be properly realized by one who has seen such desolation as that of the weather-furrowed hills of Southern France or Central Sicily, where the storm-torrents find no check to their course of devastation.

V. DESCRIPTION OF A TYPICAL CAMALDOLI VALLEY.

If a watercourse draining any area on the sides of Camaldoli be followed from its source down to one of the level plains, across which all surface drainage has to pass before it can reach the sea, it will be found that the valley passes through three phases, and that these phases stand in direct relation to the geological structure of the hill.

Phase 1.—The majority of the valleys commence as V-shaped troughs in the soft ash-beds near the principal watersheds. On their downward course their cuttings increase in depth quite uniformly, owing to the homogeneity and want of cohesion of the material in which they are excavated. Such increase of depth is in great measure proportional to the catchment area above, and therefore to the size of the stream which runs along the bed after torrential rains. The volume of water in the lower parts of the bed is naturally larger than that in the upper parts, and is therefore capable, *ceteris paribus*, of doing more work. As the bed is deepened the ash-banks soon begin to slide down and become less steep (Landslips, *vide* p. 490). The inclination of the sides of the watercourse is entirely dependent on the relation between the rate at which the bed is being deepened and the rate at which the sides are being denuded.

In exceptional cases a valley bed commences quite suddenly as a deep gully, owing to the very rapid erosion caused by a head of water falling from a height. Such chasms usually owe their origin to some interference with the natural mode of drainage, or to the existence of a harder layer over a softer and more easily erodible one.

When a valley bed deepens suddenly in this way, it is generally U-shaped in

cross-section just below the fall. As it draws away from the fall, the sides gradually become inclined outwards, and the section becomes V-shaped, owing to the gradual degradation of their slope by denudation.

The faster such a bed is being cut backwards, the greater the length of the bed with a U-shaped section. The first phase of the valley may be briefly defined as that part which is cut in the loose ash-beds. The rate at which the cutting is deepened does not bear a high proportion to the rate at which the crumbling banks are being "degraded" by denudation. The typical section is V-shaped. The banks are usually wooded or under cultivation.

Phase 2.—Some of the shorter and shallower of the valley beds remain in the first phase throughout their course. The longer and deeper ones usually cut their beds through the superficial ash strata into the underlying tufa rock. When such a valley enters the second phase, the banks on either side of the stream-bed are composed of loose ashes above, solid tufa below, and their inclination is proportional to the rates of denudation of these two materials. If the deepening of the bed has been at all rapid as compared with the degradation of the sides, the tufa banks are very steep, being almost vertical in many places. The ash-slopes have much the same inclination as in the first phase. Consequently the valley assumes the Y-shaped section, so characteristic of the deeper cuttings locally known as *cavoni*.

The character of the stream-bed differs from the stream-bed of Phase 1, inasmuch as it is interrupted by many small falls, which are due to slight local irregularities in the hardness of the rock, and which owe their preservation to the resistant qualities of the tufa. The bed is, as a rule, clean swept. The torrents flow too swiftly to permit detritus to settle anywhere but in the hollows.

Phase 3.—When the streams have reached the bottom of the hill-slopes, they have usually to cross a level plain before they can reach the sea. The rate of fall of a stream running across such a plain is exceedingly small when compared with that of its upper course down the hillside. The result is that the velocity of the streams becomes very much less; they can no longer hold as much solid matter in suspension, and their general character is that of streams which have nearly reached their base-level. They are homologous with the "*lagni*," at the foot of Monte Somma, and their flat sandy beds (*arene*) are often used as lanes.

The different phases through which most of the valleys pass are correlated with the nature of the ground. The upper portions of the watercourses are cut in ash-beds, which afford good drainage and hinder stream-formation, and are but rarely traversed by streams of any considerable size; therefore bed-erosion is but little quicker than the erosion of the sides. The middle portion of the watercourses (Phase 2) is cut in tufa, which is not capable of absorbing as much water as the bed of Phase 1. Also its streams are augmented by the water which is handed on from the catchment area of Phase 1. It therefore follows that the volume of water in the streams of Phase 2, and therefore, *ceteris paribus*, their erosive power, must be far greater than in the streams of the upper portion of the valley. Again, inasmuch as the lower layers of tufa contain more water than the upper ones, and consequently have less absorptive power, the deeper the streams run below the surface of the ground, the less will their volume diminish by absorption. In confirmation of this, I have observed on several occasions that during a sharp shower streams begin to form and run in the lower parts of the *cavoni* before they form in the upper, and long before they form in the first section of Phase 1. During a shower the process of stream-formation seems to begin low down in the valley beds, and to travel up.

In the lower section (Phase 3), where the inclination of the bed is small, and

the slower-moving streams can no longer hold much matter in suspension, sandy deposits are formed, which sometimes cause the stream to branch, as is also the case with the Lagni of Monte Somma.

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EXPLANATION OF MAPS AND DIAGRAMS.

MAP I.—Contoured map of the Campi Phlegræi, west of Naples.

Contours at intervals of 10 metres. The stronger lines are 50 metres apart. Scale 1 : 50,000.

The crests of those hills which are described as parts of volcanic crater-rings in the paper are indicated by red lines.

+ Lava-flows or trachytic lava masses.

o Mineral springs.

v Fumaroles and moffette.

The map is for the most part based upon the 1 : 25,000 map published in 1885 by the Istituto Geografico Militare, to which the reader is referred for further details. The sea-bed has been compiled from the soundings given on Admiralty Charts, Nos. 1400 and 1728. The Secca di Benda Palumma is after Colombo's map from Walther (16, p. 435).

MAP II.—Avernus group of craters. M. Nuovo, Avernus, M. Grillo-Rosso, Cuma.

MAP III.—Lake Avernus.

Soundings in metres. Contour-lines 10 metres apart. The surface of the lake is 1.08 metre above sea-level.

Sections : horizontal scale 1 : 11,000 ; vertical scale 1 : 72,000.

MAP IV.—Archiagnano group of craters. Cf. Map I.

MAP V.—The valley systems of Camaldoli.

Valley beds blue. Watersheds and contours brown. The watersheds represented by stronger lines are those separating the valley systems enumerated on p. 479. The watersheds are continued down to the contour-lines specified in the tables, p. 486.

Scale 1 : 50,000.

MAP VI.—Map of the Camaldoli hills restored, with the valleys filled in.

This map is supposed to more nearly represent the condition of things before denudation had commenced. Compare with the corresponding portion of Map I.

MAP VII.—Longitudinal sectional elevations of Camaldoli valleys.

In each diagram the lower line represents the valley bed, the upper line the mean height of the banks. The space enclosed is the "erosion area" (see p. 486).

Horizontal scale 1 : 50,000 ; vertical scale 1 : 20,000.

MAP VIII.—Vertical sections through Camaldoli.

1. Section from Piano di Quarto to the Riviera di Chiaja.

2. Section from Piano di Pianura to Capodimonte Park.

Horizontal scale 1 : 20,000 ; vertical scale 1 : 50,000.

BRITISH CAVES AND SPELEOLOGY.

By E. A. MARTEL.

At the last meeting of the Sixth International Geographical Congress held in London, in July and August, 1895, I had the honour, as delegate of the Society of Speleology, of communicating a memorandum on the encouragement which ought to be given to researches of all kinds in caves. I explained how the new means of action employed since 1883, above all in Austria by different scientists and travellers, and in France by myself and my fellow-labourers, had resulted in unexpected discoveries. The principal aim of my communication was to attract the attention of English scientific men and tourists to all that still remains to be done and to be found in the natural caves of Great Britain. Alluding to the two works that I had already published,* I tried to prove how speleology, or the science of caves, if it received the attention which it deserves, will help to solve a great number of problems, not only in physical geography, but also in palæontology, zoology, meteorology, agriculture, public works, general hygiene, etc. In order to join example to precept, I had obtained from the French Government, as I did in 1893 for the Austrian Karst, a scientific mission in the name of the Minister of Public Instruction to make a comparison between the grottoes and subterranean waters of Great Britain and those which I had already examined in France, Belgium, Austria, and Greece.

The results of this mission, very fortunately accomplished in July and August, 1895, were abundant enough to furnish matter for a special new work, which was issued in January 1897 †; but, wishing to make known to the readers of the *Geographical Journal* at least the principal observations and discoveries which I have made in Ireland, Derbyshire, and Yorkshire, I will devote these few pages to a summary relation of my underground journey in the British Isles, adding afterwards a few words on my researches of 1896 in Spain. I hope thus to succeed in arousing in England a favourable extension of all kinds of subterranean researches, as I have already had the pleasure of succeeding in doing in France.

I.—GENERAL REMARKS ON BRITISH CAVES.

At the beginning of the present century, the caves of England were the object of learned and methodical researches. In 1821 Dr. Buckland undertook the famous excavations of Kirkdale cave, described in his classical work 'Reliquiæ Diluvianæ.' ‡ One knows what splendid palæontological discoveries have been furnished by the beds of Hutton, Oreston, Wookey, Victoria, Brixham caves, of Kent's hole, Dream mine, Goat hole (Paviland), etc. The summary of all this has been described by Prof. Boyd Dawkins in his excellent work 'Cave Hunting,' published in 1874.§ The mere reading of this valuable volume will suffice to show that palæontology and archæology have been until now the principal objects of English speleologists. One may say that in general they have not thoroughly examined all that concerns the topography, the hydrology, the meteorology, and

* 'Les Cévennes.' In 8vo. Paris: Delagrave. 1890. 'Les Abîmes.' In 4to. Paris: Delagrave. 1894.

† 'Irlande et Cavernes anglaises.' In 8vo. Paris: Delagrave. 1897.

‡ In 4to. London: Murray. 1823.

§ 'Cave Hunting: Researches on the Evidence of Caves, respecting the Early Inhabitants of Europe.' In 8vo; xxiv., 455 pp.; one plate in colours and fig. London: MacMillan. 1874.

the zoology of their underground caves. On this last point they are very much behind their scientific brethren of Austria, America, and France, as, up to 1895, there was only one grotto in the British Isles—that of Mitchelstown, in Ireland—in which specimens of the fauna special to caverns had been met with. We cannot doubt that this is for want of sufficient researches. The opinion held by Prof. Boyd Dawkins in 1874, that the temperature of caves is in general (like that of springs) invariable, and equal “to the annual mean temperature of the place,” was only really recognized as inexact since my own researches. I proved that it was also without foundation in England.* It is all the more singular to see the British caves thus incompletely studied, as every circumstance seems to favour a careful investigation; in effect, great stretches of tableland and hills are perforated with fissures into which the rainwater is engulfed, with caves which receive them, and sources which distribute them. These regions are very easy of access; they are neither lost in the heart of high mountains, nor far from roads and great centres, as those into which the swallow-holes of the French *causses* open. The 1: 10,560 county map, or 6-inch map, facilitates in a very great measure, and better than in any other country, the knowledge of the land. And the nation which has created the dangerous sport of alpine climbing and founded the first alpine club is far from wanting in initiative and fearlessness. Also we can hardly understand why the courageous Messrs. Lloyd, Birkbeck, and Metcalfe, who, as far back as 1770 and 1847, did not fear to descend into Eldon hole and Allum pot—two abysses of 300 feet deep (of which 180 are perpendicular), have not had more imitators.

In short, the underground of the calcareous regions of the British Isles may be considered as being, topographically, very little known; this is the conviction which was impressed on my mind by my own researches in 1895.

II.—MARBLE ARCH (IRELAND).

Dr. Scharff, of the Irish Museum of Science and Art at Dublin, procured me the co-operation of Mr. Jameson for the exploration of some of the Irish grottoes. His help has been most valuable to me in exploring the caves near Enniskillen (Fermanagh). Marble Arch, which is certainly the most important of all these cavities, is situated 10 miles (as the crow flies) south-west of Enniskillen, at the entrance to the park of the Earl of Enniskillen. The Cladagh (219 feet), a foaming torrent rushing out of a charming woody ravine, narrow and walled in between abrupt slopes for a height of 150 to 250 feet. After a mile's walk up the ravine, we come to a natural arcade of stone, a calcareous layer which has remained stationary, and under which the entire torrent leaps, raging through the stones with which the bed is strewn. The map (sheet 56, Swanlinbar) indicates, at half a mile, two-thirds of a mile, and a mile, south and south-east of Marble Arch, three rivers (Sruh Croppa, Monastir or Owenbreen; the third has no name), which here, running under the rocks, drain the northern turfy slopes of Cuilcagh (2188 feet), and disappear suddenly into three holes, Cat's hole, Pollawaddy, Pollasumera.

On July 16, 1895, I undertook, with Mr. Jameson, to find out the quite unknown underground relations between the three rivers and the source. It is difficult to imagine a subterranean arrangement more complicated than at Marble Arch. Three storeys are here superposed: (1) the channels of the subterranean

* *Comptes Rendus* of the Academy of Sciences, Paris, March 12, 1894; January 13, 1896; May 24 and June 14, 1897.

river; (2) three galleries, perforated at about 16 feet above the water which circulated there formerly, and which perhaps passes there still when there are inundations; (3) four openings caused by the falling in of the tableland between 30 and 80 feet higher up. But it is impossible to meet with a more striking example of the destructive powers of subterranean waters. Erosion, corrosion, and hydrostatic pressure have, by widening the natural fissures of the ground, formed a real sponge of stone, about 500 feet long by 200 feet wide. Under the continual action of the internal current, the rock has become, in some way, more and more carious, like a bad tooth. At the points the most attacked, the hollowing out has reached such a development that the overweighing mass fell in, thus producing the four funnels. In short, the formation by the falling in of ground, due to the sapping of a subterranean river, is nowhere, not even at St. Canzian-in-Wald, near Adelsberg,* more evident and more eloquent than here; and the partisans of the theory which attributes the origin of natural wells principally to this cause, will find at Marble Arch one of the best arguments in favour of their thesis. They ought to note, nevertheless, that the want of thickness in the tableland over the cavern (45 to 125 feet at most) is a circumstance particularly favourable to this giving way of the earth, and that, conformably to the distinction that I established already in 1889,† and that is here confirmed, the conditions are no longer the same when the thickness is more than 300 feet. In this case, the narrow vertical abysses from 300 to 1000 feet deep, due, above all, to the external action of the streams which are, or were, engulfed into them (Karst, Causses, Vaucluse, etc.), are much more frequently met with than the gulfs really formed by the giving way of land; the latter are then only exceptions, of which the Dolinas of Recca at St. Canzian am Karst (Istria),‡ Padirac (Lot),§ and perhaps Mazocha, in Moravia, are without doubt the finest examples.

Behind the boulders, the subterranean stream occupies the entire section of a huge gallery. To the extent of 1000 feet we followed, in my folding boat, a great tunnel, previously unknown to man, elbowed in two places with sharp angles. The height and width of this tunnel vary from 25 to 45 feet; it is as imposing as the finest sections of the subterranean Piuka of Adelsberg (see engraving, "Underground river at Marble Arch, Ireland"). At the second elbow there is a cross-way, from whence a dry gallery is prolonged towards the north-east, the principal gallery coming from the south-west. At 650 feet from the cross-way we are stopped by the rocks approaching within 10 inches of the level of the water and not allowing our boat to pass. There are 15 feet difference of level between the source of Marble Arch and the water-surface of the large gallery, where the river has a temperature of 53° Fahr.

In short, it seems that the underground river here has utilized and enlarged the natural fissures of the rocks and formed them into magnificent galleries. Such is probably the origin of the curious labyrinth of the caves of Marble Arch, of which the total development attains nearly half a mile in length.

At a quarter of a mile as the crow flies, south-south-west of Marble Arch, there is another external giving way of the earth. The 6-inch map names it Cradle hole. Five or six times more vast than any of the other four funnels of Marble Arch, it was, like them, produced by the falling in of a subterranean vault. In the north-east inferior angle there is a cave, less complex and

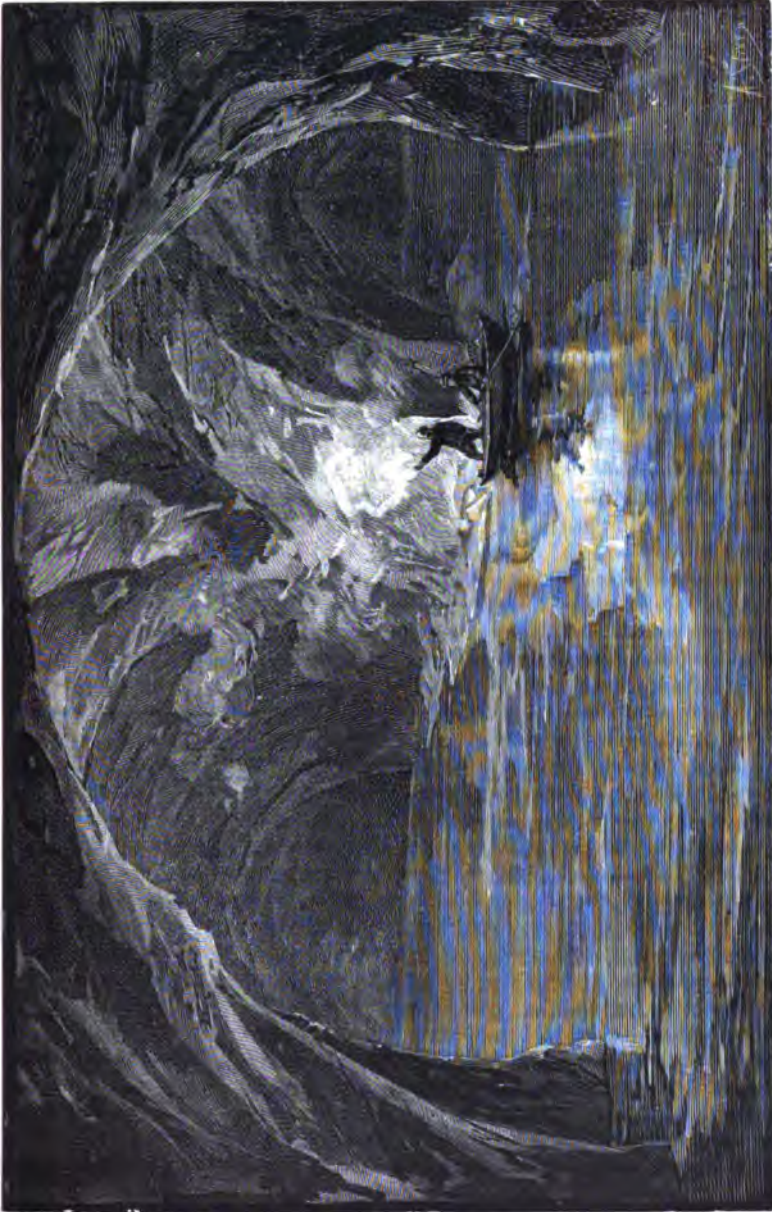
* See 'Les Abîmes,' p. 459.

† *Comptes Rendus Acad. des Sciences*, October 14, 1889.

‡ 'Les Abîmes,' p. 459.

§ *Ibid.*, p. 263; and 'Tour du Monde,' December, 1890.

less extended than those of Marble Arch, and of which every hole and corner was known for a long while. The whole ends in a wide gallery 300 feet long,



UNDERGROUND RIVER AT MARBLE ARCH, IRELAND.
(Lent by the French Alpine Club.)

similar in form, cut, and dimensions to the one we discovered at Marble Arch. There is also a river in it. The barometer marks 450 feet of altitude—that is to say, 15 feet more than at the end of the large gallery of 650 feet in Marble Arch.

A communication in form of a siphon exists between the two currents. The ramifications of the cave of Cradle hole have about from 800 to 1000 feet of development.

At 220 yards from Cradle hole there is a yawning chasm, the sides of which have been but lately disclosed; it is, without doubt, quite a recent giving way of the ground (altitude 600 feet), which is not marked on the county map. It is smaller than Cradle hole, and no cave opens at the bottom; it has unhappily obliterated the subterranean passage, over which the sinking of the earth has taken place. Barely a quarter of a mile farther on, or at about one-third of a mile from Cradle hole, and about half a mile from Marble Arch, there is a real pit (aven), that is to say, a narrow natural well (altitude 620 feet). The fathom-line descends 72 feet, that is to say, to the altitude of 550 feet, or about that. Unhappily, we had not time to descend into it, as we wished to examine, at 50 yards from there, the spot where the river Monastir (or Owenbrean) loses itself under the rocks at Pollawaddy. This river descends from the very summit of Cuilcagh. Its disappearance is very picturesque. At 612 feet of altitude (map) the ground comes suddenly to an abrupt termination, and a cliff from 60 to 80 feet high forms a precipice at our feet, barring a hollow ravine at least 320 feet wide, into which the river descends in small cascades. A little byway leads us to its banks, at the very foot of the cliff, into which the water (58° Fahr.) disappears. In the very course of the stream, which is 20 inches deep, we enter under a gallery, 3 feet wide and from 10 to 25 feet high. At 130 feet from the entrance we were stopped by a large stem of a tree, which we could not remove. Thus we were compelled not to know if the stream would have led us to the foot of the pit.

It now remains to descend into the pit (aven), and to finish the exploration of the disappearance of the river at Pollawaddy, as well as of Cat's hole (quarter of a mile north-west of Pollawaddy), where the stream Sruh Croppah disappears; and of Pollasumera (two-thirds of a mile east from Pollawaddy), where a third nameless river is also swallowed.

III.—ARCH CAVE OR WATERFALL CAVE, IRELAND.

Opposite to Cuilcagh, the mountains of Belmore (1312 feet) include also between lakes Macnean, Melvin, and upper Erne, some calcareous ground, the subterranean hydrology of which deserves to be studied. On July 14 and 15, 1895, with the very obliging indications of Mr. Plunkett, of Enniskillen, who had himself made some pre-historic excavations in different little caves of Belmore, Mr. Jameson and I examined the basin that serves to feed the source of Arch cave, or Waterfall cave, situated at about 8 miles west of Enniskillen. It is one of the most curious springs that I have ever observed, and was opened by the force of underground waters between the clefts and joints of carboniferous limestone. The origin of the powerful source of Arch cave, whose volume announces the drainage of a rather considerable surface of ground, must be as follows:—

This surface is that of a tableland with three shelves or terraces, which extends towards the west of the cave, and constitutes, in a gentle slope, the eastern declivity of the hills of Tullybrack (1223–1249 feet).

On this tableland a quantity of swallow-holes are the points of absorption of the atmospheric waters. The greatest part of these swallow-holes, or pipes, are impenetrable, being full of pebbles and lumps of earth, like the *betoires* of France, and the *Sauglöcher* of Austria; but at least two are open and penetrable, like the abysses, or pits, and we descended into them. The first, Sumera, or Noon's hole, is the deeper and the more curious; the plumb-line marked 154 feet, that is, 216 feet above the outlet of Arch cave, as the hole opens at 747 feet of altitude. It is a real

swallow-hole, but it is not finished; the stream that has already widened it continues its work of enlarging—it still falls into it, and so strongly that we were obliged to limit our descent to 60 feet. At the depth of 80 feet the cavity gets narrower; it has then only 3 feet diameter instead of from 16 to 25, as at the orifice, and the waterfall occupies all the section.

To examine the bottom of it, and to seek the prolongation of Noon's hole, it would be necessary to re-descend into it in a drier season. At least, I have had the satisfaction of verifying that most of those long and narrow vertical abysses of the Causes and of the Karst, which are to-day so dry, are in reality the work of superficial waters formerly absorbed there and now dried up; that they have been formed from top to bottom at the expense of the fissures of the ground, which have been enlarged by erosion and corrosion; and that the opposition that I made, in insisting on this new theory, to the excessive generalization of the hypothesis of the sinking vaults is absolutely justified. Ingleborough hill, in Yorkshire, will furnish us with still more magnificent examples of abysses having kept, until now, their character of absorbing wells.

The other penetrable swallow-hole is Pollanafrin, at half a mile south of Noon's hole, and at 690 feet altitude, only 32 feet deep on one side, and 46 feet on the other. This hole is really the production of a sinking-in of ground; the stream which crosses it has disappeared, a few yards upwards, on the third terrace, into small crevices of its bed. It is sure that all these waters reappear at Arch cave, which is half a mile distant.

IV.—OTHER RESEARCHES IN IRELAND.

My other underground explorations in Ireland were only interesting from a geological point of view, and were fully reported in my last book. At Cong I found the celebrated Pigeon's hole was not worth its reputation, and I could not discover the subterranean river between Lough Mask and Lough Corrib, though descending in a few not very deep, reputed unfathomable, abysses. The underground rivers of Galway and Clare (at Gort, the Tomeens near Tulla, etc.) did not prove so magnificent as Marble Arch and Arch cave. Theoretically, however, I gathered there much useful information, especially in the existence of really unfinished valleys, where subterranean rivers have not yet wholly destroyed their cavernous prisons. I think I must notice that, quite near the little town of Gort, at $1\frac{1}{2}$ mile east of Kiltartan, a phenomenon is to be seen which is perhaps unique in the physical geography of the Earth; at least, I have never seen its equivalent. In its downward course from the hamlet and the mill of Ballylee (a ruined castle), the river, which bears the six successive names of Boleynceendorish, Ballycahalan, Annagh, Turra, Streamstown, and Ballylee, forks suddenly in two arms; opposite each other, at an angle of 180° , these two arms run towards the two opposite extremities of the valley, and sink both—that of the north-east (Pollaleen, altitude 40 feet) after 800 feet of course, that of the south-west (Pollanoween, double, altitude 32 feet) after 1550 feet. The two holes into which these rivers disappear are impenetrable, as are all those of Gort. But the maps do not indicate at all this double current going in contrary directions; I have not seen it mentioned in any work, and I was quite surprised to discover, on the spot itself, this unusual division of waters, nearly on the threshold of two subterranean disappearances, which go no one knows where.

Here I find opportunity to say a word about the *turloughs* (or blind loughs) and the *sluggas* or *sluggys*.

The *sluggas* are simply the light-holes of a sinking in of the ground. These holes must not be mistaken for swallow-holes, like those into which the river

Beagh disappears near Gort, nor for real abysses (pot-holes or pipes) like Noon's hole (see above).



THE INTERIOR OF GAPING GHYLL, IN YORKSHIRE.
(Lent by the French Alpine Club.)

The *turloughs*, or lakes with changeable water-level, alternatively fill and empty themselves by the bottom, according to the oscillations of the swelling or

the decrease of the waters; they are simply the overflowing of the subterranean channels which drain the calcareous ground through its fissures. They repeat here exactly what takes place in the famous lake of Zirknitz, in Carniole (see 'Les Abîmes,' p. 458), of which the irregular ebbing and flowing were so long unexplained.

The chief causes of the multiplicity of these lakes, and the frequency of the phenomena in Ireland, are the slight altitude of the ground and the feeble slope of the subterranean waters which ensues. If the island rose only 300 feet, the drainage would be considerably accelerated, and by degrees would be formed, thanks to the recrudescence of the erosion, more important caverns and more uninterrupted valleys. The flatness of the country has not permitted the trickling down and the infiltration of the waters to do their work as deeply and as completely as, for instance, in the regions of the Causses, the Jura, and the Karst. That is why there are in Ireland so many lakes without any apparent overflow channel, and of which the subterranean issues are unknown, going out, probably, into the sea; this is certain, at least, for some of them which are rather near the coasts, and on the level of which the tide has a visible influence (see Kinahan, 'Valleys, Fissures,' etc., p. 151; 'Les Abîmes,' p. 530).

I have found that the famous Mitchelstown cave (county Tipperary), though one of the largest of great Britain (1½ mile extent), is certainly much inferior in beauty to the best Austrian and French caves, such as Adelsberg and Dargilan.

To conclude, for Ireland, very much speleological work of all kind remains to be done in the "Green Isle."

V.—THE CAVES OF THE PEAK DISTRICT, DERBYSHIRE.

Peak cavern, just behind the village of Castleton (Derbyshire), is perhaps the most popular in England, and numerous tourists visit it daily. The entrance part alone is worthy of admiration. It is a subterranean river which has made this monumental porch; but it no longer utilizes it, except for the surplus waters in moments of inundation, for its former strength has much decreased, and it bursts out to-day at three points, towards the descent of the river and on an inferior level. The interior of Peak cavern does not possess one single fine concretion. But behind the larger rooms, which are occupied by water only after floods, the subterranean river can be followed side by side in a gallery of 1000 feet; the stream runs noisily along between clay banks. In the vault are transverse diaclases widening out into spindles, as in Marble Arch, Arch cave, etc.; three of them are large fissures of infiltration. The last of these vertical crevices is an enormous abyss (swallow-hole), one of those upward fissures that the miners of the country call "rakes;" it is from 18 to 30 feet wide, and inclines from 75° to 80° towards the horizon. It is an unfinished abyss; that is to say, it is a crack that erosion has not enlarged up to the surface of the earth, for its orifice has not been found above. It is very elevated, although it has not, probably, the 300 feet in height that is attributed to it; if it had, it would pierce the surface of the earth, which, according to the superposition of the 6-inch map and of my own subterranean mapping, must be in this spot about 100 yards above the level of the interior river. This gulf closed above, called Victoria cave, discovered in 1842, enters into the category of swallow-holes grafted laterally on subterranean rivers, such as Rabanel, the Combettes, the Mas Raynal,* and the larger dome of Padirac,† in France.

* See 'Les Abîmes,' pp. 143, 172, 325.

† See *Comptes Rendus Acad. des Sci.*, October 21, 1895, and *La Nature*, October 16, 1895.

As with all the vertical clefts in the vaults of caverns, it would be well to ascend the interior of this one, in order to find out if it be not an issue to one or several storeys of other grottoes.

Just at the foot of Victoria cave, a small streamlet comes out of a very short gallery (see plan); its course is stopped above, after a few yards, by a pond of water. The temperature of this affluent I found to be 46.5° Fahr. It is very probable that it comes from the second grotto of Castleton, the so-called Speedwell mine. Afterwards the gallery of the principal stream in Peak cavern turns abruptly at right angle towards the south-east; at the end of 90 feet the path is cut off by water 3 feet deep. Wading through it 20 yards, I ascertained that the stream came from under a siphon, and that there is no prolongation, *free for man*, towards the Perryfoot swallow-hole. But it is, nevertheless, quite certain that all the swallow-holes in the great fault of Derbyshire, in the tableland north-west from Castleton, duly run their waters through these caves.

The Speedwell and Blue John mines are particularly curious for their relations with lead ore; but on this specially geological subject I have given a fuller account in my book. Here I will only say that they led to huge interior abysses, similar to Victoria cave in Peak cavern, and draining also the infiltration waters.

Another famous grotto in the district, Bagshaw cave, at Bradwell, was discovered accidentally in 1806 by four miners, who were searching for lead. In it there exists no great hall, and the width and height nowhere exceed 18 feet. The passage through it is difficult; but it must be admitted that, from a hydrological point of view, the cave of Bagshaw is also most interesting. It is composed of three parallel galleries, hollowed out on three different levels, but not on the same vertical plan, and, nevertheless, communicating with each other. The third is at this very time traversed by a subterranean river, and does not appear to be accessible to man. The middle gallery, or principal one, is the characteristic bed of an ancient subterranean river, now dried up. There it is necessary to drag one's self along flat on the ground, and to cross over a pond of water to reach a bifurcation, from whence can be heard the roaring of a torrent, which is very painfully reached. The subterranean river (altitude 606 feet) comes out of a vault nearly on a level with the water; it runs from south to north for the length of 15 or 18 feet, occupying all the width of the gallery, and is then engulfed, after rushing through the stones under another vault 2½ feet high and 3 feet wide. A boat could not pass there on account of the stones, and the strength of the current prevented my risking to go on foot. The direction is that of Bradwell, towards the north-east. There is no notice of the waterfall in guide-books. Unless the river were dried up, I consider it impossible to go farther than I have been myself. The extent of the cave of Bagshaw must, then, be limited to the half-mile that I went over myself, and to the gallery of the Dungeon; that is to say, from three-quarters to one mile in all. Such as it is, Bagshaw cave is one of the longest in England. In a straight line, the point where I met the subterranean river is half a mile from the entrance, and half a mile* from a powerful and impenetrable spring, which rushes out in the village of Bradwell itself, between 580 and 590 feet of altitude, and from 15 to 30 feet lower than the ground of the cave. It is really the torrent of Bagshaw cave that feeds the source of Bradwell, and if ever the latter dries up, they will know where to go to look for it. As for its origin, I

* It is only in adding to the accessible length the unknown and impracticable passages, and even in supposing windings that would double its length, that we arrive at the number 2 miles, which until now has been considered as the extent of the cave of Bagshaw (Baddeley, 'Guide for the Peak District').

can conjecture nothing about it, except that it surely comes from the draining of the limestone tableland towards Tideswell.

VI.—CAVES OF YORKSHIRE. GAPING GHYLL.

Long ago, Prof. Phillips, Prof. Boyd-Dawkins, Messrs. Marr, Dakyns, Tidemann, etc., have drawn attention to the caves and pot-holes of Ingleborough and surrounding mountains of Yorkshire. The two principal pot-holes of Ingleborough are Allum Pot and Gaping Ghyll; the last one engulfs the large stream of Fell Beck. Allum Pot, 300 feet deep (198 feet of which are perpendicular), was first visited in 1847 by Messrs. Birkbeck and Metcalfe, afterwards by Prof. Boyd-Dawkins and other parties.* Of the second (altitude 1310 feet), nobody, until 1896, had been able to reach the bottom. Prof. Hughes had only measured it with a plumb-line in 1872, and had found a depth of 300 perpendicular feet. On August 1, 1895, thanks to the obliging help of Mr. Farrer, who had got Fell Beck partly turned aside, I was able to accomplish the first descent of Gaping Ghyll, and to find out that this hole is, above all, an abyss of erosion formed from top to bottom by the widening out of a diacause. The vertical cascade of 300 feet, which falls into it in a single jet, and the volume of which is enormous after storms or the melting of the snow, proves that the natural chimneys of the same form must have had an identical origin, even when we find them dried up and much deeper, as those of Rabanel in the Hérault, and of Jean-Nouveau in Vacluse.† Gaping Ghyll is a swallow-hole which has not ceased to work as a perennial swallow-hole.

At a depth of 210 feet, its large pipe, from 13 to 29 feet in diameter, opens in the vault of an immense subterranean hall, 480 feet long, from 70 to 110 feet wide, and from 80 to 100 feet high. The ground (altitude, 300 metres), formed of gravel and round pebbles, is remarkably flat. The surface is about 4500 square yards. It is the work of the waters, which, stopped in their descent by the impermeable sub-stratum of the silurian slates, have, by widening the joints of stratification and the diacauses, excavated this great reservoir of more than 100,000 cubic yards of capacity. At its two extremities, I found the cave obstructed by such heaps of stone that I was not able, having gone down quite alone, to remove them. But in 1896 the large party of MM. Calvert, Gray, Booth, Green, Cuttriss, Slingsby, etc., made several descents in Gaping Ghyll, and succeeded in discovering more than half a mile of galleries behind the heaps of stones. Their researches are not finished, and will be continued. But it is now ascertained that the stream comes out 140 feet lower down, and about three-quarters of a mile farther on (as the crow flies), through the grotto of Ingleborough (altitude 825 feet). Since 1839 they have penetrated for 2000 feet into the turning gallery which this grotto forms, and they have been stopped by the lowering of the vaulting to the level of the water. In 1896 Messrs. Calvert, Gray, etc., found a new gallery in Ingleborough cave, and now but a little part of the subterranean river remains unknown.‡

I was also much interested, in the north-west of Ingleton, with the stream of Doe or Dale Beck, whose capricious course I carefully studied, marking many new observations, especially on the famous Weathercote cave, which I have accurately mapped and explained in my book (chap. xxv.).

Lots of caves, abysses, and swallow-holes are still to be scientifically explored round Ingleborough, as well as in Ireland, Derbyshire, and Mendip hills. Many

* See Boyd-Dawkins, 'Cave Hunting,' in 8vo, p. 41. London. 1874.

† See *Comptes Rendus de l'Académie des Sciences*, October 14, 1889; and 'Les Abîmes.'

‡ For a more detailed account of my descent in Gaping Ghyll, see *Alpine Journal*, May, 1896, and chaps. xxiii. and xxiv. of 'Irlande et caverns anglaises.'

months, or even years, and many men must be employed for this work. I could only, almost alone and with limited time, disclose very few of the remaining mysteries of British caves, but I trust that my too short investigations, specially those in Marble Arch and Gaping Ghyll, have succeeded in proving that speleology is quite likely to effect future discoveries in Great Britain, just as it has done in Austria and France during ten years.

This was my principal aim in the above very rapidly described journey, and I wish that cave-hunting may be now energetically resumed there by English investigators, to the great benefit of human knowledge and curiosity.

VII.—THE CUEVA DEL DRACH, IN MAJORCA (SPAIN).

In 1896 I turned my attention to another part of Europe, the Spanish Majorca, in the Balearic islands, where a natural marvel was said to be incompletely known



LAGO MIRAMAR, MAJORCA.

—I mean the Cueva del Drach, that is, the Dragon's cave, on the eastern shore of the island, about 8 miles east from the town of Manacor. Since the year 1878 only this cave had been visited, after two gentlemen of Barcelona, with an inefficient guide, had tried to thoroughly explore the cueva—had, in fact, discovered some new rooms, but succeeded principally in losing themselves during a whole day, and in getting half dead from hunger and fright. Actually about half a mile of galleries were known in this cave, adorned with the most beautiful stalactites and stalagmites, and with wonderful little lakes, which had stopped any further investigation (see Vuillier, 'Les îles oubliées').

Several years ago I was invited by His Imperial Highness, the Archduke Louis Salvator of Austria, the learned and generous owner of the Miramar estates near Palma, to work out the exploration of Dragon's cave. It was only in September, 1896, that I at length was able to carry this scheme into execution. But, thanks

to the facilities granted by his Highness and with my folding canvas boats, I was pleased and happy in carrying out at Cueva del Drach one of my most satisfactory subterranean investigations.

I found one of the largest underground lakes known in the world, which I named Lago Miramar, 570 feet long, 100 to 125 feet wide, 15 to 30 feet deep. The accompanying photographic illustration (taken with magnesium light in ten minutes) represents a corner of this lake, and shows better than any long description what a marvel is this mysterious and so long unknown pond, black as night, but sparkling under magnesium wire with all the splendours of the diamond. The vaults and walls are covered with millions of sharp and thin stalactite needles; the roof is supported at intervals by stalagmitic columns resembling the Egyptian or Indian pillars of Karnac or Kailasa. All these concretions are pure white like ermine, without any spot of clay. It presents the greatest contrast to Gaping Ghyll, being a masterpiece of beauty, just as the Yorkshire abyss is of frightful magnitude, both stupefying to human eyes.

And Dragon's cave (1½ mile long) is not only a picturesque curiosity; all its large and small lakes are on the same level as the sea, with which they communicate through narrow clefts; they are half salt and fresh water, and a hydrological marvel, of which I will give elsewhere a fuller scientific account.* For geographers I only say here that this cavern is a mere sea-cave formed by the Mediterranean waves, and not by an underground river, but a sea-cave of unusual size, unparalleled elsewhere, at least on European shores. It is said that California, Cuba, and Jamaica possess also grand caves of the same kind. When and by whom will they be scientifically explored?

ON THE DISTRIBUTION OF TOWNS AND VILLAGES IN ENGLAND.

By GEO. G. CHISHOLM, M.A., B.Sc.

II. HISTORICAL ASPECTS OF THE QUESTION.†

In examining this subject from the historical point of view, we begin, of course, with the Roman towns. In pre-Roman times there were no towns. In the state of civilization reached by the Britons, there could be no use for them. So far as Cæsar had the opportunity of observing, there was little cultivation in Britain in his time

* *Comptes Rendus de l'Académie des Sciences* 14 Juin 1897, et *Annuaire du club alpin français*, 1896 (in press).

† Owing to a misunderstanding about the proof in the first of these papers (January, 1897), several misprints were left uncorrected, and should be corrected as follows:—

- Page 79, line 3. *For* Barstone *read* Carstone.
 „ 80, „ 3. *For* deepened *read* cheapened.
 „ 80, „ 17. *For* Buckmere *read* Cuckmere.
 „ 80, „ 25. *For* Steywing *read* Steyning.
 „ 81, note. *For* Gonglis *read* Gough's.
 „ 82, line 2. *For* Whilton *read* Whitton.
 „ 82, „ 9. *For* South *read* North.
 „ 86, „ 1. *For* billock *read* bullock.

except in Kent, the inhabitants living on milk and flesh, and wearing skins for clothing. The name of "town" they gave, he says, to an inaccessible wood fortified by a ditch and rampart, where they resorted to avoid invaders.

The geographical interest attaching to the Roman towns of Britain is all the greater because these towns appear to have been mostly abandoned after the Teutonic invasions of the fifth century. The organization of the Angles and Saxons hardly allowed a place for the existence of towns. Towns are mostly brought into existence as centres of trade, seats of manufacture, or places of administration; but the remarkably self-contained village life of the Angles and Saxons enabled them for centuries to dispense both with manufacturing and trading towns. Even the administration of the villages was independent, and the only administrative centre required was a capital whence, as occasion demanded, the king might summon his immediate followers to attend him with their retainers. Hence the Roman towns, where not still left in the hands of the Britons, were forsaken. The shell, or skeleton, of the town continued to exist in many cases till life was revived, if it was ever revived at all. Town life in England, according to Cunningham, did not begin again till the advent of the Danes, and was due to their trading instincts.* An interesting mark of this breach of continuity in town life, in the case of those Roman towns which were revived and still exist, is found in the want of continuity of the town names. Very few old Roman towns, or towns on the sites of old Roman forts, in England are known by names directly descended, that is, derived by mere linguistic corruption, from those which they had in the Latin tongue.†

Now, much of the geographical interest attaching to the history of Roman towns arises from the hints we get therefrom as to the geographical conditions that may have favoured their existence in the situations where they are found or formerly existed. Where Roman towns have continued to exist, or have been restored on the site originally occupied or on a site closely adjoining, there is at least a presumption that their existence on these sites is due to geographical conditions of an enduring kind. Where Roman towns have passed away and left no modern representative, the inference is that, if their existence could ever be fairly ascribed to geographical conditions, these conditions have changed.

Among Roman towns or stations that have continued to exist or have been revived, it is natural to find a considerable number of seaports, including river-ports accessible to sea-going ships. Among these may be mentioned Londinium (London), Durobrivæ (Rochester), Dubræ (Dover), Clausentum (Southampton), Isca (Exeter), Glevum (Gloucester), Segontium (Carnarvon), Deva (Chester), Pons

* 'Growth of English Industry and Commerce: Early and Middle Ages,' pp. 88, 89.

† How different from what we find in the names of ancient Gaul compared with those of modern France! There most of the ancient Roman names have come down in some form to the present day, and the towns themselves that were important in Roman times are more or less important still, and stand on the same sites. It is interesting, too, to note that the names that have thus persisted are often tribal names, and not the official names that may have been given to the towns by the administration, but which were in many cases displaced by tribal names even in Roman times. The names are often greatly corrupted; still such changes as Lemovices, Limoges, Divio (nem), Dijon, are of the same nature as those which have changed *abbreviare* into *abrèger*, and are quite different from those which have taken place in names like Manchester and Lincoln, where new names have been formed by the combination of one element of the old name with a designation which the Anglo-Saxon settlers had learnt from the previous inhabitants.

Ælii (Newcastle), *Eburacum* (York), *Venta Icenorum* (Norwich), and *Camulodunum* (Colchester). To these we may add *Aquæ Sulis* (Bath), which, though it has long ceased to be a seaport, in all probability served all the purposes of a port for this district in Roman times when no Bristol existed, and *Luguwallium* (Carlisle), which continued to be a seaport down to a comparatively recent date.

Of the towns mentioned, *Claudentum* and *Venta Icenorum* do not appear to have occupied the exact site of their modern representatives, and the difference in situation, slight as it is in both cases, is not without interest. The exact site of the Roman *Claudentum* is now occupied by the village of Bitterne, at the head, but on the east side, of the small estuary of the Itchen,* where Camden was shown ruins, walls, and ditches of an ancient castle about half a mile in circuit, and surrounded on three sides by the sea at flood tide, where, he adds, coins of Roman emperors were frequently dug up. Through the care of the late Sir Stuart Macnaghten, the old Roman boundaries of the station, which was an insular one, have been preserved, and can still be seen. The coins found here are chiefly of the later empire, those of Tetricus, one of "the thirty tyrants," being most numerous. A port at this spot would be the highest point that sea-going ships could reach on their way to Winchester, then the principal goal in this region. As traffic increased, the more extensive accommodation for loading and unloading on the peninsula between the Itchen and Test would give greater advantages to that site. *Venta Icenorum* appears to have occupied the site of the modern village of Caistor, which lies a little to the south of Norwich, on a small river called the Tese, probably navigable to this point in Roman times, and would be the first navigable point reached in following the road to the Yare from the south.

Besides *Claudentum* and *Venta Icenorum*, *Portus Adurni* (? Porchester), Tamara (near Tamerton, on the Plym), and *Gariannonum* (Burgh Castle, on the Yare), may also be mentioned as having their modern representatives as seaports at some little distance from the ancient towns. Whether Porchester is to be identified with *Portus Adurni* or not,† its name seems clearly to indicate the presence of some Roman port here. It is now represented by Portsmouth, the foundation of which is ascribed by Camden to the removal of the inhabitants from Porchester to the island of Portsea, in consequence of "the gradual withdrawing of the sea." At no period, however, can the harbour on which these ports stand have had anything like the commercial importance of Southampton, which is much better situated for communication with the interior, and does not suffer from the disadvantage of the strongly flowing and ebbing tides, which at times render the navigation of the entrance to the other port extremely difficult. The commodiousness of the harbour as

* The very plausible derivation given by Camden for the name *Claudentum* would seem to militate against this identification. Camden suggests that *Claudentum* means the harbour of the *Entum*, or *Anton*, *claudh* meaning in "British" a harbour formed by artificial banks of earth (Pugh's Welsh dictionary defines *Clawdd* as "a dike, ditch, or trench, a pit or quarry; an embankment or wall thrown up;" the primary meaning evidently being "something made by digging"). The *dh*, or Welsh *dd*, pronounced like the *th* in *this*, would readily enough become an *s* (*sz*) in the mouths of those who could not pronounce that sound. But *Anton* is the name of the river on the west side of the small peninsula on which Southampton stands. The name may very well have been given also, however, to what we call Southampton Water, and hence the name "port of *Anton*" would be suitable for any port at the head of that inlet.

† "*Porchester* Fort, possibly *Portus Adurni*."—F. Haverfield, in the list of places contained in the map of Roman Britain in the 'Historical Atlas of Modern Europe' (Oxford: Clarendon Press, 1896). See also *Archæological Journal*, vol. xlv. p. 68.

a naval station is the main cause of the importance of Portsmouth. Modern railway facilities were required to give it the commercial value which it now also possesses.

Tamara, now represented by Plymouth, owes its displacement as a seaport to the increased size of vessels. When smaller sea-going vessels were in use, it was, of course, important that they should penetrate as far inland as they could. The displacement of Gariannonum, now represented by Yarmouth, is, on the other hand, probably due to a change in the coast-line. In Roman times, the present site of Burgh Castle appears to have been at the mouth of the Yare. Yarmouth, which dates from Saxon times, stands on a spit of blown sand, which holds back recent alluvium of the Yare and Bure.

Among Roman seaports which have not survived, at least as such, may be mentioned *Portus Lemanis* (Lympne), already referred to (vol. ix. p. 85); *Regulbium* (Reculver) and *Rutupiæ* (Richborough), both of which have lost their importance through the alluvial deposits which have filled up the Wantsum and the mouth of the Stour; *Anderida* (Pevensey), which has also been cut off from the sea by alluvial deposits; *Regnum* (Ochester); *Branodunum* (Brancaester); and *Vainona* (Wainfleet). Whether *Regnum* is, strictly speaking, to be included among the Roman seaports of Britain is perhaps doubtful. No doubt part of its importance was due to the fact that boats of light draught can navigate Chichester harbour (the inlet to the east of Hayling island); but it does not follow that they could reach the site of the city itself, the geographical importance of which is partly determined by other circumstances (see vol. ix. pp. 76, 77). Camden notes that the city "would have arisen to great splendour had not the harbour been at too great distance and inconvenient," and he adds that the inhabitants were then about to dig a new canal. The Lavant, the small stream on which the city stands, is useless for navigation; and the canal, which now admits barges of 4 feet draught to the city, follows a different course.

Branodunum is only known as one of the forts of the Saxon shore, but it is probably to be regarded as an ancient seaport, for there is no other place that it could have served as a defence for, so that it must have been erected to defend a landing-place from the sea. It is now quite cut off from the sea by the marshy alluvium already mentioned (vol. ix. pp. 76, 77), as here lining the base of the chalk cliffs of Norfolk.

Wainfleet, on the Lincolnshire shore of the Wash, is identified by Dr. Stukeley with *Vainona* (or rather with the *Navione* of Ravenna, of which *Vainona* is a corrected reading); and Mr. Skertchley, making the same identification, believes that here in Roman times was the main mouth of the Witham.* Leland (1549) speaks of Wainfleet at that time as a pretty market town on a creek near to the sea, with small vessels belonging to it; and this creek, he says, after entering a considerable way inland, sent out branches on either side into the fens.

Of Roman towns that stood on navigable rivers, the following may be mentioned as still retaining some of their ancient importance: *Durovernum* (Canterbury), *Cæsaromagus* (Chelmsford), *Camboritum* (Cambridge, or rather Grantchester, the predecessor of Cambridge), *Durolipons* (Godmanchester, opposite Huntingdon), *Ratae* (Leicester), *Lindum* (Lincoln); *Danum* (Doncaster), *Legeolium* (Castleford), *Calcaria* (Tadcaster). Most of these were probably either at the head of navigation on the rivers on which they stand, or at fords, or both. The Stour was navigable to Canterbury down to comparatively recent times. The name of Cambridge, and that of its ancient representative, show that the bridge across the

* "Geology of the Fenland." By S. B. J. Skertchley ('Memoirs of the Geol. Survey of Great Britain and Ireland, 1877'), p. 15.

river here was preceded by a ford, *ritum*—being the Latinized form of the Welsh *rhŷd*, “a ford.” The name Castleford points to a similar origin for the town and its ancient predecessor. Leicester was long at the head of navigation of the Soar, the navigation being now continued beyond the town by canal. Tadcaster is still the head of navigation on the Wharfe. The importance of Lincoln as, on account of its position at a well-marked break in the Lincolnshire limestone, a point of convergence of roads, has often been remarked on. In Roman times, and for many hundreds of years afterwards, it was perhaps quite as important as a meeting-place of waterways. The Witham below Lincoln is still a waterway to the Wash for boats of 5 feet draft, and this line is continued west of Lincoln to the Trent at Torksey by the Foss dyke. The latter navigation at least was much more important formerly than now. According to Dr. Stukeley, Torksey occupies the site of a walled Roman town, and the castle existing in his day was founded, he says, on the old Roman granary, “which was much like Colchester castle, with circular towers at the corners.” Southwards, Lincoln communicated with the Welland by the Car-dyke (that is, fen-dyke), the Roman navigable trench by which the waters from the higher grounds on the west were intercepted and thus prevented from drowning the low fenlands to the east. It began on the Welland to the west of Ermine Street, and, passing to the east side of that highway at Catesbridge, continued northwards by a nearly parallel course till it ultimately joined the Witham. The ditch still survives, though no longer navigable. In Roman times, and probably for long after, it must have added considerably to the importance both of Lincoln and Torksey. In Domesday Torksey is mentioned as a place with “two hundred burgesses enjoying not a few privileges, upon condition they should conduct the king’s ambassadors when they come this way in their boats down the Trent, and bring them as far as York.”* In Norman times, Lincoln is described by William of Malmesbury as one of the most populous cities in England, and a mart for commodities brought both by land and water. By Edward III. it was made a staple for wool, leather, lead, etc.; but two centuries later Camden says it is incredible how it had declined by age, only eighteen churches then remaining of the fifty which it had held in Edward III.’s time. By that time the Foss-dyke had got choked up. Bishop Atwater (1514–21) had begun to cleanse it in the hope of bringing vessels to Lincoln, but died before achieving his purpose.†

Of Roman river-towns which, like Torksey, have decayed without recovery, four—Isurium (Aldborough), Durobrivæ (Castor), Margidunum (East Bridgford), and Uriconium ‡ (Wroxeter)—are worthy of special notice. Next to York, Isurium, which stood on the Ure a short distance above its confluence with the Swale, was the most important city in the valley of the Ouse. It is close to the terminus of river-navigation at the present day, the navigation being now continued to Ripon by canal; but this in itself could not have accounted for the growth of a town at this point, as the Swale, or eastern headwater of the Ouse, continues to be navigable a good deal further north. Probably the adoption of the site was due to the fact that, in proceeding northwards on the right side of the river by the direct road from Tadcaster, this was the first point at which the river could be conveniently forded, the road then proceeding beyond this point, between the Ure and the Swale, to Cataractonium (Catterick Bridge), where the latter river was crossed. After its decay, Isurium never revived, and such importance as it may have possessed as a centre of trade seems to have passed over to

* Camden’s ‘Britannia,’ Gough’s edit., vol. ii. p. 227.

† I. Land, vol. i. p. 32.

‡ Or Uriconium; also found as Viroconium.

Ripon, the town which grew up round the abbey founded by Archbishop Wilfrid of York, in the infancy of the English Church.

As the importance of Isurium has passed over to Ripon, so that of Durobrivæ ("the passage of the river" Nen) has passed over to the city of Peterborough, which owes its origin to a monastery built in the early part of the seventh century by Peda and Wolpher, sons of Penda, the first Christian king of Mercia, a little to the east of the old Roman town, the site of which is still commemorated in the names of two villages, Castor, on the north or Northamptonshire (once the Danish) side of the river, and Chesterton, on the south, Huntingdonshire, or Anglian side of the river. Similarly, the importance of Margidunum, whatever that may have been, has passed over to Nottingham. The site where Roman remains have been found identified with those of Margidunum is on the Trent a few miles north-east of Nottingham, and the place may have had a certain importance in connection with the Trent navigation, since it is the first point at which the Fosse Way, coming from the south-west, approaches the river; but there are no evidences of any important crossing-place here in Roman times as there was in later days near Nottingham. Probably the forests of western Notts (Sherwood, etc.) extended further east in Roman times, and hence the most convenient communication with the north was first north-east to Lincoln, and then north-west between the forests of the present Nottingham and the marshes of the lower Trent and Don by Torkeay, Doncaster, and Castleford to Tadcaster and York.

The remaining Roman towns that it may be interesting to consider are best noticed in connection with the great Roman roads. The great north-west road is that which came to be known as Watling Street. If we take it as beginning at Dover or Richborough, it passed by Canterbury and Rochester to London, then by Sulloniacæ (Brockley Hill), Verulamium (St. Albans), thence to the south point of the modern county of Leicester, from which point it forms the whole of the south-west boundary of that county (the only county boundary composed of nearly mathematically straight lines in England). On leaving Leicestershire, it first continues in a north-westerly, then in a westerly, direction to the north of the ancient forests between the Avon and the Severn, passing Letocetum (Wall), Pennocrucium (Penkridge), and touching the Severn at Uriconium (Wroxeter). From that point it probably ran north to Chester.

Important as this road undoubtedly was for centuries, it is somewhat remarkable that there is no town on it of any importance north of the Thames except St. Albans and the terminal city on the Dee. St. Albans, though always notable in English history, is of small consequence compared with what it was in Roman times, when it was the rival of London in importance and dignity, though not, of course, in commerce. If Letocetum had any importance in Roman times, that importance has passed to Lichfield, which is situated 2 or 3 miles to the north-east. Uriconium was certainly an important Roman town. Its precise position seems to have been determined by the fact that the Severn is here fordable, which it is not lower down. After the destruction of this town by the Danes, it may be said to have been replaced by Shrewsbury, the town which arose a few miles higher up, on a red hill† nearly encircled by the Severn—a position accordingly peculiarly well adapted for defence.

This Roman road was crossed by another called the Fosse Way, running from south-west to north-east. It no doubt branched off from some point on the great

* Etocetum, hitherto the usual, is, it seems, an incorrect spelling. See the list already referred to in the 'Historical Atlas of Europe.'

† Lower Permian (Rothliedendes).

south-western road to Exeter, but only begins to be traced in the neighbourhood of Ilchester, whence it passed north-east to Aquæ Sulis (Bath), Corinium (Cirencester), and that point in the south-west boundary of Leicestershire where a slight change is made in the direction of that boundary (from north-west by north to north-west by west). At this point it crossed Watling Street, and beyond that road its north-easterly direction was continued by Leicester to Lincoln.

On the Fosse Way, the only Roman towns besides Lincoln which have retained any importance are Bath, Cirencester, and Leicester. Bath still derives importance from the hot springs, to which it owes its present, as it owed its Roman, name, and by which in ancient times it gained celebrity. Cirencester, though still a town with several thousand inhabitants, no longer has the relative importance which it must have had in the Roman times, when it was the point of convergence of several important roads, the Fosse Way being here crossed by the road from Silchester to Gloucester. It was probably the fact of the Soar navigation ending here that determined the revival of Leicester on its ancient Roman site.

An important Roman town might have been expected to exist at the point on the Leicestershire boundary already mentioned as the crossing-place of Watling Street and the Fosse Way. At present there are only one or two small villages in the neighbourhood of this spot, which still bears the name of High Cross, "from a cross," says Camden, "that anciently stood there on a high ground, now succeeded by a higher post with its props;" but the people round about stated that "here was a most flourishing city named Cleycester, which had a senate of its own, and of which Cleybrook (Claybrooke), about a mile off, was part, and that on both sides of the road foundations of hewn stone lie under the furrows, and Roman coins are very often ploughed up." This city he identified with the Bennonæ, or Venonæ, of the Itinerary of Antonine, and the identification has been generally followed.

Dr. Guest contends that the southern portion of the Ermine Street, or great north road leading out of London, was not of Roman construction, basing his belief on the absence of Roman stations, villas, and burying-grounds on the part of the road between London and Huntingdon (or Godmanchester—Durolipons), and on the fact that of the three Antonine itinera leading to London, two first run down Watling Street to the Fosse Way, and thence from Venonæ north-west, and one runs first to Colchester, and then by Cambridge to Huntingdon. If Dr. Guest is correct, we may conclude that the alluvium of the Lee, and the forests on both sides of that river, presented obstacles in the way of road-making which it was not worth while to overcome under the conditions then obtaining. The route north-eastwards led to the most populous and richest part of the country by a succession of places where deposits of gravel and sand (Ilford, Romford, Ingatestone) and pebble-beds (Brentwood) afforded sites for towns and villages, and to some extent, no doubt, road-making material. The stations between Colchester and Cambridge on the iter leading that way to Lincoln are not identified. The next beyond Godmanchester is Durobrivæ, already mentioned as identified with Castor, near Peterborough; and the only other till Lincoln is reached is Causennæ, identified with great probability with Ancaster, now only a small village a few miles north-east of Grantham. On this route, also, accordingly the only places identified still of importance are those already mentioned as sea or river ports.

It is the same north of York. As far as Newcastle, not a single Roman station in the north has been identified with a place which is now of any importance. West of the Pennine chain, Carlisle, which has always had some importance as the centre of the New Red Sandstone (Triassic red Permian) basin of the Eden, seems to be the only place of importance now which was also important in Roman times until we come to the Dee. It is noteworthy that, at least in the time of the

Itineraries of Antonine, the main line of communication with the far north, whether towards the east or west end of the wall, was by the east of England. The fifth iter, which gives one route from London to Carlisle, passes from the basin of the Tees to that of the Eden by the route now followed by the North-Eastern Railway. Bowes, the village which gives name to the station at the head of the valley on the east side of the upland part of the railway, occupies the site of the Roman station of *Lavatras* on this route. The Roman station of *Vertera*, near the head of the valley on the west side of the Pennine chain, occupied the site of the modern village of Brough, a little to the east of the northern branch of the North-Eastern line on this side. From Brough the Roman road passed down the valley to Carlisle. There was one intermediate station, and it may be remarked that this station stood not exactly on the site of the modern Penrith, the point on which one descends directly in coming from Shap Fell, by the route by the London and North-Western Railway and the high-road from Lancashire, but at the place where the road from the north-east crosses the Eamont just before reaching Penrith, namely, at Brougham Castle, whose name probably preserves that of the Roman station *Brocvam*.

There are two itinera giving routes from the north to Manchester and thence southwards, and both of these branch off from the route just spoken of. One of these (Iter II.) takes us from Carlisle to York, and then proceeds south-west by Tadcaster, and crosses the Pennine chain a second time before reaching Manchester. One intermediate station, *Cambodunum*, is mentioned, and this is now generally identified with Slack, which is now not even a hamlet, but a mere site about 3½ miles west by north in a direct line from the London and North-Western station at Huddersfield. The other route (Iter X.) is a very obscure one, and was made all the more obscure by the inconsistencies and various readings of the texts that Camden, Horsley, Reynolds, and other English antiquaries, had to deal with. A very plausible interpretation of this route, based on the revised text of Parthey and Pinder, is given by Mr. W. Thompson Watkin in vol. xxviii. of the *Archæological Journal*. According to this interpretation, Iter X. crosses Shap Fell a little to the east of the north road from Kendal, and, after crossing the Eden valley, is continued by the Maiden Way referred to by Scott in 'Guy Mannering' (ch. xxiii.) in the direction of the wall; but this view seems to be only partially adopted by Mr. Haverfield in his map of Roman Britain. Like Mr. Watkin, Mr. Haverfield appears to identify, though doubtfully, *Coccium* (an unimportant station) with Wigan on his map, but he does not enter it in his list; and *Bremetannacum* and *Galacum* are identified by both with Ribchester and Overborough respectively, the former now a mere village, though probably a considerable seaport in Roman times; the latter a site 2 or 3 miles south of Kirkby Lonsdale, about the place where the Lune enters Lancashire, now represented not even by a hamlet. Beyond this point Mr. Haverfield looks upon the route of the iter as dubious, though some Roman road is marked by him as following the remainder of the route marked out by Mr. Watkin. But on this part of the route also there was no station now of any importance, unless we may regard the modern lead-mining town of Alston as representing an ancient Roman lead-mining centre under the guardianship of a station (a mile or two to the north) at Whitley Castle, which is identified by Mr. Watkin with *Glanoventa*, and has been identified by others with other stations. All interpretations of this iter agree in identifying *Mancunium* with Manchester, but there is no evidence that Manchester itself was a place of any importance in Roman times. The Roman remains found there are scanty, and its site in Roman times had no advantages. Marshes, forests, and sandy wastes seem to have then rendered south-west Lancashire of little value. The site seems to have been determined by the "hard rock of stone" which Leland speaks of on the banks of the Irwell, a good

foundation for a fort. The Irwell afforded power at an early date for mills, but it was not till after 1720 that the "vadyd and rokkys" that obstructed its navigation were removed, and the river made navigable to the city by means of weirs and locks.

In the south-west of England, two inland towns besides Bath have maintained more or less importance since Roman times. These are Winchester and Dorchester, and along with these may be mentioned Salisbury, the modern representative of Sorbiodunum, though on a slightly different site. The natural features, all very similar, to which these three towns owe their importance have been already referred to (see vol. ix. pp. 80, 81). All the other stations of the itineraries in south-western England are identified with places now quite insignificant, unless Horsley's identification of Vindomum with Farnham be accepted; but one of them, *Calleva Atrebatum*, now Silchester, must in Roman times have been a centre of very considerable importance. Its Roman remains cover an extent of 80 acres, and in Roman times it was a meeting-place of roads from London, Cirencester, Salisbury (Old Sarum), and Winchester.

In Wales and Monmouth and the adjoining counties, three principal routes are given in the Itineraries—one along the southern maritime tract to Carmarthen, one along the northern maritime tract to the Conway river, and one running from south to north, east of the Welsh mountains, connecting the first route with Wroxeter and Chester. The Roman ferry across the Severn appears to have been about the place where the estuary begins to expand, in the neighbourhood of the present tunnel. The landing-place on the English side is not definitely ascertained, but on the Welsh side it must have been about Portskewet, for the first station on that side, *Venta Silurum*, a very important one, has been clearly identified with Caerwent, on a height immediately above that village. From that station the southern road running west appears to have touched four seaports, all of which are seaports at the present day, or have a representative immediately adjacent. The first of these seaports was *Ica Silurum*, remains of which are found at Caerleon, on the Usk, from which the station took its name, the seaport on which, however, is no longer at Caerleon, but at Newport, a short distance lower down. The other three seaports are *Nidum* (Neath), *Leucarum* (Loughor, or, in Welsh spelling, *Llŵchwr*), and *Maridunum* (Carmarthen). In the north the road took a more inland course, its line being apparently determined, not by the ports, but by the fords. Only two stations west of Chester are mentioned in the Itineraries, *Varæ* (Bodfari) and *Conovium* (the "Conway" station, placed by Horsley at Caerhun). Probably this road was afterwards continued to Carnarvon (*Segontiacum*), which is mentioned in the *Notitia*, but not in the Itineraries or by Ptolemy.

The road leading from the south to Wroxeter started at Caerleon, and first followed the Usk valley. The intermediate stations on it are identified with Usk, Abergavenny, Kenchester (north-west of Hereford), and Leintwardine (crossing-place of the Teme in north-west of county of Hereford). Two of these have still a certain amount of at least relative importance arising from their situation. Usk, in Roman times as now, was the starting-point of a road, now a railway, ascending the valley of the small stream that here joins the Usk river, and passing by Monmouth, Ross, and just north of the Forest of Dean to Gloucester. Abergavenny stands at a still better-marked node, the point of convergence of four valleys, the upper and lower Usk forming two of these (running respectively north-west and south), that followed by the railway to Merthyr Tydvil forming a third, and that by the Great Western line to Hereford the fourth. The other two stations have been replaced by modern towns at a greater or less distance from the ancient, their sites being now occupied only by insignificant villages.

So much with regard to the towns or more important stations which did exist in Roman times. It is in some respects even more instructive to consider shortly some of those which did not then exist. And from this point of view there is, perhaps, nothing more striking than the scanty indications of Roman settlement on the three great rivers, the Thames, Severn, and Trent, above the limits reached by sea-going vessels. True it is that Roman stations, as we have already seen, are mentioned in the Itineraries at points far from the mouth on all these rivers; but all of them seem to have been mere crossing-places, and, except in the case of Wroxeter, there are no remains to show that they were of any great importance. Pontes, on the Thames, whether at Old Windsor or Staines, was merely the crossing-place on the road to Silchester. The name of the station, Ad Pontem, on the Fosse Way, together with the distances mentioned in the fifth Itinerary, makes it extremely probable that there must have been a station at a crossing-place of the Trent about Farndon, just above the islands enclosed by the two arms of the river, on one of which now stands Newark. The station must have been on the right bank, as there is no mention or indication of any other crossing of the Trent on the way to Lincoln, and no trace of any Roman road running north on the left bank of the river. There must, of course, have been some population on that bank of the river, but that population seems to have been very scanty. The absence of all traces of the station at which the river was here crossed seems to justify the inference that there was no such population on the left bank as to give to the station any great importance. At Wroxeter it was different, but the difference was not due to any additional value given to the site by the navigation of the Severn, but to the fact that the station at this ford was the point of convergence of roads from the south-east (London), the north (Chester), and the south (Caerleon and the Severn estuary).

Of course we have other evidence of the existence of Roman towns and settlements than the fact of their being recorded by one or other ancient writer. There is the evidence of names and remains. There are, it is said, 119 -chesters or -cesters, or some other form of the Roman castra, in Domesday, and it is probably fair to presume that all of these represent Roman towns. There are none of these, however, in the course of the Trent. The equivalents of the Roman *strata* are more doubtful signs of a Roman origin, but there is no name of this root met with in ascending the river till we come to Stretton, near the mouth of the Dove (the valley containing Uttoxeter). On the Thames between Cirencester and London, the only name indicating a Roman origin is Dorchester, and the Roman remains found here confirm the indication. Possibly, seeing that it is not mentioned by any ancient writer, the place is of late Roman origin. In any case, its existence on the banks of the Thames is no sign of extensive settlement on these banks, for it also was only a crossing-place—from the vale of Aylesbury, north of the Chiltern hills, to that of the Ock, in Berkshire. There are several "fords" about this part of the river, and the name Shillingford, exactly at the mouth of the Thame, would indicate that there was once a ford close to Dorchester. Roman remains have also been found at Sinodun hill, on the opposite bank.

Between Wroxeter and Gloucester there is also only one -cester—Worcester. Here, however, there are no Roman remains, though an old parchment, Camden tells us, boasted that it once had Roman walls. Probably it too was of late Roman origin, and if Prof. Thorold Rogers was right in saying (I don't know on what authority, except perhaps on the presumption that Droitwich is the Salinae of the anonymous writer of Ravenna) that the Romans undoubtedly made use of the Worcestershire salt deposits, it is possible that the salt was conveyed down the Severn from Worcester.

All these indications of Roman occupation on the banks of the three great rivers

of England are, however, very scanty, and the absence of others would seem to justify the conclusion that in Roman times the valleys of these rivers were very thinly peopled. In all probability they were still, for the most part, unreclaimed marsh and forest.

If that was so, that single fact implies that the conditions under which towns, having practically ceased to exist in England, arose again after four or five centuries of village life, were to a large extent different from those under which they had been created by the Romans. During this long interval, an interval as long as that between the Wars of the Roses and the present time, but of which our only record is a story, and that imperfect, of wars between Angles, Jutes or Saxons, and British, between Saxons and Saxons or Angles, and between English and Danes, the great work of reclaiming the land, making it fit for agricultural settlement, must have gone on incessantly. Great numbers of the villages to which continental invaders after the departure of the Romans gave their names must have existed in Roman times, but multitudes of others must have received their names from these settlers through the original right of first occupation. And it is to be noted that when towns did come into being under these circumstances, they would grow; they would not be created. They would serve in some way local convenience, and increase from villages to towns in proportion as they did so. On the other hand, the Roman towns or more important stations on the great roads appear to have been established merely with reference to military and administrative convenience, and without any special regard to the trade requirements of the districts in which they were situated. Some of the more important towns, such as London, Lincoln, York, Winchester, Bath, Gloucester, and others, had their sites determined by natural conditions which have made themselves good throughout the history of this island. These were almost of necessity fixed points in any network of roads constructed for military purposes. But between such points the roads were laid with as much directness as the state of the country permitted, and no deviations seem to have been made, even for the sake of passing through important mining districts. Though pigs of lead with Roman inscriptions, dated in the sixth year after the invasion of Claudius, have been found in or near the Mendip hills, showing that the lead-mines here were worked from the very beginning of the Roman occupation, the Fosse Way is laid so as to run to the east of those hills, the mines in which were served by a mere vicinal road. So also, if Ariconium in the thirteenth *Iter* is rightly identified with Ross, the distance to Gloucester given in the *Itineraries* does not admit of any deviation into the mining district of the Forest of Dean, the produce of which must also have been carried along vicinal roads, or possibly on pack-animals by mere tracks.

A few important places having thus determined the direction of the main roads, the intermediate stations—which became, in some cases at least, the nuclei of considerable towns—had their sites necessarily determined by the direction of the roads, and only in a secondary degree by local circumstances, and these determining local circumstances were regarded rather from the military and administrative than the commercial point of view. Hence it is that, while many of the more important Roman towns have their modern representatives on the same site or a site immediately adjoining, many others have utterly disappeared, or have given place only to insignificant villages.

Nevertheless, there may have been reasons in certain cases why new towns should grow up under new conditions on or near the sites of some of these intermediate stations. This is notably the case with ford towns or stations. The position of intermediate Roman stations on rivers seems to have been determined rather with reference to the convenience of crossing the river by fords or bridges

than with reference to the use of the river as a waterway. But when the termini of the road made it convenient to cross by the lowest ford, that was often almost identical with the head of navigation. Hence, when a river came to be used as a waterway, a town would naturally grow up on or near the site of a previous ford-town. Thus *Camboritum* (Grantchester), the predecessor of Cambridge, was, as its name implies, originally a ford-town, but may have gradually acquired importance as a town at the head of navigation. Moreover, as Mr. Loftie has pointed out in his 'History of London,' fords are apt to occur at expansions of a river immediately above more contracted and deeper parts of the course, and these contracted parts are those which it is easiest to bridge; and so an original ford-town may grow in importance through its convenience as the starting-point of down-stream navigation, and then acquire still greater consequence through being made a bridge-town.

In some cases the deserted shells of Roman towns were themselves reoccupied.* Chester, for example, which seems to have been abandoned for three centuries after the victory of Æthelfrith about the end of the sixth century, was reoccupied by the daughter of Alfred in the beginning of the tenth century.† Carlisle had already been reoccupied by the English when it was destroyed by the Danes in 877; but Freeman conjectures that it was desolate two centuries later, when it was repeopled with English and Flemish colonists by William II.‡

In other cases an adjoining site became that of the succeeding town, probably for no other reason than that it was easier to utilize the material of the older town on an adjoining site than amidst the ruins of the previous town. Sometimes, however, some neighbouring site may have presented a distinct advantage in the eyes of both Saxons and Normans which was held of little account by the Romans. While the Romans seized on positions of great natural strength for their more important stations, such positions were of less consequence to them after they had established themselves, when they could rely confidently on their power of fortifying any position that it might be convenient for them to occupy against any attack that was likely to be made upon it. The Saxons, on the other hand, in their wars against the British and against each other, sought to turn to account every position of natural strength. Hence places that had eminences suitable for strongholds became in many cases the nuclei of their towns, and Saxon strongholds were frequently succeeded by Norman castles. Such probably was the reason why Wroxeter gave place to Shrewsbury and Caistor to Norwich,§ though in this latter case the original nucleus of the new town was the ford of the Yare (Conesford), to the south of the castle hill. Some of these Saxon strongholds, at one time important, but owing their importance solely to facilities for defence which were afterwards of no consequence, sank into insignificance at an early date. Such, for instance, were Amesbury (Ambresbury, the city of Ambrosius) in Wilts, Badbury in Dorset, and Almondbury, near Huddersfield.

It has been stated above that when towns again began to grow up in England after centuries of village life, the geographical conditions affecting their development were essentially different from those of Roman times. But it must not be understood that these changed conditions were final. They continued to be modified in many ways, and in some cases, even before the great revolution

* Freeman, 'History of the Norman Conquest,' vol. i. p. 15 n.; Loftie, 'History of London,' vol. i. p. 54.

† Freeman, vol. iv. p. 313.

‡ Freeman, vol. v. pp. 118, 119.

§ The actual mound on which the castle is built is artificial, but the ground rises considerably to the site of this mound from the rivers Yare and Wensum.

wrought by the application of coal to the production of steam-power, which has been the greatest town-forming influence in England, these modifications had their effect in the rise and fall of towns. But towns, once in existence, make a struggle for life. If conditions are changed, efforts are made by the inhabitants to adapt them to the new conditions, and towns accordingly may have owed their origin to conditions that have long since ceased to exist. In many cases, too, these conditions may not have been at the first strictly geographical, and even when they are geographical, the geographical advantage may often seem very slight in consideration of the importance of the town. When the population and industry of some district requires a town somewhere as a centre of exchange, perhaps an important centre of exchange, a very trifling circumstance may determine the exact site on which that centre grows up.

The first towns that are likely to grow up of themselves are centres of trade. These, of course, are preceded by seats of government; but such towns are frequently on sites chosen more or less arbitrarily, and the nature of the site may have little to do with their growth. With a geographical object in view accordingly, centres of trade may be first considered, and, with reference to their growth, navigable rivers must be a prime consideration at a time when internal communications of another kind are imperfectly developed. At the present day their importance in this respect is obvious enough in new countries, though we in England are apt to forget it, since railways have so completely put internal waterways into the background.

But, in the case of old English towns, the inquiry as to the influence of navigable rivers on their origin is often rendered difficult by our ignorance as to the condition of rivers at the time when the towns arose. We know that in some cases rivers were navigable in former times that are not navigable now, and, again, that rivers are now in some cases navigable to a greater extent than they were formerly. Acts have been passed at different times for the making now of one river, now of another, navigable up to a certain point, but these Acts do not prove that these rivers were not at some earlier date navigable to an even higher point. We are told, for example, by Gough, in his edition of 'Camden's Britannia' (1789), that the Trent had lately been made navigable to Newark; but we know from Domesday that this river was then navigable at least as high as Nottingham. Gough's statement, moreover, must mean that the Trent was then made navigable for larger craft to Newark, for Arthur Young, writing a little earlier (1770), states that flints were brought to Burslem from the Thames first to Hull, and then to Burton. Probably a similar meaning is to be attached to being "made navigable" in other cases also.

Prof. Thorold Rogers, in the course of his quarter of a century of researches into the history of prices from the fourteenth century downwards, collected a good deal of information as to the use of waterways in early times; and he informs us that in the fourteenth century the Thames, the Severn, the Lower Avon, the Cambridgeshire Ouse, the Humber, the Itchen, the Test, the Stour (which Stour he refers to he does not say), the Wye, and many other rivers, were navigable and navigated.*

The Thames, however, was not navigated to so high a point as it was subsequently. In the fourteenth and fifteenth centuries, and even as late as 1541, Prof. Rogers says in a later volume,† Henley was apparently the limit of navigation.

* 'Agriculture and Prices,' vol. i. p. 663. I have substituted Lower Avon for "the Ouse on which Bristol was built."

† Vol. vi. p. 758.

Afterwards for about 70 or 80 years it was Burcot, a hamlet about $1\frac{1}{2}$ mile from Dorchester, and there Prof. Rogers tells us he could still, in 1877, discover, from four or five ruts cut deep through the ground between the water and the high-road, where the pier must have been. Subsequently, either through improvements in the river itself or by the building of barges that could pass the shallows, the navigation was continued to Oxford, and even beyond it, for, though this is the limit of water-carriage in the instances that fell under Prof. Rogers's eye, Yarranton, in his 'England's Improvement by Land and Sea' (1677), speaks of Lechlade, the present limit of barge navigation, as at the head of the navigable waters of the Thames in his day.

In the case of the Severn, Prof. Rogers gives an instance from the year 1374 of the carriage by water of $1\frac{3}{4}$ fother of lead, first from Worcester down to Bristol, then up the Wye to Monmouth, its ultimate destination being St. Briavel's. No doubt this lead was originally from Wirksworth, for centuries the principal lead market in England, and in that case it may have been previously carried down the Severn from some higher point than Worcester, though this city, which is still the limit of navigation for the larger river-boats, was no doubt a more important trade-centre than any town on the river higher up. At any rate, there is no reason to believe that this was then the highest navigable point on the river. Yarranton mentions Welshpool as at the head of navigation in his day, which it continued to be for more than a century later, and he points out the importance of the navigation of this river for the conveyance of the "sow iron" of the Forest of Dean to the forges of Worcestershire, Shropshire, Staffordshire, Warwickshire, and Cheshire, counties, he says, in which "there never will be any want of pit-coals to work and manufacture the iron when once made into bars." At the same date the Wye was navigable to Hereford, but the Worcestershire Stour was not navigable. The making of it navigable was one of Yarranton's own abortive projects.

Of the relative importance of towns in past centuries we have only doubtful indications. Estimates of the population have been made on the basis of the subsidy roll of 1377, these estimates assigning to London a population of about 85,000, to York one of nearly 11,000, to Bristol one of 9500, to Plymouth and Coventry each about 2750, to Norwich nearly 6000, and to Lincoln a little more than 5000. Only three, Salisbury, Lynn, and Colchester, are credited with a population of between 4000 and 5000. Eight, namely, Beverley, Newcastle-on-Tyne, Canterbury, Bury St. Edmunds, Oxford, Gloucester, Leicester, and Shrewsbury are estimated to have had between 3000 and 4000, and the remaining towns with more than 2000 inhabitants are eleven in number, namely, Yarmouth, Hereford, Ely, Cambridge, Exeter, Worcester, Kingston-upon-Hull, Ipswich, Northampton, Nottingham, and Winchester. Twelve other towns are mentioned in the list. These are Newark, Wells, Ludlow, Southampton, Derby, Lichfield, Chichester, Boston, Carlisle, Rochester, Bath, and Dartmouth, the latter three of which are estimated to have had less than 1000 inhabitants.*

This list deserves a little consideration. It includes in all forty-two towns, of which nineteen were seaports, and at least fourteen were river-ports—seventeen, if we may include among the latter Shrewsbury, Hereford, and Winchester. (According to Prof. Thorold Rogers, the Itchen was navigable at this time.)

Among seaports, the high place belonging to Bristol is very noticeable. It is the port of a region which has always been one of the richest, agriculturally, in England, and one to which population had been also attracted at a very early

* These estimates are all from Macpherson's 'Annals of Commerce,' vol. i. p. 583, but the exact figures of Macpherson's list are converted into round numbers.

date by the working of the lead-mines of the Mendips. But its great importance is probably to be referred to its foreign commerce—above all, its commerce with Iceland and the north generally, which dates from the century to which the list belongs—that in which lived the first William Canynge, who began the rebuilding of the church of St. Mary Redcliffe. It was not a Roman town. In Roman times, no doubt, Bath served all the purposes of a seaport for this region; and from this list it would appear that as Bristol rose Bath declined. But if we account in this way for the importance of Bristol, it is surprising to find Southampton and Boston both so low in the list. Both of these were likewise important for their foreign commerce at this date, and another assessment list twenty years later gives a very different relative position to these seaports among English towns, although it does not afford the means of estimating the population. In this later list of 1397 we only get the amounts for which different towns were assessed, but in it we find that Boston and Southampton ranked respectively as fourth and tenth, instead of thirty-eighth and thirty-fourth, as in the list of 1377. Boston in this list is assessed at £300, Southampton at £113½; against £800 for Bristol.* About a century later, in the reign of Henry VII., Southampton, if we may judge by the amount of customs dues levied, had about the same relative importance as it now has among the ports of the south-east of England—ranking next after London, and separated by a long interval from the third in this respect, which was then Boston. Bristol then had the fourth place, coming next after Newcastle.†

Plymouth, notwithstanding the excellence of its natural harbour, was a place of comparatively recent growth in 1377. It is described by Leland as having been, in Henry II.'s time—about two hundred years before—a mean thing inhabited by fishers.

The position of Norwich, which comes next among the seaports, at the end of a waterway leading far into the interior of one of the richest corn counties of the kingdom, fully accounts for the important position that that town has always managed to retain. Lynn and Cambridge, on the Ouse, show the importance of the navigation of that river—a circumstance which in all probability led to the locating of the great fair of the eastern counties, the Stourbridge fair, which was largely frequented even down to the latter part of the eighteenth century, close by Cambridge.

Hull at this time was less than a hundred years old, but had already completely displaced its predecessor Hedon, which does not appear either in the list of 1377 or that of 1397. In Leland's time the harbour of Hedon had almost completely silted up, and though formerly the town had been nearly insulated by the subdivisions of the inlet from the Humber on which it stood, it was in his time approached by three bridges.

Nottingham is mentioned as a river-port, though the town itself is separated from the river by a mile or two of alluvial meadow-land, probably regarded as too valuable for sheep and cattle to be turned into sites for houses, especially since much better building land was to be got on the adjoining Bunter pebble-beds, under the protection of the castle crowning the chief height. In Domesday it is mentioned as guarding the waters of Trent and the road to York, and that the waters

* Cunningham, 'Growth of English Industry and Commerce: Early and Middle Ages,' p. 343.

† The total amount of customs dues levied during the reign of Henry VII. at London was £144,660; at Southampton, £170,200; at Boston, £57,600; at Newcastle, £45,800; at Bristol, £30,600 (Schanz, 'Englische Handelspolitik gegen Ende des Mittelalters,' ii. pp. 37-45).

of Trent are regarded as navigable waters is shown by the fact that a fine is imposed on any who should hinder the passage of ships. Whether the road to York is anything else than the Trent itself is not clear, but at a later time, at any rate, Nottingham derived additional importance from the fact that this was the crossing-place of the main road from south to north.

The towns in the list of 1377 that were neither seaports nor river-ports are—Coventry, Salisbury, Bury St. Edmunds, Oxford, Ludlow, Lichfield, and Chichester, besides the doubtful ones of Shrewsbury, Hereford, and Winchester. To these the list of 1397 adds Abingdon and Grantham, besides the seaports of Sandwich and Scarborough among the towns paying an assessment equal to that paid by Canterbury, Chichester, Leicester, and a number of others.

Among these Hereford, Ludlow, and Lichfield owed such importance as they possessed to their position in well-watered fertile plains or hollows at river-crossings. Of Salisbury, Shrewsbury, and Chichester nothing more need be said. About the time to which these lists refer Coventry was just beginning to be known as a manufacturing town. There is no geographical reason to be assigned for Coventry becoming either a manufacturing town or a centre of trade. It not only stands on no navigable river, but it is out of the route of the Fosse Way, which may be considered as giving some of its importance to Leicester, the nearest of its considerable neighbours. But its wealth and industry are amply accounted for by its special privileges. A wealthy monastery was founded here by Leofrick, Earl of Mercia, in the reign of Edward the Confessor. Early in the thirteenth century (in the second year of Henry III.), the charter for a fair was granted to it. Under Edward III. the original privileges of the monastery were confirmed and extended, no doubt through the influence of Queen Isabella, who possessed some land adjoining the monastery and afterwards surrounded by the walls of the town. The privileges conferred by Edward included exemption from several taxes for all lauds assigned to the monastery, and these privileges, together with the wealth of the monastery itself, would serve to attract a considerable population. To so great an extent did the town depend on the monastery that, whereas at the time of the dissolution of the monasteries the population was said to have amounted to 15,000, in the third year of Edward VI. it had sunk to about 3000. On the other side of England Bury owed its importance to similar circumstances, though here additional consequence may have been given to it as a trading centre if it was then, as it is now, at the head of the navigation of the Lark. If so, the Lark again required to be made navigable about 1730, when an Act was passed for the purpose.

Oxford and Abingdon both owed their rise to the same cause, namely, the fact of their standing at crossing-places (fords) of the Thames. In the first of these that is indicated by the name, but Oxford already at this time was, of course, a place of note and wealth as a seat of learning. At the date to which the list now under consideration refers, Abingdon was nothing but a ford-town (with a very wealthy abbey adjoining, however). There were two fords at or near the town, the Borough ford and Culham ford, both somewhat dangerous; and the town had rivals at other fords lower down—one, as we have already seen, at Dorchester (Shillingford), and another at Wallingford, this last, at a somewhat earlier date, the most important of all. But, says Camden, "About the time of the dreadful plague which followed the conjunction of Saturn and Mars in Capricorn, and raged all over Europe, A.D. 1348, so many persons died here, that from being a populous town, and having twelve churches, it has now but one or two." "The inhabitants, indeed," he adds, "refer this desertion to the bridges built at Abingdon and Dorchester, over which the road was turned."

The importance of Grantham in the fourteenth century may be connected with that of the seaport of Boston. As Lincoln would be the inland centre in communication with that port for the northern districts, so Grantham would be the same for the midland and southern districts of the interior. The town lies on post-glacial gravel and sand, in a slight but well-marked hollow at the convergence of small valleys between middle and upper Lias sands and clays and marlstone rockbeds with ironstone. Whether the ironstone was already worked in 1397 I cannot say.

Among the more noteworthy omissions in these lists are Chester, Liverpool, Manchester, Leeds, Halifax, Wakefield, Sheffield, and Birmingham. The omission of Chester is fully accounted for by the fact that the whole county was excluded from the assessments as being under a separate jurisdiction. Most of the other towns were more or less noted for their manufactures of one kind or another, if not in the century of which we are now speaking, in that which followed, but it was long before manufacturing towns in England, merely as such, became populous places. Sheffield, we know from Chaucer, was already noted for its cutlery in the fourteenth century. It has continued to be so ever since, yet in 1615 it had a population of only 2200.* Leeds, Halifax, and Wakefield became noted as seats of the woollen industry in the fifteenth century. According to Anderson,† the industry had migrated from the southern and eastern counties to the valleys of Yorkshire on account of the abundance of water, fuel, and cheap provisions. No doubt, the vicinity of the supplies of the excellent Lincolnshire wool, which (in its much improved condition) is still so valuable a commodity in the manufacturing towns of Yorkshire, would also be an important circumstance in favouring these seats of the industry. But these places grew but slowly in population. This was largely because the industries referred to belonged to districts rather than to towns, spinning especially being carried on to a large extent as a bye-employment on farms. Rapid concentration in towns was brought about in most cases only when machinery worked by steam-power came to be employed in factories, though two or three inland towns so placed as to be the natural centres of trade for populous districts, while at the same time carrying on manufactures of their own, grew with exceptional rapidity.

At the first census there were only three inland towns in England, Manchester, Leeds, and Birmingham, with a population of more than 50,000, and all these belonged to this class. Manchester then had a population of about 89,000; ‡ that of Birmingham, 73,700; and that of Leeds, 52,200.

According to Prof. Leone Levi,§ Manchester was known for its textile manufactures as far back as 1328, when a number of Flemish weavers settled there. Its site makes it the almost inevitable focus of all the roads leading across the Pennine chain to the south-east of Lancashire, as well as of others leading across detached parts of that chain. One road proceeds north-west to Bolton, and there forks so as to pass round an elevated patch capped by millstone grits, one branch going by Chorley to Preston, the other going to Blackburn. A more northerly road proceeds by Bury to Accrington between two similar outliers of the Pennine chain. Another runs north by east to Rochdale, then crosses the waterparting between the Roch and the Calder to the east of all these outliers, following the route of the railway to Todmorden and Halifax. Another goes north-east to Oldham, then east to

* Hunter's 'Hallamshire,' new edit. by the Rev. A. Gatty (1869), p. 148. In 1736 the total ascertained population was only 10,121 (*ibid.*).

† 'History of Commerce,' vol. i. p. 526.

‡ Including Salford.

§ 'History of Brit. Commerce,' p. 5.

Saddleworth, and then by a short and sharp ascent and descent passes across the millstone grit of Clowes Moss from the valley of the Etherow to that of the Colne with Huddersfield, the London and North-Western railway crossing this waterparting by nearly the same route in Stanedge tunnel, 3 miles long. Another road from Oldham crosses Clowes Moss with gentler slopes, though with more windings, more to the north-east, following nearly the route of the old Roman road by Slack to York. Eastwards from Manchester a road runs by Ashton and Stalybridge to Penistone, where it forks for Sheffield and Barnsley; and, finally, there are roads south-east leading to the valleys of the Dove and Wye in Derbyshire, as well as one across the high ground between these valleys, following somewhat the old Roman route to the ancient as well as modern lead-mining centre of Wirksworth.* A town so situated could not fail to become a centre of trade once population had grown up in the valleys to which these roads lead, but the development of industries on the east side of the Pennine chain was one of the conditions required for the full growth of Manchester. These facts help to explain the development of Manchester, such as it was, even before the rapid growth of its manufactures, consequent on the inventions first applied to the cotton industry. A survey of Manchester and Salford made in 1773 and 1774 enables us to estimate the effect which these inventions had on the population of this centre between that date and the census of 1801. The earlier date is a few years subsequent to the introduction of the spinning-jenny (invented 1764, patented 1770) and previous to that of the mule (patented 1779). In 1789 the first cotton-mill worked by steam was set in operation in Manchester. In 1773-4 the population ascertained for the two townships was 27,200; † in 1801 almost exactly 84,000 (being about 94 per cent. of the total population of the municipalities). But even since these inventions it is more as a business than as a manufacturing town that Manchester has continued to grow. The spinning-jenny and the mule were both to a large extent, perhaps chiefly, employed in country districts, and, as is well known, it is rather in the towns round about Manchester than in Manchester itself that the cotton industry is now, and has long been, carried on by steam-machinery.

With regard to Liverpool, which, like Manchester, is unmentioned in the lists of 1377 and 1397, and which, as is well known, was an unimportant place even in the early part of the seventeenth century, all that need be said is that its growth as a seaport was retarded by the same circumstances that kept back the growth of Manchester, on which its trade has always in a large measure depended.

On the east side of the Pennine chain, Leeds has a position somewhat analogous to that of Manchester on the west side, only the convergence, owing to the greater extent of open plain on this side, is less marked. On the west side, Manchester is the only point of convergence in or near the border of the more open part of the plain. On the east side, in addition to Leeds, such a situation is occupied by Sheffield, and in a less degree by Wakefield and Barnsley. It is probably, therefore, to be ascribed, at least in part, to this circumstance that Leeds has not grown so rapidly as Manchester, either before or since the beginning of the present century. In 1801, Sheffield was the only town besides Leeds with a population exceeding 10,000 in the West Riding of Yorkshire. Its population then amounted to 31,314; but this population does not correspond to that of the present municipal and county borough, which occupies an extensive area stretching 11 or 12 miles from north-east to south-west, nearly as large as the former parish of Sheffield, which in 1801 numbered 45,755 inhabitants. Though no other town in this district then had a population

* I have mentioned only such roads as existed before the close of last century.

† Wheeler's 'Manchester,' p. 249.

exceeding 10,000, there were some populous parishes, but most of them of great extent. Wakefield parish, with an area of 9311 acres, had 16,600 inhabitants, the borough (township) 8131 inhabitants. The only other township with more than 8000 inhabitants was Halifax (8886); but the parish of Halifax, which embraced all the Calder valley above the confluence of the Colne, extending westwards to the frontier of Lancashire, comprising an area about nine times as great as that of the present borough, had a population of 63,000.

Birmingham, the last of the three inland towns as having had more than 50,000 inhabitants at the first census, belongs to the region already referred to as having early attained celebrity for the working of iron. In Domesday it had only nine heads of families. Probably the district then was almost entirely forest, the part of the county to which it belongs having been, even in Camden's time, designated the Woodland, as distinguished from the Feldon or Fieldland south-east of the Avon. But in Leland's time it was already noted for the large number of its smiths. Yet the site occupied by it has neither coal nor iron, both of these materials having been got by the smiths, even in Leland's time, out of Staffordshire—in the close vicinity of Birmingham, however. The growth of the town may have been favoured by its position at a point almost equidistant between the navigable waters of the Trent, Severn, and Avon. It grew rapidly in the eighteenth century, in the latter part of which it had the advantage of canal communication with the coal-pits of Wednesbury, and with the Stafford and Worcester, ultimately also with the Trent and Mersey canal. Gough (Camden's editor) tells us that between 1741 and the time when he wrote (about 1789), it added 25,000 to its population.

One other inland manufacturing town is worthy of notice, not on account of its size, but on account of the persistence with which it has managed, in spite of all economic changes, to maintain its fame in connection with some branch or branches of the woollen industry for more than five hundred years. The town I mean is Kendal, situated in a beautiful but somewhat isolated valley at the south end of a lozenge-shaped patch of fertile alluvium. The fertility of its valley has always favoured the production of abundance of provisions, while the comparative isolation has kept them cheap, and this, no doubt, is one great cause that has promoted its manufacturing industry. The fact of its being a very plentiful and cheap place is noted by Arthur Young in 1770, and is amply borne out by the prices he gives (fat stubble geese, 1s. 4*d.* each; bread, that is, oatmeal cakes called clapbread, 1*d.* per pound; cheese, 3½*d.* per pound; beef, 2½*d.* and 3*d.* per pound; trout often 1*d.* per pound, etc.). Flemish woollen weavers settled here in the reign of Edward III., and its early manufactures, which have been rendered by Shakespeare and Scott familiar as a household word, are celebrated both by Leland and Camden, the latter mentioning that they were sent all over England. Though the valley is somewhat isolated, yet it lies on the south side of the high fell which separates the valley of the Eden from the rest of England, so that it is in easy communication with the south; and Young mentions that in his day all the Kendal manufactures were sent to London by land carriage, which, he says, was the longest stage for broad-wheel waggons in England. Among the manufactures of Young's time it is interesting to find mention made of "Kendal cottons," in the sense in which the term was used in the sixteenth century,* as the name of a fabric made of coarse local wool.† The woollen goods which it still produces are chiefly heavy fabrics,

* When "Manchester cottons" and "Welsh cottons" of the same kind were also celebrated.

† 'Tour in the Northern Counties,' vol. iv. pp. 131-136.

such as railway rugs. In 1801 the population of the town was nearly 7000, more than that of the Yorkshire Bradford. Of course it has not been able to vie in growth since that date with the towns on the coalfields, but it is still prosperous, its population showing an increase at every recent census. In 1891 it amounted to 14,400.

ON THE DISTRIBUTION OF EARTHQUAKES IN JAPAN DURING THE YEARS 1885-1892.*

By CHARLES DAVISON, So.D., F.G.S.

HALF a century ago, the foundations of Seismology as a science were laid by Mallet, when his celebrated paper on the "Dynamics of Earthquakes" was read before the Royal Irish Academy. Since that time many attempts have been made to represent graphically the distribution of earthquakes over the surface of the globe. One of the most successful, though not the earliest, of these seismic maps was that prepared by Mallet himself, and published in a reduced form in the 'British Association Report' for 1858. As the methods on which this map was constructed have been followed more or less closely in other and more recent maps of special districts, it may be fairly taken as a type of its class.

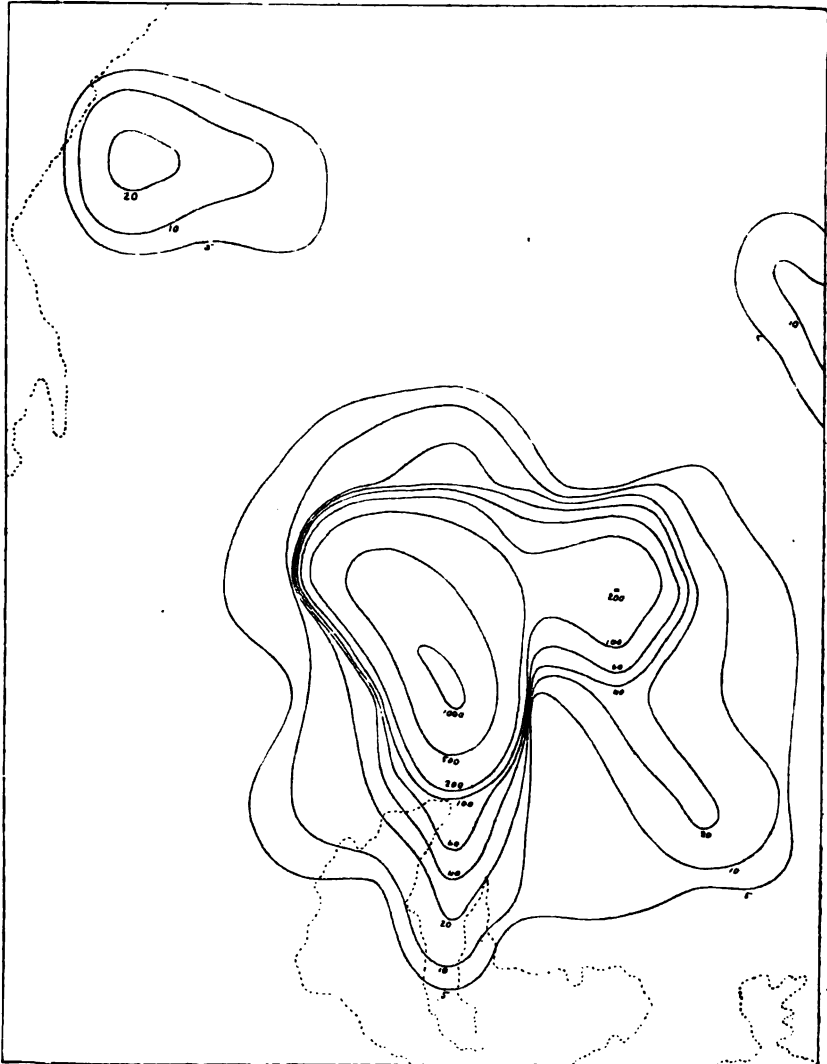
The chief principles adopted by Mallet were, that the area disturbed by each earthquake should be laid down on the map and coloured, and that the darkness of the tint covering the area should be roughly proportional to the intensity of the shock. As far as possible, he divided all earthquakes into three classes, the first consisting of great earthquakes, like that of Lisbon; the second of mean earthquakes, like those which are of not uncommon occurrence in Italy and at the east end of the Mediterranean; and the third of minor earthquakes, which take place almost daily in every quarter of the globe. The intensities of the tints representing an earthquake of each class were made proportional to the numbers 9, 3, and 1; and a single wash of the proper tint was laid down over the disturbed area in every case. Sometimes the known data were insufficient to determine the boundaries of these areas, and their radii for the different classes were then assumed to be 540, 180, and 60 geographical miles respectively. The most deeply tinted areas mark the regions where either the number or intensity or both of successive earthquakes was the greatest, but whether the darker tinting is due to frequency or intensity can only be determined by reference to the great catalogue on which Mallet founded his map.

The coloured areas exist principally in the form of bands of great but variable width, generally following the lines of elevation which bound the great ocean basins. As these are frequently the lines of mountain chains, and these again of volcanic vents, the seismic bands so far follow those in which active or recently active volcanoes are prevalent. The areas of minimum disturbance, according to Mallet, are the central districts of "great oceanic or terr-oceanic basins or saucers, and the greater islands existing in shallow seas."

Valuable as are the results thus deduced from Mallet's map, it is subject to one very important defect: it furnishes no information as to the exact seat of disturbance in any case. For instance, corresponding to the great Lisbon earthquake of 1755, nearly all Europe would receive a wash of colour. The tinting at some point of the map might conceivably be fairly dark, and yet few, perhaps no, earthquakes may have originated within many miles.

* Map, p. 564.

Thus, while Mallet's map is the result of enormous labour and great care, and was, indeed, the only kind possible in his time, it is clearly the product of an incipient science. As our knowledge extends, our inquiries inevitably become more detailed in their character; and as our measurements become more refined and our seismic catalogues more complete, so our maps will become more elaborate.



DISTRICT IN THE PROVINCES OF MINO AND OWARI.

I believe that all seismologists are now agreed that the general seismic maps of the future should indicate, not disturbed areas, but epicentres or centres of disturbance. There are few countries in which such a method of mapping is at present possible, but far in advance of all others in this respect stands the empire of Japan. While destructive earthquakes are unfortunately anything but rare in

that country, it is, on the other hand, favoured by the occurrence of almost innumerable minor shocks, more than eight thousand having been recorded and mapped during the eight years 1885-1892. For the admirable organization which has been created for their study, we are very largely indebted to our countryman, Prof. Milne; and one of his last acts before leaving Japan was to publish his great catalogue of Japanese earthquakes during the eight years just mentioned.* Some idea of the value of this catalogue, and of the immense labour involved in its preparation, will be evident from the statement that, though it contains more than eight thousand entries, it yet gives, with comparatively few exceptions, the epoch of every earthquake, the dimensions of the disturbed area, the approximate path of its boundary, and the position of its centre.

For the construction of seismic maps, the last is the most important element. The map of the whole country is divided by lines drawn north-and-south and east-and-west into a network of more than two thousand rectangles, the sides of which are respectively one-sixth of a degree of latitude and longitude in length. These rectangles are numbered consecutively, and for each earthquake is given the number of that one in which its centre lies.†

To the large "key-map" which illustrates the catalogues, Prof. Milne has added a reduced copy of it, showing the distribution of earthquake centres in Japan. In this the positions of the centres are indicated by small dots, but in two of the fifteen seismic districts into which the country is divided, the shocks were so numerous that the boundaries are represented as straight lines beyond the proper limits, as there would not otherwise have been room to insert all the dots. In one district, especially that to which the great earthquake of 1891 belongs, the dots are distributed uniformly over an area more than two degrees from north to south, and nearly two degrees from east to west, whereas the majority of the earthquakes originated near the centre of the district. Prof. Milne's map thus indicates the regions of greatest seismic frequency; but, as it does not show the details of the distribution very clearly, it seemed to me that a somewhat different method of representation might be employed with advantage.

This method consists, briefly, in drawing curves through the centres of all rectangles in which the same number of earthquake centres (or epicentres) lie. The curves so obtained are thus analogous to contour-lines. When they are grouped closely together, they imply a rapid change in seismic frequency; when they are far apart, they indicate a near approach to uniformity of distribution.

In practice the application of the method is not quite so simple. The number of epicentres in adjacent rectangles does not vary continuously. For instance, if we wished to draw what we may call the frequency-curve 10, we should find comparatively few rectangles which contain exactly this number of epicentres. But in two adjacent rectangles there might be eight and twelve epicentres respectively, and in this case the curve would be drawn so as to bisect the line joining the centres of the rectangles. Or there might be nine epicentres in one and thirteen in the other, and then the line joining the centres of the rectangles would be divided into four equal parts, and the frequency-curve would be drawn through the point of division nearest the centre of the rectangle containing nine epicentres.

In drawing isobaric and other lines, a similar method is of course adopted, but the interpretation of the frequency-curves is less simple than in these cases. It

* 'A Catalogue of 8331 Earthquakes recorded in Japan between 1885 and 1892,' *Seismological Journal*, vol. iv. (1895), pp. i.-xxi., 1-367.

† Sometimes the centre is stated as lying between two adjacent rectangles. In such cases I have allotted one-half to each rectangle.

may be stated as follows: Let any point of the frequency-curve 10 be imagined as the centre of a rectangle whose sides run north-and-south and east-and-west, and are respectively one-sixth of a degree of latitude and longitude in length; then the number of epicentres within such a rectangle will be at the rate of ten during the epoch considered.

One or two defects, not so much in the method as in its application, should be referred to. If it should happen that the epicentres are not distributed uniformly between the centres of two adjacent rectangles, some error must arise from the assumption that they may be regarded as collected at the centres of the corresponding rectangles. But in the present case, as the area of the rectangles is so small compared with that of the whole country, the error can never be of much consequence, except perhaps in minute details. For even in the extreme case in which all the epicentres are grouped close to one side of the rectangle, their distance from its centre must be less than one-twelfth of a degree, and thus the error in the position of any curve drawn on the map must be smaller still.

Another defect arises from the fact that the rectangles are not of equal area throughout the map; for the breadth of a rectangle depends on the length of a degree of longitude, and this varies with the latitude. Thus in the north of Japan, in latitude $45^{\circ} 30'$, the area of a rectangle is about 92.8 square miles, and near the south, in latitude $30^{\circ} 30'$, about 114.3 square miles. This difference is not unimportant, and might have been allowed for, but the labour of making the necessary conversions would have been considerable, and would hardly have been repaid by the increased accuracy of the results. Regarding a rectangle in latitude 38° as the unit area, the effect of taking into account the varying length of the degree of longitude, would be to expand very slightly outwards all curves to the north of this latitude, and to contract all those to the south.

The interest and value of the map would have been much increased if the curves had been continued over the surrounding sea. But it seemed undesirable to attempt this for several reasons. It is difficult, for instance, to determine with accuracy the position of the epicentre when only part of the boundary of the disturbed area can be drawn. Another and more important reason is that, while some earthquakes are known to have originated at a distance as great as 50 or 60 geographical miles from the coast, it is only the stronger of such earthquakes that can be felt on the land at all, and still fewer that can be felt over an area large enough for the epicentre to be located even approximately. Thus the frequency-curves would have been accurate only in the immediate neighbourhood of the coast.

In the map of the whole country, curves are drawn corresponding respectively to 1, 5, 10, 50, 100, and 500 epicentres in a rectangle, and the intervals between the curves are shaded in different ways in order to show the distribution more clearly. During the eight years 1885-1892 no epicentre was situated within the unshaded areas, with a few exceptions in which single epicentres occur in isolated rectangles.

In several districts the earthquakes were so numerous that the details of the frequency-curves cannot be drawn accurately on so small a scale. This is especially the case in the provinces of Mino and Owari, which suffered so severely during the great earthquake of 1891. In the accompanying figure (p. 531) this district is represented. It is bounded by the parallels $34^{\circ} 40'$ and $36^{\circ} 20'$ north latitude, and by the meridians $2^{\circ} 10'$ and $3^{\circ} 50'$ west of Tokio. The curves correspond to 5, 10, 20, 40, 60, 100, 200, 500, and 1000 epicentres in a rectangle. The district being a comparatively small one, there is no sensible variation in the size of the rectangles. But, on the other hand, there may be some slight errors in the form and position of

the curves, owing to the assumption that the epicentres are supposed collected at the centre of each rectangle.

Prof. Milne remarks that his "map of earthquake origins or centres shows that the central portions of Japan, which are the mountainous districts where active volcanoes are numerous, is singularly free from earthquakes" (p. xv.). This feature in the distribution of epicentres is also brought out very clearly in the present map. The volcanoes, most of which are active, are indicated by black dots, and it will be seen that these are almost entirely absent from the more darkly shaded areas. It is also supported by the following brief analysis:—

Excluding those in the smaller outlying islands, there are 88 volcanoes. Some of these lie exactly on the border of two rectangles, and there are thus 96 rectangles in which volcanoes are entirely or partly situated, while there are 1476 rectangles on land without volcanoes. Now, epicentres lie in 22 (or 22·9 per cent.) of the volcanic, and in 527 (or 35·7 per cent.) of the non-volcanic rectangles. Counting by epicentres, however, the disproportion is still greater. The average number of epicentres in each non-volcanic rectangle is 3·57, and in each volcanic rectangle is 0·73; so that the number of epicentres in a non-volcanic rectangle is on the average very nearly five times as great as in a volcanic rectangle.

A large number of the Japanese earthquakes originate beneath the sea, especially, as Prof. Milne remarks (p. xv.), from "the face of the steep monoclinical slope which Japan presents towards the Pacific Ocean." As might be expected, most of the epicentres of *recorded* earthquakes lie near the land. For instance, the epicentres of 518 earthquakes were 5 geographical miles from the coast-line, 1539 at a distance of 10 miles, 6 at 15 miles, 146 at 20 miles, 30 at 30 miles, 14 at 50 miles, and 1 at a distance of 60 miles.

It is remarkable, however, that the coast-line itself is comparatively free from earthquakes. It will be seen from the map how many curves are entirely unbroken by the sea; how few of the curves corresponding to a large number of epicentres lie anywhere near the coast. The principal exceptions are at the two extremities of the country, towards the north-east at Nemoro, and the south-west at Kumamoto. In the four larger islands, the number of rectangles whose centres lie just within the coast-line is 412, and of these 131 (or 31·8 per cent.) were the seat of earthquakes. The total number of epicentres was 504, giving an average of 1·22 epicentre for each rectangle. The number of inland rectangles is 1150, and epicentres occur in 418 (or 36·4 per cent.) of these. The total number of epicentres in them was 4841·5, or an average of 4·22 epicentres in each rectangle.

Part of the island of Yezo, it should be mentioned, is sparsely populated, and it is possible that the seismic record there is less complete than in the rest of the country. Omitting this island, the number of coast rectangles is 307, of which 120 (or 39·1 per cent.) include epicentres. The number of epicentres is 470·5, or 1·53 in each rectangle. The number of inland rectangles is 883, and of those containing epicentres is 492 (or 55·7 per cent.). They contain 4615·5 epicentres, giving on an average 5·23 for each rectangle. Thus the main seismic activity of the inland rectangles is about three and a half times as great as that of the coast rectangles.

It is interesting to notice how this conclusion agrees with the theory of the distribution of earthquakes worked out so admirably by M. F. de Montessus.* The principal result at which he has arrived is that, in a group of adjacent seismic regions, earthquakes are most frequent in those in which the general inclination of the ground is greatest. The steep boundary-slope of a continental plateau is such

* "Relation entre le relief et la sismicité," Paris, *Acad. Sci. Compt. Rend.*, vol. cxx., 1895, pp. 1183-1186.

a region. When a coast-line coincides approximately with the boundary-slope, it is in general long and regular, and we should then expect to find it the seat of numerous earthquakes. But in the case of a coast-line broken and indented by the superficial irregularities of the plateau, the boundary-slope lies at some distance seawards, and the coast region should be characterized by an inferior degree of seismic activity.

The regions in which many and violent shocks occur are those in which the rate of terrestrial growth is most rapid. The coast-lines near which earthquakes are comparatively rare are thus the seats of less considerable change. At the same time they are the districts from which our measurements of the rate of secular elevation and depression have so far been derived. It follows, therefore, that our present estimates of the rate at which the development of the Earth's surface features is now taking place may be very much less than the true value.

THE MONTHLY RECORD.

THE SOCIETY.

The New Session.—The first meeting of the new session will take place on Monday, November 8, when Mr. F. G. Jackson will give an account of his three years' work in Franz Josef Land. At the second meeting the young Swedish explorer, Dr. Sven Hedin, will describe the results of his four years' travel in Central Asia. Lieut. Peary has promised to come to England in the end of November, and it is hoped that he will appear before the Society at one of the December meetings. It is expected that in the same month Mr. H. S. H. Cavendish, who has just returned from a remarkable journey in Somaliland, during which he travelled all round Lake Rudolf, will give some account of his journey to the Society. Other papers may be expected by Sir W. Martin Conway, on his recent expedition to Spitsbergen; Mr. E. A. Fitz Gerald, on his exploration around Mount Aconcagua; Dr. John Murray, on his Researches in the Scottish Lakes; Mr. H. Warington Smyth, on the Eastern Malay States of Siam. During the session a special meeting will be held in connection with the four hundredth anniversary of the discovery of the Cape route to India by Vasco da Gama. For other special features reference is made to the provisional programme of the session inserted in the present number.

EUROPE.

Dry River-bed near Malham, in Yorkshire.—The question of the exact source of the river Aire was not definitely settled until 1879, when an investigation proved that the waters of Malham tarn, which receives the drainage of Hard Flak and Fountain's fell, sink below the surface half a mile below its outlet, and reappear again in part at the foot of Malham cove and in part at Airehead springs, below the village of Malham. The stream has, however, not always flowed underground, but its dry river-bed can be distinctly followed during the interval between its disappearance and re-emergence. In fact, old accounts speak of occasions when the channel was filled with flood-water, which formed a magnificent cascade down the

sides of the cove. An excellent series of photographs, illustrating the course of the river-bed in its present state, appears in the *Proceedings of the Yorkshire Geological and Polytechnic Society* (New Series, vol. xiii. pt. 1), the same body which published the results of the investigation carried out in 1879.

A Mountain Observatory in the Pyrenees.—The *Bulletin de la Société de Géographie Commerciale de Bordeaux* (No. 13) contains an account of the high-level meteorological station established by the south-western section of the French Alpine Club at Gavarnes, a village situated in the Hautes-Pyrenees, at an elevation of 4430 feet. Observations were begun in 1892, and the routine consists of three eye observations daily, filled in with various self-recording instruments, and a record is kept of avalanches, earth-tremors, migrations of birds, phenological changes, and so on. Apart from purely meteorological interests, the chief object is to cooperate with the observatory on the Pic du Midi de Bigorre in studying the variations in distribution of snow and glacier ice. The records of these elements have hitherto been very irregular and unsystematic, and the glaciers of the Pyrenees offer many points requiring careful investigation. M. Lourde-Rocheblade, vice-president of the section of the Alpine Club responsible for this work, and author of the paper under notice, does not give sufficient topographical information to enable a just estimate of the meteorological value of the observatory to be made; but it is interesting to note that the results of the observations have already led M. A. Millet, chief engineer of the Chemins de fer du Midi, to make experiments in the acclimatization of bees, which have attained very considerable success.

Dr. Thoroddsen's Explorations in Iceland.—In June and July this year Dr. Thoroddsen interrupted his systematic exploration of Iceland in order to examine the region affected by the great earthquake of last year, and in a letter from Edinburgh to the editor of *Petermanns Mitteilungen*, he furnishes a brief account of the results of that examination. The track affected was a somewhat irregular curve stretching from Tindafjöll to Ölves, surrounding the plain. But the whole strip was not set in motion at once, but sharply defined fragments were each in turn agitated separately—first the eastern section in the neighbourhood of Rangavellir, then the western near Ölves and on Lake Thingvall. Many large fissures, two of them measuring about 10 miles in length with a width of 6 to 9 feet, were formed, and various other changes were wrought on the surface. Several of the older hot springs have disappeared, and new ones have been formed. In August Dr. Thoroddsen was able to resume his systematic work, and he then completed his survey of the coast-line with all its fjords and capes. Of the interior only the highlands north-west of the Langjökull remain to be explored, and this he hopes to do next summer, thus completing a task on which he entered in 1881, and which he has carried on regularly in every subsequent year.

ASIA.

The Danish Expedition to the Pamirs.—Lieut. Olufsen, the leader of the Danish Expedition of 1896 to the Pamirs, read an account of his journey before the Berlin Geographical Society in May last, which appears in the sixth number of the *Verhandlungen* for the current year, illustrated by a sketch-map. Another account, accompanied by a more detailed map of the Panj river, is published in the *Geografisk Tidsskrift* (Nos. 3-4). Lieut. Olufsen approached the Pamir region by way of Osh and Gulcha, whence he reached the great Kara-kul by crossing the Taldyk and Kisil-art passes. The latter marks the point of transition between the damp climate of the Alai and the dry, clear atmosphere of the Pamirs. South of the pass, as little as six to eight per cent. of relative humidity was often registered. The direction of the wind was generally from north-north-east to east. From the

Kara-kul the expedition proceeded south-east to the Pamirsky post in the upper Murghab, and thence by the Alichur Pamir to Yashil-kul, and on over the Karghosh pass to the Pamir-darya. Here the less-known part of the route began. The Pamir-darya (often only 10 to 15 yards wide) was descended to its junction with the Panj or upper Oxus. The latter stream was followed down by a route along its northern bank, which had hitherto been considered impassable. During its passage through Wakhan the stream is often only 20 yards wide, but it is very rushing, and its water is of a dirty black colour. The rocks and glaciers of the Hindu-kush afforded a fine spectacle to the south, but the northern bank was less interesting, the way leading over swamps and deposits of drift sand, and being rendered very difficult by the many tributaries of the Panj, many bringing down a large volume of water. A considerable amount of cultivation is carried on, especially in the valleys of the tributaries. The Wakhan people are of middle size. Though said to be Iranian, they often showed Mongolian traits, perhaps through mixture with the Kirghiz. Their domestic animals are small on account of the severe climate, but the original report of their exceeding smallness seems to have been due to a misunderstanding. Their houses are built of stone, with flat roofs. Many ruined forts were seen, which were said to have been built by the Siah-posh Kafirs. The most difficult part of the route was that between Ishkashim, where the Panj makes its great bend to the north, and Garan, the district south of Shugnan. Here the granite rocks fell almost sheer to the water, and several horses were lost. The river is hemmed in into an extremely narrow channel, but widens out on reaching the province of Roshan, which, like Shugnan and Darwaz, struck the traveller by its fertility. Between Kala Wamar and Kala Wanj, the route led across the glacier passes of Odudi and Gushom, the passage of the moraines being both difficult and dangerous. The return was made from Karateghin, up the valley of the Surkhab, to the 'Taldyk pass.

Return of Mr. Landon from Tibet.—Telegrams from Bombay, published by the *Daily Press*, announce the return of Mr. Henry Savage Landon to India from an unsuccessful attempt to reach Lhasa. The reports state that the traveller underwent some terrible experiences, being abandoned by most of his men, and made prisoner by the Tibetans, narrowly escaping with his life. The following telegram has been received from Mr. Landon by the *Daily Mail*, whose representative he was :—"Naini Tal, October 22.—Arrived. Holding conference with Government. Point reached within four days' journey of Lhasa. Am suffering from injury to spine. Saved my diary, drawings, and maps. Am writing full account."

The Island of Cagayan Sulu.—A short account of the island of Cagayan Sulu, lying between the Philippines and Borneo, is contributed to the *Journal of the Asiatic Society of Bengal* (vol. lxx. part 3, No. 1), by Mr. E. F. Skertchly. The island is of volcanic origin, one extinct volcano rising to a height of 1105 feet, and a noteworthy feature is the occurrence of three lakes occupying the craters of old volcanoes. The outer wall of one of these has been broken through, so that the deep basin within communicates with the sea. The water of the two other lakes is fresh. The soil of the island is fertile, and much of the jungle has been cleared for cultivation. Although nominally under Spanish rule, the inhabitants would resent all attempts at interference. Their fighting force is estimated at from twelve to fifteen hundred men, and they have fortified one of the craters as a place of refuge. Fishing is practised with the aid of a root called *tubur*, which is used to stupefy the fish. The natives hold some remarkable superstitions, one of which relates to the "Berbalangs," who inhabit a village in the centre of the island, and are held in great fear by the rest of the inhabitants. They are believed to live partly on human flesh, and to have the power of assuming astral bodies,

which enter houses and feed on the entrails of their occupants. Mr. Skertchly paid a visit (alone) to their village, but found it deserted, although hot rice was standing in basins in the houses. By a strange coincidence, the death of a native occurred at the same time, under unexplained circumstances, in an isolated house in the neighbourhood, barred on the inside.

The Ob and Yenesei Expedition.—The trading expedition despatched this summer to Siberia by Mr. F. W. Popham by the sea-route has returned after a successful voyage, and the hopes entertained of establishing a permanent market for British goods in those regions have thus received a decided encouragement. No fewer than eleven steamers took part in the expedition, forming a larger fleet than had ever before traversed the once dreaded Kara sea at one time. The vessels sailed in two detachments; but, after an easy course, assembled at Khabarova, in Jugor straits, where a coal-ship was in waiting, and made the passage of the Kara sea in company. The water was found to be shallow, and many sandbanks not marked on the charts were discovered. Careful soundings were made, which should prove of much value to future navigators. After passing White island the fleet divided, part going up the Gulf of Ob under the command of Captain Tinkler of the *Naranja*, and the remainder making for the mouth of the Yenesei. Proceeding carefully up the centre of the gulf, new and unmarked banks being constantly discovered, the Ob detachment reached Nakodha bay, a desolate spot at the mouth of the Ob river. Four tugs and four grain-barges were already in waiting, and an exchange of commodities at once commenced. In fourteen days about 2000 tons of wheat, 1000 tons of oats, and 1000 tons of other grain were taken on board in exchange for the outward cargo of brick-tea, preserved fruits, rice, hand-tools, steel rails, etc. Brick-tea, which apparently formed the most important item, is allowed to enter Siberia on payment of a much lower duty than that charged in European Russia, and the comparative cheapness of its carriage by the water-route is likely to seriously affect the caravan trade between China and Siberia overland. At the Yenesei, where the outward cargo was also successfully disposed of, three paddle steamers were left to ply on the river, two having been ordered from Yeneseisk and Irkutak respectively. One of the most satisfactory points is the amount of grain sent down to meet the expedition from Western Siberia. The establishment of such a trade should give a decided impetus to the development of that region.

Hydrography of the Great Plain of China.—The Hungarian geologist, Dr. Lugen von Cholnoky, has begun his investigations on this subject. In the middle of February he repaired to Hangchau-su in order to study the embankments which shut off the old Yangtse delta from the sea, and to make observations on the bore of the Tsien-tang. Detailed notes of his journeys and investigations are expected to be given shortly in *Petermanns Mitteilungen* from letters of Prof. von Lóczy.

AFRICA.

Mr. Cavendish's Expedition to Lake Rudolf.—Mr. H. S. H. Cavendish, a young Englishman, who set out in September of last year on an expedition through Somaliland to Lake Rudolf, has just returned to this country after accomplishing a most successful journey. From Berbera he proceeded southward to Lugh, on the Jub river, whence he made his way westwards to Lake Stefanie. About 100 miles east of the lake he discovered a remarkable salt crater 1300 feet deep, while to the southward of it (as also subsequently to the west of Lake Rudolf) a bed of good coal was met with. Passing to the northward of Lake Rudolf, Mr. Cavendish was struck with the size of the Nianam river, the identity of which with the Omo had already, as mentioned in our last number, been

demonstrated by Captain Böttge. The country west of the lake, as seen from a mountain 5000 feet high, is described as a mass of uninhabited mountains. Between these and the lake-shore, however, is a flat plain 50 miles wide, which, as noticed by the Italian travellers, accounts for the fact that too great a width was assigned to this part of the lake by Von Hönel, who merely surveyed it from the opposite shore. The plain is, however, according to Mr. Cavendish, often flooded by the lake-water to a considerable distance. Like Captain Böttge, the English traveller continued his march along this western shore of the lake, but, instead of turning back at the mouth of the Tiroli river, he kept on in a southerly direction, and thus made perhaps the most interesting discovery resulting from his journey, viz. that the Teleki volcano at the southern extremity of Lake Rudolf has been completely shattered by a recent convulsion, nothing now remaining but a plain of lava. It may be remembered that when Dr. Donaldson Smith passed to the eastward of the lake, the volcano seemed to be very active, sending up great clouds of smoke. On his further journey to Mombasa by way of Lake Baringo, Mr. Cavendish discovered a new lake, in which had been another volcano, but this has now shared the fate of Mount Teleki. We hope to hear from Mr. Cavendish a full account of his journey at an early meeting of the Society.

M. Foa's Expedition in Central Africa.—Writing to us from Abercorn, at the south end of Lake Tanganyika, in July last, M. Foa announces the safe arrival of himself and his caravan at that point. He had deviated, *en route*, from the usual road to Tanganyika, and explored the Awemba country, mapping the course of the Chozi and Chambezi rivers, hitherto shown incorrectly on the maps. After making some astronomical, zoological, and ethnographical observations on Lake Tanganyika, M. Foa hopes to proceed to the Congo river, and thence to French Congo, by new routes.

The French in the Lake Chad Region.—The latest news of M. Gentil, published in the French papers, states that that explorer began the last stage of his journey to Lake Chad in May last, taking with him the steamer, the *Léon Blot*, intended for the navigation of the lake. Five permanent posts had been established between the Ubangi and the Shari. Meanwhile a commercial mission to the same region has been entrusted to M. de Behagle, who, with his second in command, M. de Mézière, recently left Loango *en route* for Brazzaville by way of the Kwilu. Both explorers already possess some experience of the country to be traversed, having accompanied M. Maistre on his journey to the Niger basin. They are said to be taking with them a large quantity of merchandise for exchange with the natives.

The Deposits of the Nile Delta.—The *Proceedings of the Royal Society*, No. 369, contains a second paper on this subject by Prof. Judd, forming a second report of the "Delta Committee" of the Royal Society. The first report (*Proc. R.S.*, No. 240) was noticed in our vol. viii., 1886, p. 189. This gave an account of borings which reached a maximum depth of 84 feet without touching the rock on which these deposits lie, and from which the Nile valley was originally excavated. With the co-operation of various military and railway authorities, the committee has since carried out further borings with a Legrand-and-Sutcliffe boring apparatus at a selected station in the neighbourhood of Zagazig, and a depth of 345 feet below the surface has been reached, still without any indication of solid rock. The deposits passed through, however, are of considerable interest, and Prof. Judd incorporates in his paper reports on the lithological characters by Dr. Karl von Zittel, of Munich, and on the scanty fossiliferous yield, by Prof. Rupert Jones. From the surface to a depth of 115 feet, the strata passed through in the new Zagazig boring—which, it should be mentioned, was carried out under the superintendence of Captain

Dickenson, B.E.,—closely resembled those described in the previous report; but at that depth a remarkable change occurred, the blown sand and alluvial mud of the Nile suddenly giving place to masses of shingle and sand, which prevailed down to the greatest depth reached, except at 151 feet, when a band of yellow clay 2 feet thick was passed through. Specially coarse shingle beds, some containing rounded pebbles up to the size of a hen's egg, were met with at depths of 121, 160, 175, 190, 208, 250, 265, and 270 feet. This boring is compared with one made at Rosetta by Mr. T. E. Cornish, C.M.G., director of the Alexandria waterworks, which showed the same sudden change, but at a depth of nearly 144 feet. The surface of these gravelly deposits, which were evidently laid down under conditions totally different from these which prevailed while the delta deposits were formed, seems accordingly to be very irregular, and the determination of their geological age is a problem of the greatest importance. Sir Samuel Baker suggests that the "turtle backs" of this region, patches of sand which appear like islands in the wide expanse of dark alluvium, may be parts of this original floor; but it is possible that they may be only lenticular masses of blown sand, alternating with the alluvial deposit. Unfortunately, all attempts to obtain contemporary fossils have been fruitless, although derived fossils are in some cases abundant. The spot where the Zagazig boring was made is directly opposite to the Great Wady (W. Tumulat), which opens on the delta from the east, and it is therefore possible that much of the gravelly material may have been brought down by this tributary rather than by the main stream of the Nile; hence the section obtained may not be so good an average sample of the sub-delta formation as it might have been. But there is little doubt that we have here a series of deposits which must have been laid down when the land was at least 100 to 300 feet higher than it is at present, and when the lower Nile, instead of forming an alluvial flat, was depositing coarse sands and gravels. Upon this very uneven surface the alluvial sands and muds of the delta were deposited as the surface gradually sank below the level of the Mediterranean.

Alfred Kaiser's Journey in East Africa.—Dr. Schöller, whose journey to the Victoria Nyanza in 1896 has been more than once referred to, was accompanied by Herr Alfred Kaiser, who appears to have undertaken the scientific work of the expedition, while Dr. Schöller travelled mainly for purposes of sport. Herr Kaiser has now returned to Germany with extensive scientific collections, and a short sketch of his journey appears in the twelfth number of the current volume of *Globus*. One of the principal objects of the expedition was the exploration of the great East African valley between Lakes Manyara and Naivasha. Proceeding by way of Kilimanjaro and Great Arusha to Simangori, north of Manyara, the travellers made their way northwards along the valley floor towards the Natron lake. An attempt to ascend the active volcano Doenyongai was frustrated by the attack on the party by a rhinoceros, by one of which animals Herr Kaiser had previously been badly wounded. From the Natron lake the travellers followed the Guaso Njiro, which enters that lake after breaking through the wall of the valley from the north-west. Reaching Kavirondo, Herr Kaiser fell ill, and was unable to accompany Dr. Schöller to Uganda. He returned to the coast by way of Lake Naivasha, in the neighbourhood of which he continued his examination of the "rift valley." It is said that his researches will throw new light on the question of its mode of origin. The scientific results of the journey include careful topographical surveys, a number of mountain profiles, and collections of objects relating to botany, geology, and ethnology.

AMERICA.

The Utilization of Niagara.—Mr. T. Commerford Martin contributes to the *Proceedings of the Royal Institution* a very readable abstract of a lecture on the

gigantic engineering works, already in part carried out, for collecting and distributing part of the vast energies of Niagara Falls. A clear and non-technical description is given of the power installation at work on the American side, with its intake canal adequate to the development of 100,000 horse-power, the gigantic wheel-pit cut out of the rock to accommodate the 5000 horse-power turbines, and the colossal dynamoes which convert the energy into electricity. It is proposed to carry out similar works on the Canadian side, and when both stations are in operation it is estimated that no less than 350,000 horse-power will be available, a quantity which, although it only represents one-twentieth of the whole power supposed to be locked up in the falls, is nevertheless calculated to mean a saving of two millions sterling annually to New York State alone for motive-power. The geographer and geologist may find instructive information in the minute studies of the work of Niagara incidental to this immense undertaking.

The Mesa Encantada of New Mexico.—We learn from *Science* (September 17) that a survey of the "Enchanted Mesa," or Mesa Encantada of New Mexico, has been made by a party sent out by the United States Bureau of Ethnology. As we have already mentioned (*ante*, p. 214), an expedition to this mesa or sandstone tableland—the summit of which, according to native tradition, was once the site of an Indian settlement—was undertaken a few months ago by Prof. W. Libbey, who appears to have made a successful ascent, but without finding evidence of occupancy. A party, composed of Mr. Hodge, Major Pradt, and others, has since ascended the mesa, which was found to attain a height of 431 feet above the plain. Several potsherds, two stone axes (broken), and one or two other articles were found on the narrow crest, while abundant potsherds, etc., were seen in the talus swept down from the summit. All vestiges of the ancient trail ascending the talus have vanished, but some traces of the hand and foot holes in the rock above were discovered. A survey of the mesa was made, and photographs taken by the party.

Boundary between Mexico and British Honduras.—A parliamentary paper has lately been issued (Treaty Series, No. 6, 1897) relative to the boundary between Mexico and British Honduras, accompanied by a map on which the accepted line is clearly laid down. The treaty regulating the boundary was signed on July 8, 1893, but was supplemented in April last by an additional article, while the ratifications of the whole treaty were only exchanged on July 21. In the treaty concluded between Great Britain and Guatemala in 1856, a line was agreed upon, as part of the western limit of British territory, which should run due north as far as the Mexican frontier. As, however, this had not been precisely defined, while the boundary between Mexico and Guatemala, as agreed upon in 1882, depended to some extent on the position of the British frontier, the need clearly existed for an agreement between this country and Mexico on the subject. As now defined, the boundary runs thus: Beginning at the strait which separates Ambergris cay from the mainland of Yucatan, and passing between two small cays lying north-west of the former, it afterwards coincides with portions of the following parallels and meridians: 18° 10' N., 88° 2' W., 18° 25' N., 88° 18' W., 18° 28½' N. This brings it to the mouth of the river Hondo, the deepest channel of which is followed—Albion island being left in British territory—as far as the junction of Blue creek and Booth's river. It continues up Blue creek as far as the meridian of Garbutt's falls, which forms the northern part of the boundary between British Honduras and Guatemala, running then south along this meridian to the point where the three boundaries intersect. The clause added during the present year secures to Mexican vessels, in perpetuity, the free navigation of the strait between Ambergris bay and the mainland, and of the territorial waters of British Honduras in general.

Influence of Physical Conditions on Economic Development in Tropical America.—In a short article contributed to the first quarterly *Bulletin* of the American Geographical Society for the current year, Mr. F. C. Nicholas draws attention to the importance to intending settlers of a knowledge of the ways in which atmospheric, physical, or geological conditions affect the healthiness, and consequent capabilities of development, of different areas in Tropical America. It is the want of this knowledge which has brought about the great sacrifice of human life in the endeavour to open up certain localities, while other vast regions capable of supporting a large population have remained almost unoccupied. It is, of course, the lowlands which should be avoided as a general rule, but there are exceptions in particular cases. One of the principal conditions needed is the free circulation of the atmosphere, either through the trade winds or local currents, and this is largely affected by the disposition of mountain ranges. Zones of stagnation are usually caused by abrupt unbroken ranges lying in the path of the trade wind. Good natural drainage is of the greatest importance, and excessive rainfall, though otherwise disadvantageous, is no drawback where this is present. Geological conditions should also be studied with care. Swamps often occur where troughs are formed by tilted strata, or where impervious underlying strata form basins. Recent alluvial deposits are as a rule dangerous; but older alluvium, if well drained, is often desirable. A sketch-map is given showing roughly the distribution of favourable and unfavourable districts, but on too small a scale to be of much practical value. The unfavourable districts are, of course, as a rule those along the coasts, but much of those of Central America, especially towards the Pacific, and that of Venezuela, with the exception of the Orinoco delta and the shores of the Gulf of Maracaibo, are regarded as suitable for settlement.

Tierra del Fuego.—The September number of *Petermanns Mitteilungen* contains a brief preliminary account of the work of the expedition to this archipelago under the command of Dr. Otto Nordenskjöld in 1895–96. The account is accompanied by a map on the scale of 1 : 1,600,000. With regard to the scientific results of the expedition Dr. Nordenskjöld can say little, as the considerable zoological and botanical collections have not yet been worked up. Work was done with the drag-net and trawl at thirty-seven stations, and land, fresh-water, and coast forms were collected at forty stations. From a geological point of view, the fossils of animals and plants that have been collected point to a Tertiary climate, somewhat but not much warmer than the present. Afterwards an ice-period supervened. The ice completely covered Tierra del Fuego, and filled the straits of Magellan, but nowhere reached the present Atlantic coast north of 52° S. At the end of the glacial period Tierra del Fuego was about 200 feet lower than at present; but elevation seems now to have ceased, or, at least, to be going on very slowly.

Cable-laying on the Amazon River.—The *Proceedings of the Royal Institution* contains a brief abstract of Mr. Alexander Siemens's lecture on the above subject, delivered on May 15, 1896. Belem, the capital of the state of Pará, has been connected by a sub-fluvial cable with Manaus, the capital of Amazonas, and the intermediate stations, and branch cables from Pará to Cameté on the Tocantins, and from Santarem to Alemquer, serve to open up communication with a large area of what has hitherto been almost inaccessible country. The preliminary surveys were made during the hottest season, in the month of October, while the cable was laid during January and February after the rainy season had begun; the meteorological observations made on board ship are accordingly of considerable interest. Observations of river temperature during the cable-laying expedition show a remarkable uniformity, indicating rapid movement of a very large body of water. The abstract does little more than mention many points of great interest

with regard to the Amazon and its tributaries—the steep banks and flat bottom characteristic of the channel through the Tabatinga or hard clay banks of the narrows; the extraordinary narrowing at Obidos, where the whole volume of water passes through one channel a little over a mile wide, at an average rate of three knots, the depth obtained by Thomson sounder being 58 fathoms; the remarkable navigation of the “furos” or channels connecting the Pará river with the Amazon; and the peculiarities of the rubber trade of the islands of the lower Amazon, centred at Breves. Accurate and extensive information has evidently been collected on these and many other things in the manner characteristic of expeditions of this kind, and in addition collections were made, particularly during an enforced delay at the mouth of the Baiassu, not far from Breves, by two naturalists from the British Museum. It is interesting to note Mr. Siemens’s remark with reference to photographs illustrating the luxuriance of the vegetation met with everywhere, that “no attempt will be made to describe it, as that has been done to perfection in the classical works of Bates and Wallace; . . . hardly anything new can be added to their description of the general features of the Amazon valley.”

The Argentine Andes.*—The seventy pages of text in this book are chiefly occupied with descriptive matter referring to the excellent photographs of scenery reproduced in colotype. The author made two journeys from Europe to the La Plata and the mountainous regions of the Argentine, the first time chiefly by way of reconnaissance, and the second with the primary object of fully exploring some of the valleys flanking the mountain mass of Aconcagua. On the second journey the valleys of the Rio de las Bodegas and Rio de las Crevas, and of the Rio de los Horcones were surveyed up to their glaciers, but the work was cut short by the Argentine authorities, who considered further exploration of the mountain inexpedient, pending settlement of boundary disputes with Chili. The narrative contains observations on many points of geographical and geological importance, and gains considerably in interest from the fact that Mr. Vines and the guide Zerbruggen have since ascended Aconcagua from the Horcones valley. A good sketch-map is appended, and some of the panoramic photographs, with the direction angles marked, are of exceptional merit.

POLAR REGIONS.

Mr. Arnold Pike’s Cruise in the Arctic Seas.—During the past summer Mr. Arnold Pike and Sir Savile Crossley made an interesting cruise off the east coasts of Spitsbergen and Kong Karls Land. We hope shortly to receive from Mr. Pike a full account of the observations made during the cruise, but meanwhile the following details will be of interest. After steaming through Hinlopen straits and coasting North-East Land as far as Charles XII. island, the voyagers returned through the strait and crossed over to Kong Karls Land. These islands were twice circumnavigated, and a landing effected in several places. An advance was then made for about 40 miles in an east-north-east direction from the east point of Kong Karls Land, no sign being seen, in clear weather, of the land supposed to have been discovered by Captains Johannessen and Andreassen in 1884. Mr. Pike considers that the nature of Kong Karls Land, consisting as it does of high land to the east and west with low land in the centre, may have given rise to the belief that what is really continuous land formed two or even three islands. There is a small island, 8 miles in length, a little north of the east end of Kong Karl, and what seemed to be a lofty island was sighted in an east-north-east direction from the north end of Bremen sound, but, as the weather was thick, the existence of such an island seems

* ‘Aussichten aus Südamerika.’ Von Jean Habel. Berlin: Dietrich Reimer.

somewhat doubtful. Kong Karls Land was free from snow, and from the well-marked sea-beaches with driftwood, etc., upwards of 100 feet above the present sea-level, Mr. Pike concludes that the land is rising. Many bears were met with on it. Throughout the whole voyage no old pack was seen, and the sea generally was remarkably free from ice. Mr. Pike was informed by the captain of a walrus sloop that the water was much warmer than usual.

Lieut. Peary's Latest Expedition.—Further details respecting Mr. Peary's arctic cruise during the past summer have been telegraphed by the *Times* correspondent at St. John's, Newfoundland. The steam-whaler *Hope*, Captain John Bartlett, with Mr. Peary and various scientific parties on board, left Boston on July 18, and, having put ashore the latter at the spots chosen by them for scientific research, reached Whale sound, Inglefield gulf, on August 10. This point, which the explorer had made his headquarters on previous expeditions, was visited with a view to making arrangements with the Eskimo for the polar expedition planned by Lieut. Peary for next year, details of which have already been given in our pages (vol. ix. p. 223). The explorer puts much stress on the co-operation of the Eskimo, and was able to secure the prospective services of six families, who will be awaiting his arrival next spring. The Cape York meteorite, said to weigh 70 tons, was got on board on the return voyage after incredible efforts, and the *Hope* proceeded homewards, picking up the scientific parties *en route*. The meteorite is to be placed in the Museum of Natural History in New York City.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Seiches and their Cause.—M. Forel contributes to the *Académie des Sciences* (*Comptes Rendus*, 1897, No. 20) a valuable note containing a careful examination of the relation between sudden changes of barometric pressure and the amplitude of the waves known as seiches. Taking as a specimen a record at the Tour St. Jacques in Paris, of a sudden barometric variation of 6 mm. in a few minutes, Prof. Forel compares this with the amplitude of the highest seiche on record at Geneva—1.87 metres, on October 3, 1841. The comparison is worked out as follows: (a) barometric change of 6 mm. represents 82 mm. of water—amplitude of wave 163 mm.; (b) these waves are frequently binodal, and may therefore be doubled in amplitude by interference, 326 mm.; (c) observation shows that a wave at Chillon may be quadrupled by the time it reaches the observatory at Secheron through the narrowing of the lake, after the manner of a "bore;" (d) and at Geneva the amplitude may be half as much again as at Secheron, giving a total of 1.95 metres. Hence an observed change of pressure is more than sufficient to produce the highest observed seiche.

GENERAL.

New Soundings and Deep-sea Temperature Observations.—We have received the Admiralty list of oceanic depths and serial temperature observations for the year 1896. Most of the work has been done by H.M.S.S. *Penguin* and *Waterwitch* in the Southern and South-Western Pacific, the former series including the now famous soundings of 5147 fathoms in lat. 28° 44' S., long. 176° 4' W., and 5155 fathoms in lat. 30° 28' S., long. 176° 39' W., and those in the neighbourhood of Funafuti in connection with the scientific investigations on that island. A few soundings in the Western North Atlantic were made by H.M.S. *Rambler*, H.M.S. *Stork* contributes some from the Mediterranean, and the remainder are from the Indian Marine Survey vessel *Investigator* and three telegraph ships.

Death of the Amazonian Pilot, Captain Manoel Urbano di Monte.—We learn from the *Sketch* for September 22, that the famous pioneer of the

Amazon and its tributaries, Captain Manoel Urbano, died recently at his farm near Manaus, at the junction of the Rio Negro with the Amazon, at an age, it is stated, considerably exceeding a century. Urbano's services to the cause of geography had been no slight ones, as he had served as pilot or guide to most of the chief exploring expeditions into the unknown parts of the Amazon basin, notably that of Chandless for the exploration of the Rio Purus in 1864-1865. He is described as a short, slightly built, dark mulatto, with much of the Indian in his constitution. A portrait given by the *Sketch* shows both the intellectual form of his head and the expression of a gentle, amiable nature. Urbano had constantly endeavoured throughout his life to shield the aboriginal Indians of the Amazon, with whom he mixed freely, from the aggressions of traders and rubber collectors. The story of adventure by Mr. J. W. Wells, entitled 'The Voice of Urbano,' is founded to a large extent on the life-history of the venerable pioneer.

OBITUARY.

E. von Mojsisovics.

THE talented geologist and palæontologist, Edmund Mojsisovics, of Mojsvar, died at the end of August last at Feldebach, in Styria, after a prolonged illness caused by brain disease. Born at Vienna on October 18, 1839, his principal claim to recognition as a benefactor to geography lay in the foundation by him, in 1862, of the Austrian Alpine Club, which—largely also through his efforts—was amalgamated with the German Alpine Club in 1873. In 1867 he entered the Imperial College of Geology, and in 1870 became chief geologist and mining expert. In 1891 he was elected an effective member of the Vienna Academy of Sciences, and in 1892 was appointed Vice-director of the Imperial College. He was best known for his palæontological work, the most valuable outcome of which, in addition to minor contributions, was his great work entitled 'Die Cephalopoden der Hallstätter Kalke,' which appeared in two volumes accompanied by an atlas. His services in the field of geographical morphology were, however, by no means inconsiderable. For example, in his work on the dolomites of the Southern Tirol, he confirmed and extended the theory, propounded by Baron von Richthofen nineteen years before, which considered them to be the remains of former coral reefs. Valuable also from a morphological point of view was his demonstration of the constancy of mountain elevations in the Alps; as, again, was the idea—which originated with him—of the division of the Alps into *two* main sections, West and East Alps, separated by the line drawn through the upper Rhine and the Splügen pass, in contra-distinction to the subdivision (morphologically) into *three* parts. In many ways, too, his researches on the phenomena of the "Karst" laid the foundation of our present knowledge. They were in part a result of his scientific work in the mountains of Bosnia and Hercegovina, in the morphological and geological exploration of which he took a large share. Finally, it deserves mention that the zoo-geographical section of the great geographical work set on foot by the late Crown Prince Rudolf, entitled 'Die Oesterreichisch-Ungarische Monarchie in Wort und Bild,' was contributed by Mojsisovics. The deceased scientist was in 1896, at his own wish, transferred to Gratz, where he held the post of Professor of Zoology.

GEOGRAPHICAL LITERATURE OF THE MONTH.

*Additions to the Library.*By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.	Mag. = Magazine.
Ann. = Annals, Annales, Annalen.	P. = Proceedings.
B. = Bulletin, Bollettino, Boletim.	R. = Royal.
Com. = Commerce, Commercial.	Rev. = Review, Revue, Revista.
C. Rd. = Comptes Rendus.	S. = Society, Société, Selakab.
Erdk. = Erdkunde.	Sitzb. = Sitzungsbericht.
G. = Geography, Geographia, Geografia.	T. = Transactions.
Ges. = Gesellschaft.	V. = Verein.
I. = Institute, Institution.	Verh. = Verhandlungen.
J. = Journal.	W. = Wissenschaft, and compounds.
M. = Mitteilungen.	Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 x 6½.

EUROPE.

Alps—Glaciers. *Jahrb. Schweizer Alpenclub* 32 (1897): 282-300. Forel and Du Pasquier. Les variations périodiques des glaciers des Alpes. Par Prof. Dr. F.-A. Forel et Prof. Dr. L. Du Pasquier.

This is the seventeenth report of the Commission for the study of the glaciers of the Alps.

Austria—Istria. *Mem. S. Spéléologie* 1 (3) (1896): 1-20. *Marinitseh*. La Kačna-Jama (l'Abime des Serpents). Par M. J. Marinitseh. *With Plans*.

Austrian Alps. *M. G. Ges. Wien* 40 (1897): 421-456. *Schönberger*. Orometrisches aus den Niederen Tauern. Von Franz Schönberger. II. Die Thäler.

This paper includes elaborate statistics of 121 valleys of the Austrian Alps, with reference to their length, elevation at different points, angle of slope, etc.

Austrian Alps. *Deutsche Rundschau G.* 19 (1897): 481-484. *Umlauf*. Die Bahn auf den Wiener Schneeberg. Von Friedrich Umlauf. *With Illustrations*.

Central Europe—Ice Caves. *Appalachia* 8 (1897): 201-209. *Balch*. Ice Cave Hunting in Central Europe. By Edwin Swift Balch. *With Illustrations*.

France—Brittany. *J. Anthropol. I.* 27 (1897): 96-103. *Topinard*. On the Anthropology of Brittany. By Prof. Paul Topinard. Communicated by J. G. Garson, M.D.

France—Corrèze. *Mém. S. Spéléologie* 1 (7) (1897): 1-32. *Lalande*. Les Grottes artificielles des Environs de Brive (Corrèze). Par M. Philibert Lalande. *With Plans and Illustrations*.

It is suggested that the artificial caves here described and figured were excavated at a very early period by a prehistoric race accustomed to natural cave-dwellings.

France—Côte d'Or. *Mém. S. Spéléologie* 1 (8) (1897): 1-28. *Drioton*. Les Cavernes de la Côte-d'Or. Par M. Clément Drioton. *With Plans and Illustrations*.

Explorations amongst the caverns of Côte d'Or, with diagrams and photographs.

France—Gard. *Mém. S. Spéléologie* 1 (2) (1896): 1-38. *Mazauric and Cabanès*. Le Spélunque de Dions (Gard). Par MM. F. Mazauric and G. Cabanès. *With Illustrations*.

The description of the cavern of Dions is accompanied by a list of the flora of that part of the department Gard.

- France—Jura.** *Mém. S. Spéléologie* 1 (4) (1896): 1-24. **Renauld.**
La Grotte de Baume-les-Messieurs (Jura). Par M. Edmond Renauld. *With Plans and Illustrations.*
- France—Jura.** *Mém. S. Spéléologie* 1 (6) (1896): 1-36. **Viré.**
La faune souterraine, études sur la Faune Cavernicole du Jura, avec quelques mots sur la faune des Catacombes de Paris et des souterrains refuges de Naours (Somme). Recherches préhistoriques dans le Doubs et le Jura. Par M. Armand Viré. *With Plans and Illustrations.*
- France—Lozère.** *Mém. S. Spéléologie* 1 (5) (1896): 1-28. **Carrière.**
La Grotte de Dargilan (Lozère). Par M. Gabriel Carrière. *With Plans and Illustrations.*
- France—Marseille.** *Mém. S. Spéléologie* 1 (9) (1897): 1-70. **Fournier.**
Les Cavernes des environs de Marseille. Par M. E. Fournier. *With Plans.*
A generalized study of the caverns of the neighbourhood of Marseille, taking account specially of the fauna discovered in the cave deposits.
- France—Mont Blanc.** *Alpine J.* 18 (1897): 461-471. **Wilbraham.**
The Narrative of an Ascent of Mont Blanc in 1830. By the Hon. E. Bootle Wilbraham. With an Introductory Note by Douglas W. Freshfield.
- France—Padirac.** *Mém. S. Spéléologie* 1 (1) (1896): 1-24. **Martel and Rupin.**
Troisième exploration du Gouffre de Padirac (Lot). Par MM. E.-A. Martel and E. Rupin. *With Illustrations.*
- France—Vosges—Place-Names.** *B. S. G. de l'Est* (1896): 356-365. **Fournier.**
Sur la prononciation de quelques noms de lieux dans les Vosges. Par A. Fournier.
- Germany.** *Globus* 72 (1897): 69-77. **Jansen.**
Die Müggelberge, der Müggelsee und der Teufelssee bei Friedrichshagen in der Mark. Beschreibung, Entstehung, Sagen und Sprachgeschichtliches. Von Dr. Hubert Jansen. *With Maps.*
- Germany.** *Aus allen Weltteilen* 28 (1897): 537-542, 581-587, 605-614. **Oehlmann.**
Die Herzogtümer Bremen und Verden. Von Dr. E. Oehlmann.
- Germany.** **Richter.**
Bibliotheca Geographica Germaniæ. Litteratur der Landes- und Volkskunde des Deutschen Reichs bearbeitet im Auftrage der Zentral-Kommission für wissenschaftliche Landeskunde von Deutschland durch Paul Emil Richter. Autoren-Register. Leipzig: W. Engelmann, 1897. Size 9½ x 6, pp. 54.
This is the author's index to the great bibliography of Germany.
- Germany—Frisian Islands.** **Leichsering.**
Aus allen Weltteilen 28 (1897): 505-514, 549-557.
Zur Rettung der nordfriesischen Insellande. Von Aug. C. Leichsering. *With Illustrations.*
- Germany—Prussia.** *Globus* 72 (1897): 10-12. **Andrée.**
Das zweiherrige Dorf Woltorf und die preussisch-braunschweigische Grenze bei demselben. Von Richard Andrée. *With Plans.*
The town and district of Woltorf present as curious an instance of complicated political geography as can well be found, both being divided up like irregular chessboards into detached areas subject to the jurisdiction of Prussia, of Brunswick, or of both conjointly.
- Holland—Waterways.** **Beekman.**
Tijds. K. Ned. Aard. Genoots. Amsterdam (2) 14 (1897): 365-396.
Waterwegen in Oud-Holland. Door A. A. Beekman. *With Map.*
A historical map describing the ancient canals of Holland, with a map of the dykes and canals existing in 1631 between Rotterdam and Amsterdam.
- Hungary—Historical.** *M. G. Ges. Wien* 40 (1897): 457-524. **—————**
Die Bevölkerung Ungarns zur Zeit der pragmatischen Sanction.
Extracts from a Hungarian work published on the occasion of the millennium celebration, which deals nominally with the population of Hungary in 1720-1721. The work is really much more extensive, being a general statistical account of the monarchy in the first quarter of the eighteenth century.

- Italy—Lago di Fusino.** *Globus* 72 (1897): 88-94, 105-110. Hassert.
Der Fusiner See einst und jetzt. Von Kurt Hassert. *With Map.*
- Mediterranean—Crete.** *B.S.G. Lyon* 14 (1897): 375-386. Chambeyron.
L'île de Crète. Par E. Chambeyron.
- Portugal—Wine Industry.**
Le Vin de Porto à l'Exposition de Bruxelles. 1897. Size 6½ × 9, pp. 32.
Illustrations. Presented by l'Association Commerciale de Porto.
- Russia—Finland.** *Acta S. Sci. Fennicæ* 21 (1896): 1-184. Homén.
Ueber die Bodentemperatur in Mustiala. Von Theodor Homén.
On ten years' observations of Earth-temperatures in Southern Finland (60° 49' N., 23° 47' E.), made in the open country and in forests. The observations are recorded in full, and are very comprehensively discussed with relation to depth in the soil, seasonal change, the influence of dry and wet summers, and the effect of snow-covering in winter.
- Scandinavia.** *K. Svensk. Vetensk.-A. Handlingar* 28 (1896): 1-210. Törnebohm.
Grunddragen af det centrala Skandinavien bergbyggnad. Af A. E. Törnebohm.
With Maps and Plate.
- Switzerland—Railways.** *Rev. Scientifique* (4) 8 (1897): 46-51, 78-81. Hubon.
Les chemins de fer suisses. Par M. E. Hubon.
- Switzerland—Zermatt.** Whympér.
The Valley of Zermatt and the Matterhorn. A Guide. By Edward Whympér.
London: John Murray, 1897. Size 7½ × 5, pp. xiv. and 212. *Maps and Illustrations. Price 3s. Presented by the Author.*
Mr. Whympér has produced a second Alpine Guide-book no less valuable and even more interesting than his guide to Chamönix. Dealing with the Zermatt district, he combines his unsurpassed local knowledge with carefully selected historical matter. The thrilling account of the first ascent of the Matterhorn is reprinted with notes from the author's 'Scrambles amongst the Alps.' There are many excellent illustrations, and a wealth of maps unusual in books of the kind.
- United Kingdom—England.** *J. Manchester G.S.* 12, 1896 (1897): 205-236. Tracy.
The Manchester Ship Canal: the Story in Brief from 1708 to 1896. By W. Burnett Tracy. *With Map, Plan, and Illustrations.*
- United Kingdom—Ireland.** *Nineteenth Century* 42 (1897): 185-205. Mayo.
The Tourist in Ireland. By the Right Hon. the Earl of Mayo.
A statement of the comfort of modern conditions of travelling in Ireland.
- United Kingdom—Tide Tables.** Harris and Goalen.
Tide Tables for the British and Irish Ports, for the year 1898: also the times and heights of High Water at full and change for the principal places on the Globe. By Captains H. R. Harris and W. N. Goalen. London: J. D. Potter, [1897]. Size 10 × 6, pp. xl. and 262.
- United Kingdom—Trade.** *Contemporary Rev.* 72 (1897): 333-340. Mulhall.
Our Trade with Germany and Belgium. By Michael G. Mulhall.

ASIA.

- Afghanistan—Káfiristan.** *J. Anthropol.* 1. 27 (1897): 75-89. Robertson.
Káfiristan and its People. By Sir George Scott Robertson, K.C.S.I. *With Plates.*
- Asia.** Cahun.
Introduction à l'Histoire de l'Asie, Turcs et Mongols des Origines à 1405. Par Léon Cahun. Paris: A. Colin & Cie., 1896. Size 9½ × 6½, pp. xiv. and 520.
Presented by the Executors of the late Mr. Ney Elias.
After a short geographical chapter, M. Cahun discusses successively the earliest inhabitants of Asia, the Turks and Islam, the Mongols, Asia under the Mongols, and concludes with an account of Timour and the triumph of Islam. The book deals with the period which elapsed between the fall of the Persian civilization in Asia and the rise of the great power of China.
- Asia Minor.** *P.R. Artillery* 1. 24 (1897): 427-443. Clayton.
Consular experiences in Turkey. By Colonel E. Clayton. *With Map.*
Describes a journey from Erzerum to Van and through Armenia, with references to the condition of Asiatic Turkey.

- China.** *B.S.G. Commerc. Paris* 19 (1897): 477-511. Dujardin-Beaumetz.
Le commerce de la Chine avec l'Étranger. Par M. F. Dujardin-Beaumetz.
- China.**
China. Imperial Maritime Customs. 1.—Statistical Series: Nos. 3 and 4. Returns of Trade and Trade Reports for the year 1896. Part 1.—Report on the Trade of China, and Abstract of Statistics. Shanghai: Kelly & Walsh, 1897. Size 11 × 9, pp. 32.
- China.** *B.S.G. Paris* (7) 18 (1897): 86-80. Sculié.
De Ta-tsien-loû à Tse-kou (rive droite du Mékong). 11 octobre—7 décembre 1897. Nouvelle route à travers le pays de Ly-thang et de Bathing, passage du Yalong-Kiang, du Fleuve Bleu et du Mékong. Par le R. P. J. Soulié. *With Map.*
- China and Japan.** *B.S.G. Lyon* 14 (1897): 293-308. Pila.
Le développement économique de la Chine et du Japon. Par M. Ulysse Pila.
- China—Western Provinces.** Hosie.
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 The Colony of Lagos. By Sir Gilbert T. Carter, K.C.M.G.
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 The Voyages made by the Sieur D. B. to the Islands Dauphine or Madagascar and Bourbon or Mascarene in the years 1669-70-71, and 1672. Translated and Edited by Captain Pasfield Oliver. *With Facsimile Maps and Illustrations.* [Supplement to the Voyage of François Leguat, issued by The Hakluyt Society, Nos. lxxxii. and lxxxiii., 1891.] London: David Nutt, 1897. Size 9½ × 6, pp. xxxvi. and 160. Price 10s. 6d. *Presented by the Publisher.*
 The original of this journal, which is now first published in English, was printed in Paris in 1674 in duodecimo form. The author, whose name, as appears from his dedicatory letter, was Dubois, went to Madagascar at the time of the early French connection with the island, apparently to find official employment at Fort Dauphin. The chief interest in his account centres in his description of the fauna of Réunion (Mascarene as he calls it), including the dodo and the gigantic tortoises of the island. The

present edition contains, in addition to the Editor's notes, appendices by well-known zoologists on points with reference to the fauna needing elucidation. The greater number of the illustrations are from the photographs of Dr. Catat.

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A treatise on the anthropology of the Hamitic races of Africa, which will be farther referred to along with other recent books on Africa.

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A short account of a collection of documents relating to Marocco, many derived from native sources, made by order of the Governor-General of Algeria.

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Note on a Portion of the Nubian Desert south-east of Koroako. I. Field Geology. By Capt. H. G. Lyons. II. Petrology. By Miss C. A. Raisin, B.Sc. III. Water Analyses. By Miss E. Aston, B.Sc. *With Map.*

Somaliland—Stone Implements. J. Anthropol. 1. 27 (1897): 93-95.

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Further Discoveries of Ancient Stone Implements in Somaliland. By H. W. Seton-Karr. *With Plates.*

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En Afrique australe et à Madagascar. Par M. Henri Gindre.

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- Mexican Islands.** *B.S.G. y Estadística Rep. Mexicana* (4) 3 (1894): 168-206. ———
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- Mexico—Mountains.** *Alpine J.* 18 (1897): 456-461. Hamilton.
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Bureau Général de Statistique de la Province de Buenos Aires. L'Agriculture, l'Élevage, l'Industrie et le Commerce dans la Province en 1895. Mémoire publié sous la direction de Carlos P. Salas. La Plata, 1897. Size 11½ × 8, pp. cx. and 102. *Maps. Presented by Carlos P. Salas, Directeur-Général de la Statistique.*
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This important work includes the paper read by Sir Wm. Macgregor at the Royal Geographical Society. It is the most complete and authoritative treatise on British New Guinea ever compiled.
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Plains of Marine and Subaërial Denudation. By W. M. Davis.
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Note on the Warm Undercurrent in the Arctic Ocean between Greenland and Spitzbergen. By B. Leigh Smith.
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- Oceanography—Adriatic.** *Riv. G. Italiana* 4 (1897): 266-281. **Gavazzi.**
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- Oceanography—Marine Life.** *Natural Sciences* 11 (1897): 17-27. **Murray**
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- The author terms the limit of saturation the "surface of the sub-lake," and describes observations on wells which confirm the relation of underground water to rainfall as elaborated by the long series of observations in Europe.

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- Cabot.** *Rev. G.* 40 (1897): 401-408; 41 (1897): 36-43. **Harrisse.**
Sébastien Cabot, pilote major d'Espagne, considéré comme Cartographe. Par H. Harrisse.
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The Discovery of North America by John Cabot, the alleged Date and Landfall, also the ship's name, the *Matthew*, a forgery of Chatterton? By Henry Harrisse. Third Edition. London: B. F. Stevens, 1897. Size 8 × 5½, pp. 48. *Presented by the Publisher.*
Mr. Harrisse advances reasons for his belief that the data available for the discussion of Cabot's voyage are not sufficient to justify any conclusion as to the place or date of the landfall, and the name of the ship, the *Matthew*, he imputes to a forgery of Chatterton's.
- Dutch Voyage.** **Groeneveldt.**
Tijds. K. Ned. Aard. Genoots. Amsterdam 14 (1897): 397-410.
Eene Reis van eene Nederlandsche Vloot in het begin der 17 de eeuw. Door W. P. Groeneveldt.
Account of the voyage of a Dutch fleet from Java to the Chinese coast in 1622.
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The Effects of Geographic Environment in the Development of Civilization in Primitive Man. By Gardiner G. Hubbard.

- Historical Routes.** De la Blache.
Les voies de commerce dans la Géographie de Ptolémée. Par M. Vidal de la Blache. Extrait des Comptes Rendus de l'Académie des Inscriptions et Belles-Lettres. Séance du 6 Novembre 1896. Paris: Imp. Nationale, 1896. Size 9 x 6, pp. 32. *Maps. Presented by the Author.*
- An endeavour to elucidate Ptolemy's Geographical Tables by reference to the trade routes in use during the second century, showing what were the probable data thus available for Ptolemy, and what use he made of them.
- Historical—Vespucci.** *Mem. S.G. Italiana* 6 (1897): 209-226. Martino.
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- Italian Emigration.** *Ann. G.* 6 (1897): 123-132. Yver.
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A study of the destination and origin of the migrating Italians, nearly 300,000 of whom leave Italy annually.
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- Newton.** Gibbs.
Hubert Anson Newton. By J. Wittard Gibbs. [From the *American Journal of Science*, vol. iii., May, 1897.] Size 9½ x 6, pp. 20. *Portrait. Presented by the Author.*
Mr. Newton's work as an astronomer was concerned mainly with meteors.
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Josias Simler als Verfasser der "Vallesiae Descriptio" und des "Commentarius de Alpibus." Von G. Meyer von Knonan.
Josias Simler, born in 1580 in Zurich, wrote a description of Valais and of the Alps, of which a summary is given in this article.
- Stephan.** *Deutsche Rundschau G.* 19 (1897): 422-424. ———
Der deutsche Generalpostmeister Dr. Heinrich v. Stephan. *With Portrait.*
- Wilson-Barker.** *Nautical Mag.* 66 (1897): 567-569. ———
The Editor's Album. Captain David Wilson-Barker, Lieut. R.N.R. *With Portrait.*

GENERAL.

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I Cataloghi e l'Istituto Internazionale di Bibliografia. Osservazioni di D. Chilovi. I. I Cataloghi delle Biblioteche. Firenze: Fratelli Bocca, 1897. Size 11 x 7½, pp. 42.
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P.R. Colonial I. 28 (1896-97): 484-494.
Index to the Papers and Authors in Volumes I. to XXVIII. of the *Proceedings of the Royal Colonial Institute.*
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A Bibliography of Geography, being the sections relating to that subject in 'The Best Books' and 'The Reader's Guide.' By William Swan Sonnenschein.

- London: Sonnenschein & Co., 1897. Size $10\frac{1}{2} \times 8\frac{1}{2}$, pp. [138]. Price 4s. 6d.
Presented by the Publishers.
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- Bibliography.** Thoulet.
Notice sur les travaux scientifiques publiés, par M. J. Thoulet. Nancy, 1897.
Size $10 \times 6\frac{1}{2}$, pp. 64. Presented by the Author.
- Prof. Thoulet gives a chronological list of 140 memoirs, of which he is the author, ranging from 1868 to the present year. They deal with many questions of mathematical and physical geography, latterly largely with oceanography. Most of the titles are followed by a summary of the contents of the papers referred to.
- Commercial Geography.** *Contemporary Rev.* 73 (1897): 213-218. Mulhall.
Twenty Years of Trade. By Michael G. Mulhall.
Contrast of the trade of the world in 1876 and 1896.
- Commercial Geography.** *Scottish G. Mag.* 13 (1897): 337-357. Tyler.
The Geography of Communications. By Sir Henry Tyler.
- Educational—Methods.** Davis.
Studies for Students. Large Scale Maps as Geographical Illustrations. By W. M. Davis. (Reprinted from the *Journal of Geology*, vol. iv. No. 4, May—June, 1896). Chicago, 1896. Size $9\frac{1}{2} \times 7$, pp. [30].
- Egyptian Writing.**
An Egyptian Alphabet for the Egyptian People. Florence: The Landi Press, 1815-1897. Size 10×7 , pp. 56.
- This anonymous pamphlet proposes a transliteration of the Arabic alphabet for the use of Egyptians. The form adopted is a Roman alphabet with a few diacritical marks. Its use is illustrated by a number of examples.
- Geography in 1895.** Campos.
La Geografía en 1895. Memoria sobre el VI. Congreso Internacional de Ciencias geográficas celebrado en Londres. Por Rafael Torres Campos. Madrid, 1897.
Size $9\frac{1}{2} \times 6\frac{1}{2}$, pp. 288. Plates. Presented by the Author.
- Señor Torres Campos has, in his lengthy report on the Sixth International Geographical Congress, given a very full account of the work of the London meeting, with original notes, and in some instances bibliographies of some length bearing on the subject of the Congress papers.
- German Colonies.** Barré.
B.S.G. Marseille 20 (1896): 225-243, 396-413; 21 (1897): 25-40.
Notes sur l'Empire colonial de l'Allemagne. Par M. Henri Barré.
- German Colonies.** *Kolon. Jahrb.* 10 (1897): 18-39. Pfeil.
Ein Beitrag zur Frage der Verbrecherdeportation nach deutschen Kolonien. Von Joachim Graf Pfeil.
- Lima Geographical Society.** Carranza.
Memoria que el presidente de la Sociedad Geográfica de Lima Dr. D. Luis Carranza presenta a la junta general de la Sociedad en su última sesión de año (1897). Lima, 1897. Size $10\frac{1}{2} \times 7$, pp. 24. Presented by the Author.
- The annual address to the Lima Geographical Society, summarizing the geographical activity of Peru.
- Missionary Reports.**
Free Church of Scotland. Missionary Reports (Foreign), May, 1897. 1. Foreign Missions (including Report of Woman's Society). 2. Colonial Missions. 3. Continental Missions. 4. Missions to the Jews. Edinburgh, 1897. Size $9 \times 5\frac{1}{2}$, pp. 128, 78, 20, 16, and 20.
- Monetary Systems.** *Deutsche G. Blätter* 20 (1897): 1-66. Shurtz.
Beiträge zur Entstehungsgeschichte des Geldes. Von H. Schurtz.
Notes on the history of the origin of monetary systems in different parts of the world.
- Mountain Observatories.** Holden.
Smithsonian Miscellaneous Collections. 1035. Mountain Observatories in America and Europe. By Edward S. Holden. Washington: The Smithsonian Institution, 1896. Size $9\frac{1}{2} \times 6$, pp. vi. and 78. Plates. Presented by the Smithsonian Institution.
A study of the conditions for meteorological observations at high altitudes in Europe

and America. There are excellent photographs of all the mountain astronomical observatories referred to.

Mountaineering—Historical.

Jahrb. Schweizer Alpenclub 33 (1897): 203-216.

Zschokke.

Zur Geschichte des Bergsteigens. Pilatusberg und Mont Ventoux. Von Dr. A. Zschokke.

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Königl. Preuss. Landes-Aufnahme.

Karte des Deutschen Reiches. Herausgegeben von der Kartogr. Abtheilung der Königl. Preuss. Landes-Aufnahme, 1894. Sheets: 379, Elberfeld; 429, Düren; 480, Malmedy. Scale 1: 100,000 or 1.7 stat. mile to an inch. Price 1.50 marks each sheet.

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(7th edit.), parts of Manipur (Assam) and of districts Upper Chindwin and Katha (Upper Burma), Seasons 1881-82 and 1886-94.—South-Eastern Frontier, 4 miles to an inch. No. 2 n.e. (6th edit.), parts of Lower Chindwin, Sagaing, Myingyan, Pakokku, Meiktila, and Kyankae (Upper Burma), Seasons 1886-90; No. 4 n.w. (6th edit.), parts of districts Katha, Bhamo, Shwebo, Ruby Mines, and Northern Shan States (Upper Burma), Seasons 1886-95; 4 s.w. (7th edit.), parts of districts Ruby Mines, Shwebo, Sagaing, and Mandalay (Upper Burma), and of Northern Shan States, Seasons 1886-93; 6 n.e., part of Southern Shan States, Upper Burma, Seasons 1890-91 and 1892-93.—N.W. Provinces and Oudh Survey, 1 mile to an inch. No. 63 (2nd edit.), districts Naini Tal and Garhwal, Seasons 1868-69, 1873-75, and 1888-90.—Madras Survey, 1 mile to an inch. No. 23 (2nd edit.), portions of districts Chitaldroog and Dharwar (Bombay), Seasons 1882-83 and 1893-94.—Central India and Rajputana Survey, 1 mile to an inch, No. 210 (2nd edit.), part of Jeypur (Rajputana Agency), Season 1865-66.—Upper Burma, 64 miles to an inch, with additions and corrections to 1896.—Skeleton map of the Punjab and surrounding countries, 32 miles to an inch, with additions and corrections to railways, etc., up to July, 1896.—The Provinces of Assam, 16 miles to an inch, with additions and corrections to 1896.—Route Map for the Western Himalayas, Kashmir, Punjab, and Northern India, with portions of Afghanistan, Beluchistan, etc., 32 miles to an inch, with additions to railways, 1896.—Calcutta and surrounding country, 1 mile to an inch, December, 1896.—Map showing the path and limits of totality of the total eclipse of the sun in India on the 21st January, 1898, 64 miles to an inch, November, 1896.—Conventional signs to be used on topographical maps, with additions and corrections to November, 1896.—Chart of Triangulation and Traversing, Gujarat Survey, Degree Sheet i., 2 miles to an inch, Seasons 1884-85 and 1886-87, 2 sheets.—Chart of Triangulation and Traversing, Gujarat Survey, Degree Sheet vii., 2 miles to an inch, Seasons 1884-89, 2 sheets.—District Champaran, Bengal, 8 miles to an inch, 1891.—District Balaghat, Central Provinces, 12 miles to an inch, 1897.—District Shahabad, Bengal, 8 miles to an inch, 1894.—District Chhindwara, Central Provinces, 8 miles to an inch, 1897.—District Jullundur, Punjab, 8 miles to an inch, 1897.—District Khulna, Bengal, 8 miles to an inch, 1890.—District Nimar, Central Provinces, 8 miles to an inch, 1897.—District Goalpara, Assam, 8 miles to an

inch, 1897.—District Cawnpore, N.W. Provinces and Oudh, 8 miles to an inch, 1893.—Garhjat States, Tributary States of Chota Nagpur, Bengal, 16 miles to an inch, 1896.—District Mooltan, Punjab, 8 miles to an inch, 1896.—District Naini Tal, N.W. Provinces and Oudh, 10 miles to an inch, 1896.—District Bannu, Punjab, 8 miles to an inch, 1896.—District 24, Paganas, Lower Provinces, Bengal, 4 miles to an inch, with corrections and additions to July, 1896.—District Dacca, Lower Provinces, Bengal (2nd edit.), 4 miles to an inch, with additions and corrections to roads, etc., to July, 1896.—District Gaya, Lower Provinces, Bihar (Bengal), 4 miles to an inch, with corrections and additions to boundaries and railway to November, 1896.—District Lakhimpur, Assam, 4 miles to an inch, with additions and corrections to boundaries, roads, and railway up to August, 1896.—District Saran (3rd edit.), Province of Bihar, 4 miles to an inch, with additions and corrections up to March, 1896.—District Bankura (2nd edit.), Lower Provinces, Bengal, 4 miles to an inch, November, 1896.—District Champaran (2nd edit.), Lower Provinces, Bengal, 4 miles to an inch, with additions and corrections to boundaries, roads, etc., up to June, 1896.—District Khasi and Jaintia Hills, Assam, 4 miles to an inch, June, 1896.—District Manbhum, 4 miles to an inch, October, 1896.—District Puri, Lower Provinces, Bengal, 4 miles to an inch, additions to June, 1896.—District Naintal, 2 miles to an inch, 2 sheets, September, 1896.

(E. Stanford, Agent.)

North-West Frontier of India.

Stanford.

Stanford's Sketch-Map of the North-Western Frontier of India. Scale 1 : 633,600 or 10 stat. miles to an inch. By E. Stanford. Stanford's Geographical Establishment. London, 1897. *Presented by the Publisher.*

AFRICA.

Central Africa.

Hassenstein.

Neue Reiserouten in Marangu und Itawa 1891 bis 1895. Mit Benutzung einer Originalskizze des S. G. Msor. Boelens, Priester de Mission d'Afrique des Pères Blanches, gezeichnet von Dr. B. Hassenstein. Scale 1 : 750,000 or 11.9 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1897, Tafel 14. Gotha : Justus Perthes, 1897. *Presented by the Publisher.*

German East Africa.

Kiepert and Meisel.

Karte von Deutsch-Ostafrika. Scale 1 : 300,000 or 4.7 stat. miles to an inch. Sheet C 5, Maasai-Steppe. Berlin : Geographische Verlagshandlung Dietrich Reimer (Ernst Vohsen).

AMERICA.

British Columbia.

Fletcher.

Map of the East and West Kootenay District. Scale 1 : 380,160 or 6 stat. miles to an inch. By Frank Fletcher, F.L.S., Nelson B.C. *Presented by the Author.*

The present edition of this map has been corrected to 1897, and contains a large amount of information as to the location of minerals in the district. The blocks which have been surveyed by the author, and appeared on the earlier edition of this map for the first time, are also shown.

Patagonia.

Petermanns Geographische Mitteilungen.

Karte der Chilenisch-Argentinischen Grenzregion im Feuerland. Nach den Aufnahmen der Subkommissionen 1894-1895. Scale 1 : 500,000 or 7.9 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1897, Tafel 13. Gotha : Justus Perthes, 1897. *Presented by the Publisher.*

Peru.

Raimondi.

Mapa del Peru. A. Raimondi. Scale 1 : 500,000 or 7.9 stat. miles to an inch. Engraved and printed by Erhard Bros., Paris. Sheets Nos. 26, 28, 30, 31, 32. *Presented by the Geographical Society of Lima.*

These five sheets include portions of Southern Peru, and appear to have been compiled from the most recent and reliable information. The hill-work is shaded in brown, and the rivers and lakes in blue, the combination being very effective. A full explanation of the symbols employed is given at the foot of each sheet.

Only five sheets now remain to complete this map, which is by far the best of this country which has ever been published.

AUSTRALASIA.

Tasmania. Department of Lands and Surveys.

Mineral and Land map of Tasmania. Scale 1 : 950,400 or 15 stat. miles to an inch. Department of Lands and Surveys. Hobart, 1897. *Presented by Land and Survey Office.*

Tasmania. Department of Lands and Surveys.

Map of Tasmania. Scale 1 : 506,800 or 8 stat. miles to an inch. Department of Lands and Surveys. Hobart, 1897. *Presented by Lands and Survey Office.*

GENERAL.

German Colonies.

Langhans.

Deutscher Kolonial-Atlas, 30 Karten mit 300 Nebenkarten, entworfen, bearbeitet und herausgegeben von Paul Langhans. Erschient in 15 Lieferungen (jede mit 2 karten). Parts 13, 14, and 15. Gotha : Justus Perthes, 1897. *Price 1 mk. 60 pf. each part.*

Part xiii. contains No. 7, showing German colonization in Eastern Europe; No. 19 is Sheet i. of a map of German East Africa. Part xiv. contains No. 8, map showing the distribution of Germans in North America; No. 22 is Sheet iv. of a map of German East Africa. Part xv. contains Nos. 20 and 21, Sheets ii. and iii. of a map of German East Africa, together with a table of contents of the atlas, and other explanatory matter.

With the issue of these parts this excellent atlas is now complete. The maps throughout have been compiled with the greatest care, they are beautifully drawn, are quite up to date of publication, and contain a vast amount of information with regard to the German colonies.

CHARTS.

Admiralty Charts.

Hydrographic Department, Admiralty.

Charts and Plans published at the Hydrographic Department, Admiralty, during July and August, 1897. *Presented by the Admiralty, through the Hydrographer.*

No.	Inches.		
1432	m = 4.88	France, north coast :—Approaches to L'Abervac'h.	2s. 6d.
160	{ m = 2.8	Plans on the west coast of Italy :—Port Anzio, Gaeta bay, mouth of the Tiber (republished).	1s. 6d.
	{ m = 1.4		
1315	m = 12.0	Bermuda islands :—The Narrows.	2s.
2240	m = 1.2	Iceland, west coast :—Grundar and Kolgrafa fiords.	1s. 6d.
2692	m = 7.9	North America, east coast :—Louisburg harbour.	2s. 6d.
699	m = 7.0	Plans on the coast of Chile :—Esmeralda cove.	1s. 6d.
2889	m = 2.93	Plans on the coast of Peru :—Cerro Azul bay.	1s. 6d.
977	m = 3.0	Philippine islands :—Nin bay and Port Mandaon.	1s. 6d.
1926	m = 4.0	Formosa, west coast :—Anpei (Aumping) anchorage.	1s. 6d.
2878	m = 5.8	Japan, Nipon, south coast :—Mera Koura.	1s. 6d.
2249	{ m = 5.4	Ports on the east coast of Kiusiu :—Port Inokushi, Port Yonozu.	1s. 6d.
	{ m = 3.65		
2985	m = 3.0	Japan :—Saiki bay.	1s. 6d.
2277		White sea, Sheet ix. :—Plan added, Porja anchorage and approaches.	
899		San Diego bay to Conception point, etc. :—Plan added, Santa Monica.	
2797		Anchorage off the coast of California :—New Plans, Cuyler harbour, north-west harbour (San Clemente island), South-east harbour (San Clemente island).	
1109		Harbours and anchorages in the Red Sea :—New plan, anchorage of Raweiya.	
2388		Sea of Okhotsk :—Plan added, Ola anchorage.	

(J. D. Potter, agent.)

Charts Cancelled.

No.		Cancelled by	No.
160	Civita Vecchia to Policastro.	New Chart.	160
2692	Louisburg harbour.	New Chart.	2692
2530	Plan of Santa Monica on this sheet	New plan of Santa Monica on sheet	899
977		New Chart.	
		Nin bay and Port Mandaon,	977
700	Makambi river.		

Charts that have received Important Corrections.

No. 2175, England, south coast:—Poole harbour. 2800, Ireland, east coast:—Lough Carlingford. 2810, Ireland, east coast:—Lough Carlingford entrance. 125, Belgium:—Ostende roads. 300, Anchorages on the north and west coasts of Spitzbergen. 2812A, Baltic sea. 2289, Baltic sea:—The Skagerrak or Sleeve. 2297, Gulf of Bothnia:—Hango head to South Quarken. 2229, Denmark:—Entrance to Great and Little Belts. 2116, Baltic sea:—Great and Little belts. 498, France, north coast:—Cape d'Alprech to Ambletouse. 88, Spain, west coast:—Cadiz harbour and approaches. 2157, Sardinia:—Maddalena and adjacent islands. 1189, Mediterranean:—Bonifacio strait. 867, Bermuda:—From the Narrows to Hamilton. 2740, Iceland and the Faeroe islands. 565, Iceland, western portion. 566, Iceland, eastern portion. 2733, Iceland:—Portland to Snefells Jökul. 1677, Newfoundland:—St. Margaret bay and Castors harbour. 797, River St. Lawrence:—Quebec to Kingston, etc. 1207, Central America:—River Dulce. 2314, Gulf of Mexico:—Mobile bay. 537, South America, north coast:—Ceara bay. 2530, United States, west coast:—San Diego bay to Cape Mendocino. 570, British Columbia:—Quatsino sound. 592, British Columbia:—Barclay sound. 607, Africa, west coast:—Entrance to the Salum and Jumbas rivers. 1003, Africa, east coast:—River Pungue. 674, Africa, east coast:—Dares-Salaam harbour. 758, Madagascar:—Cape St. Andrew to Antongil bay. 378, Madagascar:—Maromanjo point to Makambytra bay. 823, Bay of Bengal:—Koronge island to White point. 833, Bay of Bengal:—Rangoon river and approaches. 825, Andaman islands. 941a, Eastern archipelago, western portion. 2636, Strait of Makassar, north part. 2637, Strait of Makassar, south part. 2577, Eastern archipelago:—Between St. Bernardino and Mindoro straits, with adjacent islands. 1260, China:—Chifu or Yen-tui harbour. 806, Japan:—Sendai bay to Miyako bay. 2759A, Australia, northern portion. 2650, Strait of Tartary and entrance of the Amur river. 1056, Australia, west coast:—Cape Cuvier to Champion bay. 1750, Australia, south coast:—Port Adelaide. 1018, Australia, east coast:—Montagu island to Becroft head. 1460, Ports in Arafura sea. 1080, Tasmania:—Tamar river. 105, Tasmania:—Port Hobart. 2726, New Zealand:—Manukru harbour. 2685, New Zealand, south island:—Cook strait anchorages, Sheet 2. 2459, North-west Pacific ocean. 2658, Solomon islands:—Gavutu and Tulage harbours.

(*J. D. Potter, Agent.*)

United States Charts.

U.S. Hydrographic Office.

Pilot Charts of the North Atlantic and North Pacific Oceans for September, 1897. Published at the Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Jamaica.

Swinton.

Ten Photographs of Jamaica, taken by Colonel A. Swinton, R.A., 1892. *Presented by Colonel A. Swinton, R.A.*

This is a series of enlargements, which are chiefly valuable as showing the tropical vegetation of the island of Jamaica. They are as follows: (1) Moneague; (2) Screw pine, Moneague; (3) Moneague; (4) Cotton tree, Moneague; (5) Cotton tree, Maudeville; (6) Cabbage palm, near Claremont; (7) Coco-nut palm, Moneague; (8) Royal palm, Spanish town; (9) Ocho Rios; (10) St. Anne's bay.

Mexico.

Stephenson.

Fifty-four Photographs taken by J. Gurdon L. Stephenson, C.E., during the Mexican Western Railway Expedition, 1897. *Presented by J. Gurdon L. Stephenson, Esq.*

This series contains fifty-four photographs taken during the Mexican Western Railway Expedition, 1897. The greater number are photographs of the country through which the expedition passed. Among others, there are several illustrating the industries of the country, the natives and their dwellings, a Maya Indian war-dance, and ancient ruins. The following is a list of the subjects:—

(1) Fuerte river—Ford between Baca and Agua Caliente; (2) Hacienda, El Dorado, Agua Caliente; (3) Hacienda, El Dorado, Agua Caliente; (4) Hacienda, El Dorado, Agua Caliente; (5) Mr. J. Gurdon L. Stephenson, C.E., F.R.G.S., chief of the expedition—Mr. O. V. Lane, mining prospector; (6) Mr. A. Krauss, railway contractor, Bristol; (7) Mr. E. J. Moon, A.M. INST. C.E., chief engineer's assistant; (8) Don Francisco Lasselle, voluntary guide between Agua Caliente and Batopilus; (9) Doooring a mule, Agua

Caliente; (10) Lanphar's distillery, Agua Caliente; (11) Carpenter's shop, Agua Caliente; (12, 13, 14) Maya Indian war-dance; (15, 16, 17) Dan and hot spring, Agua Caliente; (18) View of Agua Caliente; (19) House at Agua Caliente; (20) Lanphar's Tannery, Agua Caliente; (21, 22, 23, 24) Views of Agua Caliente; (25) Mount Rosario district; (26, 27, 28) Mount Rosario; (29) Chinipas valley, from La Guasa; (30) Septentrion valley, from La Guasa; (31, 32) Uvalama; (33) Ancient Spanish silver-mine workings at Septentrion, in the bottom of the cañon; (34) Ancient Aztec store prison at Septentrion; (35) Overlooking Septentrion; (36) Between Temoris and Bahuina; (37, 38) Mamaripa cañon in the Sierra Madre; (39) Cuiteco; (40) Tannery, Cuiteco; (41) Church, Cuiteco; (42) Indian Mozo; (43) Indians at Cuiteco; (44) Between Cuiteco and Los Tascates; (45) Los Tascates, wooden plough; (46) Indian hut at Orihivo; (47) Barranca de Cobrs; (48) Indian woman weaving at Barranca de Cobra; (49) Near Los Ajitos; (50) The judge's coach, Bocoyna; (51) The judge's house at Bocoyna; (52) Church at Bocoyna; (53) Indians, Bocoyna; (54) Indian children, Bocoyna.

Morocco.**Loch.**

Twenty-five Photographs of Morocco, taken by the Hon. E. D. Loch, during Sir Arthur Nicolson's Mission in 1896. *Presented by the Hon. E. D. Loch.*

This is a remarkably fine series of photographs, and the subjects are well chosen. It consists of the following:—

(1) Magador, taken from east; (2) Magador, taken from east; (3) Ain Rashá near Marakesh; (4) Glaiva pass taken from the Kasbah-el-Glaiva; (5) The Wad Nefis looking south, Atlas mountains in the distance; (6) Gateway leading towards Sultan's palace, Morocco city; (7) Two soldiers of the British Legation; (8) Gateway in Magador; (9) Gateway into the inner part of the Kasbah-el-Glaiva; (10) Sheik's house and Zarkten at the northern entrance to Glaiva pass; (11) View looking northwest from top of Glaiva pass; (12) Avenue of orange and olive trees in the Mamonia palace, Morocco city, where the Embassy was quartered; (13) Kontabia mosque, Morocco city; (14) Kautara Wad-Tenuift, near Morocco city; (15) Group taken in the Kasbah-el Glaiva; (16) Government mosque, Morocco city; (17) No title; (18) No title; (19) Taken from the top of Glaiva pass looking south; (20) Kasbah-el-Glaiva (a large castle belonging to the Kaid of Glaiva, situated on the south side of the Atlas mountains); (21) Bridge over Wad Ghadat in Atlas mountains; (22) View of the Kasbah-el-Glaiva; (23) Jibel Ofraz, taken from the north; (24) Jibel Glaiva, taken from a pass about 6000 feet above sea-level, and about 4000 feet above Zarkten; (25) Haj Abalam Ould Haj Maati Meyauzi, Kaid of Shaonia.

Persia.**Churchill.**

Sixteen Photographs taken in the neighbourhood of Resht, Persia, by H. L. Churchill, Esq. *Presented by H. L. Churchill, Esq.*

The following is a list of the subjects:—

(1) Peasant types of Resht; (2) Small waterfall in hills of Talish; (3) Persian tea-picnic by river-side near Resht; (4) Type of Persian private tea-house, known by the name of Kolab Frangee, or "European hab," in large private garden at Resht; (5) Famous dervish at Resht; (6) Peasants returning to their villages after selling their wares at Resht; (7) Wayside shop hut at "Inek"—small lakes in shape of spectacles, showing humped bull in foreground; (8) Road being constructed by a Russian company between Resht and Kazneen; (9) Kilihter, Bahmelabad, near Menjil, between Resht and Kazneen; (10) View of Shah's Shanes ul Amaret, or "Palace of the Sun," Enzelli-Resht; (11) The Moonshie of the British Consulate, Resht; (12) Type of Persian dervish; (13) Clearing road, Resht to Peri Bazar; (14) Country house of Persiau gentleman (this is the house where Sir M. Durand was entertained by the Persian Government on his first arrival in Persia in 1894); (15) View of Rahmetabad, showing construction of houses; (16) View of "Inek" Spectacles, Resht.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

Handwritten notes on a vertical line, including the number 30 and some illegible scribbles.



The Geographical Journal.

No. 6.

DECEMBER, 1897.

VOL. X.

THE PRESIDENT'S OPENING ADDRESS, NOVEMBER 8, 1897.

DURING the recess geographers and explorers have not been idle. Progress has been made and good work has been done in several directions, to which it becomes my duty to allude in opening the present session. The most important step taken by the Council has been the resolution to grant diplomas to students who had gone through a complete course under Mr. Coles. This measure has already had an excellent effect on our system of instruction, and I have no doubt that the diploma will be very highly valued, and sought for by increasing numbers of candidates. Its possessor will, if his ambition leads him either to active work in the field or to the equally useful labours connected with literature and education, find that our diploma will often serve him in good stead. Our graduates will be included in the list of referees.

The gigantic task of making a classified catalogue of our library is at length so far completed that the tickets are all arranged in continents, Asia is arranged in countries and has been used by Fellows, and Europe is quite completed, and has been much used for reference. Cards for all works and periodicals of the last five years are kept complete and ready for the use of readers. The whole number of title-cards is 71,735. The execution of such a vast undertaking involves much thought, as well as hard work, and reflects great credit on Dr. Mill, our librarian, and on Mr. Heawood, his assistant in this task.

Before passing on to the work of our explorers, I must dwell on the loss we have sustained by the death of Sir Rutherford Alcock. I was his colleague on the Council for a period of twenty years, and had good reason to know how anxious he always was to further the best interests of our Society. Judicious, patient, and courteous, he was esteemed by us all, and his able advice helped us out of many a difficulty. The

period of his presidency will always be remembered for the energy with which he advocated African exploration, the results of his efforts being represented by the memorable expeditions of Joseph Thomson.

The recess has been signalized by the publication of two important geographical works: the admirable monograph on British Central Africa, by Sir Harry Johnston, with its fascinating chapters on the scenery and the physical aspects of that region; and the 'First Crossing of Spitsbergen,' by Sir Martin Conway; while we have ourselves brought out Sir William Macgregor's interesting paper on British New Guinea in the form of a small volume.

There has also been much activity in the field, the fruits of which you will, I trust, gather and enjoy during the coming session. In Africa, Mr. Cavendish, who only completed his twenty-first year last May, has made a very remarkable journey from Berbera, across the Somali country, to the river Jub, and then inland to Lake Rudolf. He shares with the late Captain Böttgero the honour of being the first to explore the western shores of that lake; he has collected important information respecting the region between the basin of Lake Rudolf and the White Nile, has helped to solve the problem of the Omo river, and has returned to the coast at Mombasa. With regard to Siam, we may expect another communication from Mr. H. Warrington Smyth, whose two previous papers give us the assurance that it will be a valuable contribution to our knowledge, as well as a source of pleasure to those who listen to it. In Central Asia the labours of Dr. Sven Hedin, which have been continuous during several years, are of great geographical importance. Among other achievements, he has ascended Mustagata to a height of 20,000 feet, and mapped its glaciers; he has, at the utmost peril of his life, crossed the desert of moving sandhills between the Yarkand and Khotan rivers; he has traversed a previously unknown route along the northern rim of the great Tibetan plateau; and he has solved the geographical problem relating to Lob Nor. We hope to have Dr. Sven Hedin with us on the 22nd, when we shall listen to a paper of the deepest interest, read by a young but most accomplished and enthusiastic geographer. Dr. Sven Hedin has devoted himself to the study of geography since he was a boy at school, is a splendid linguist, and is well versed in all those collateral studies which are required by those who wish to become real adepts in our science.

Not less important and quite as interesting are the explorations now being carried on in the Afridi country by our gallant associate, Sir William Lockhart. We must all feel enthusiastic on reading of the skill and ability with which my old friend is conducting a most difficult campaign, and of the brilliant dash and devotion of the Gordon Highlanders and other troops who are serving under him. As Fellows of this Society, we rejoice that the success of our arms also entails success for the cause of geography.

Our friend and associate, Mr. Fitzgerald, is also returning from his arduous examination of Aconcagua, which is believed to be the loftiest peak in the Chilian Andes. Personally I have taken a great interest in this last enterprise of the gallant young explorer, because I have known the mountain of Aconcagua by sight better than any other in the world, gazing at it daily during many months that I was at Valparaiso, and once having had a nearer view of it, from a shoulder of the Campana de Quillota. That Mr. Fitzgerald will give us an exceedingly valuable account of his labours in the Andes we, who know his powers of description, can have no doubt. I may add that there is no region in the world less known than, and which offers so many geographical problems for solution as, portions of the Chilian Andes to the south of Aconcagua.

There will, so far as I am aware, be no new work from the antarctic regions during the ensuing season, unless, as I hope, the Belgian Expedition, commanded by M. de Gerlache, should be able to send news of any discovery before the close of the session. But the efforts of our Council to procure the despatch of a British Antarctic Expedition have never ceased. Last June we had a conference, and subsequent correspondence with the Australasian premiers and agents-general on the subject; and an appeal has since been made to Lord Salisbury. Meanwhile Sir George Newnes has supplied funds for an enterprise, to be conducted by Mr. Borchgrevink, who, it will be remembered, visited Victoria Land in 1895, on board the whaler *Antarctic*, commanded by Captain Kristensen. I understand that his plan is to sail from England next July, land at Cape Adare in Victoria Land, winter there, and attempt to make a journey into the interior in the spring. We wish Mr. Borchgrevink all possible success in his undertaking.

In the arctic regions there has been much activity this summer, and it is reported that it was the most open season that has been known for many years. We hear this from Mr. Jackson; from Mr. Pike, who sailed round Wyche's Land to the east of Spitsbergen; and from Colonel Feilden, who has been in the Kara sea and along the east side of Novaya Zemlya. We look forward to an account of his second visit to Spitsbergen from Sir Martin Conway; and to interesting papers from Colonel Feilden and Mr. Arnold Pike, who will describe to us the very remarkable absence of ice this season in two distant parts of the northern seas.

In my report on our existing knowledge of the arctic regions, which was printed in our *Proceedings* for September, 1877, just twenty years ago, I pointed out that there were four important portions which needed exploration: First, the regions north and west of the Parry islands, to be reached by way of Jones sound; second, the north side of Greenland; third, the North-East Passage; and fourth, the exploration

of the archipelago known as Franz Josef Land. The first has not yet been attempted. With regard to the second, we hear of two contemplated undertakings. Mr. Peary intends to adopt the plan of taking Eskimo families up Smith sound, and, with their aid, to discover the most northern land to the north of Greenland. Captain Sverdrup, Nansen's companion, is fitting out the *Fram*, also with the intention of proceeding up Smith sound and exploring the unknown part of the north coast of Greenland. I greatly fear that neither Peary nor Sverdrup have any adequate conception either of the difficulty of navigating the channels beyond Smith sound, or of travelling over such ice as is met with beyond Robeson strait. This was not the route I recommended for completing the discovery of the Greenland coast, an achievement second to none in geographical interest. The third enterprise enumerated by me in 1877, namely, the North-East Passage, was achieved by Baron Nordenskjöld three years afterwards. It was reserved for the Jackson-Harmsworth expedition to achieve the fourth—the exploration of Franz Josef Land.

We now have to welcome Mr. Jackson, Mr. Armitage, and the other members of the expedition on their safe return, and to congratulate Mr. Harmsworth on the valuable results of his patriotic munificence. Our explorers have passed three consecutive winters in the arctic regions close to the 80th parallel. They have maintained themselves in excellent health throughout that long and trying period; they have diligently registered observations, and have completed exhaustive researches in the zoology, botany, and geology of a new region. This alone is a great work; but it is only a small part of what has been done under Mr. Jackson's command. That explorer, always, I believe, accompanied by Mr. Armitage, has made daring sledge-journeys and boat-voyages, and by these means he has given us a completely new idea of Franz Josef Land. In this present year, by the examination, under exceptionally trying and difficult circumstances, of the land mass to the westward, I think he has surpassed all he had done before, and it will now be our privilege to hear, from Mr. Jackson's own lips, the interesting story of his expedition and its work.*

RECENT JOURNEYS IN PERSIA.†

By Captain P. MOLESWORTH SYKES.

THE ancient kingdom of Persia, to which I would draw your attention this evening, is perhaps one of the most attractive countries in the world, as not only is it rich in remains of a hoary antiquity, which

* Mr. Jackson's paper will appear in a future number of the *Journal*.

† Paper read at the Royal Geographical Society, June 28, 1897. Map, p. 660.

have been the constant theme of historians for more than two thousand years, but to-day it presents so great a variety of interesting problems, and has so faithfully preserved its ancient immutable civilization, that every traveller who has once crossed its great plateau is fired with the desire to return again and again. Before approaching the subject of my three journeys, I would give a brief description of the country upon which we are about to enter.

The kingdom of His Imperial Majesty the Shah stretches, roughly speaking, for 1000 miles from east to west, and for 800 miles from north to south—an area rather larger than that of the countries composing the Triple Alliance. In the provinces which border the Caspian sea the rainfall is very heavy, but, with that small exception, the most noticeable feature is the dryness of Persia, and this is the main cause of its delightful climate. I have mentioned this before anything else, as it appears to me that sufficient attention has not been paid to the enormous effect that deforestation has had, not only on Persia, but on Central Asia generally. It is this fact, and this alone, I would urge, that explains how great armies were able to march across countries the sterility of which would, at the present time, bar the progress of anything beyond a very moderate force; and, conversely, it is upon the successful solution of this problem that the future of these desiccated regions (I use the term advisedly) depends.

To continue, both on the north and south, the great Iran plateau is held up by mighty ranges, which are traversed by mule-tracks, and it is owing to the rugged nature of these passes that the isolation of Persia from the rest of the world is partly due. The plateau once reached, the traveller finds himself on a series of broad plains with mountain ranges on each side of him, which trend to the north-west with amazing regularity. For instance, when travelling to my district of Kerman, a distance of 600 miles from Tehran, I traversed the same great plain throughout, and never lost sight of the two parallel ranges at any portion of my journey. These mountains, which rise to great elevations, are, as my previous remarks would show, entirely bare of timber, while the whole country consists of desert with rare oases, dependent for their existence upon "kanats." By this term, underground channels which tap distant springs in the hills are signified, and it may be imagined how costly and laborious a system this is, the water being frequently carried a distance of over 30 miles to the village it supplies.

There are no navigable rivers in Persia, with the exception of the Karun, and it is extraordinary that between the Indus and this river, a distance of 1500 miles, no considerable body of water reaches the sea. To the north, owing to the heavier rainfall, it is different, and there are two or three rivers of moderate volume flowing into the Caspian sea.

This summary would not be complete without a reference to the

appalling wastes known respectively as the Dasht-i-Kavir and the Dasht-i-Lut. These two great deserts stretch right across Eastern and Central Persia, with the result that there is much less communication between neighbouring provinces of the Persian Empire than their juxtaposition would lead one to expect, the wastes of salt-swamp and sand dividing the districts more completely than any range of mountains, however difficult its passes might be.

It was at the beginning of 1893 that I obtained permission to rejoin the "Bays," at that time stationed in the Punjab, *via* Persia, and I first of all travelled to Odessa, where Colonel C. E. Stewart, Her Majesty's consul-general, and a prominent Fellow of this Society, not only gave me much valuable advice, but also furnished me with letters of introduction. In consequence, I did not enter Persia by the usual route, but crossed from Baku to Uzun-Ada, the starting-point of the Transcaaspian railway, and thence steamed down the eastern coast of the Caspian to its south-east corner. At Ashurada, we lay to off the Russian naval station for a few hours, and soon after reached the end of the "Murdab," or lagoon, where we rowed through myriads of duck and every sort of aquatic bird, to the rickety pier of Bunder Gez, after traversing which, we found ourselves nearly up to the knees in mud. There being no hotel, and tents being out of the question, we were only too glad to find quarters at the telegraph office, where a room was placed at our disposal.

After two days' delay, we started for Astrabad in wet weather, and enjoyed a very full experience of what muddy roads can be. The mules were not so badly off, their loads being high up on their backs; but the ponies, which carried my servant and myself, must have been very weary, as we could hardly ever keep our feet out of the mud, so deep was it. Five hours' marching through the mire only brought us 7 miles on our way, but, as we were told that the road upon the morrow was much better, we decided to halt for the night, and found quarters in the village of Kurd Mahalla, in the house of its headman. Our host professed himself a profound theological student, and, after introducing the subject generally by stating that all Europeans worshipped machines, was anxious to know whether we English worshipped a steamer or a locomotive.

On the following morning the country, which had hitherto been a melancholy tangle of low thorns and bushes, became quite park-like, and, as it cleared up, matters looked more cheerful. On passing through the village, which covers a large area, we saw wheat being thrashed by means of a see-saw—a girl sitting on one end of the plank, and pulling herself up and down by a rope suspended above her. It was nearly sunset when, amid a deafening chorus of jackals, we entered the city of Astrabad, through a dilapidated gate. Inside not a soul was to be seen, and we rode on for a considerable distance before we pounced upon a

stray citizen, whom we induced to guide us to the house of the British agent. My first inquiries were as to the possibility of travelling up the river Atrek to Bujnurd, but my host told me that the country was so disturbed, that the Persian Government would insist on sending a large escort with me, which would have effectually prevented my mixing with the Turkomans, and so I determined not to seek any aid from the authorities.

For about a week I made constant shooting-trips into the Elburz range, during the course of which I bagged a few wild boar, but saw no sign of the magnificent stags that roam the forests. Meanwhile my



THE FARMAN FARMA'S GARDEN AT MAHUN.

preparations were being made, and upon their completion, I marched off due north across a rich alluvial plain, until we sighted Ak-Kala, a fort that commands the bridge over the Gurgan, and the home of the Kajar tribe, whose chief is now Shah of Persia. We then turned due east, and followed up the river, until we reached the encampment of Moussa Khan, the chief of the Ak Ata Bai, the most powerful tribe of Yomut Turkomans. The camp consisted of about thirty "alachuk," and as I lived in these superior nomad dwellings for nearly a month, it might be as well to describe them.

We must first of all imagine a huge beehive framework of wood, some 16 feet in diameter; over this thick black felt is stretched, and we have an ideal movable house, which, in cold weather, is infinitely superior to any tent. Inside are the "lares and penates," packed up in big trunks, while the rifles of the owners hang within easy reach.

Strips of carpet are stretched round wherever there are joinings in the felt, and altogether, when the fire is lit on the hearth, one enjoys a feeling of real comfort.

I had a letter of introduction from Colonel Stewart for my host, and in it my plan of travelling up the Atrek was mentioned. Moussa at first, however, utterly declined to help me, averring that I was sure to be robbed, if not killed, in which case he would be held responsible by the Persian Government. He was also at a loss to know the object of my journey, and, as Colonel Stewart had not mentioned that I was an officer travelling on leave, I told him that I was a Fellow of the Royal Geographical Society. When he found out that the object of this Society was the collection of geographical information, he could not conceal his contempt for a body which existed solely for this purpose, while I am afraid that he thought me mentally weak for taking so much trouble without the hope of making money thereby. For three days nothing was settled, a hot discussion being eternally carried on in Turkish, until I told him that if he would not help me, he would lower his reputation for hospitality in Europe—this is always a terrible threat—and, as I also presented him with a revolver, he finally agreed to send me on to the Atrek, where further arrangements would be made.

It was across the snowy steppe that we marched, after bidding farewell to our host at the ford of the Gurgan, or Wolf river, which is apparently the same as Hyrcania, the Greek name for this district. After a long day we sighted the Atrek, and were glad to reach an encampment, as the snow was falling somewhat heavily. In the morning I was informed that forage for the next five stages must be bought, as none could be procured further on. This was followed by an intimation that I must purchase a camel for £40 to carry it. Fortunately, I guessed that the desire to sell me a camel at five times its value was the reason for the alleged scarcity of barley, so I declined to do anything but move on. This was not so easy, as the Yomut Turkomans are very loth to speed the parting guest without first fleecing him, so that it was noon before the march was resumed, more or less parallel to the yellow-coloured Atrek, to which river, as to the Tiber, the epithet of "flavus" is most appropriate. Our way lay across what should be a fertile country, but the treeless, snow-covered steppe looked extremely dreary, and, to add to our discomfort, no meat was procurable, as all the sheep were dying of some disease, and we had, consequently, to depend upon shooting a few pigeons, which were hard to approach.

For two or three days we were accompanied by a "mollah," or priest, and, under his guidance, we steadily ascended the left bank of the Atrek, as far as a point opposite Chat, where we forded the river, and followed up the right bank through a mass of low hills. Our escort consisted of three or four Turkomans, who, whenever they met another

party, took the most warlike precautions, until they discovered whether those approaching were friends or foes. About 20 miles above Chat our priestly guide intimated that he was going no further, so, before continuing our march the next morning, I sent him a silver watch and a present of money. However, he returned them without thanks, and intimated that he would like my telescopic-sighted rifle, which he had greatly admired. At the same time the muleteers came in weeping, and said that the Turkomans were going to take their mules and also rob me. I tried to quiet them, and sent my servant into the "alochuk" to harangue the heads of the tribe, while I got the mules loaded



THE TAFTAN RANGE, SARHAD.

up. For an hour we waited, hearing only a stormy flow of Turkish from the council-room, so, when the mules were ready, I thought that I had better see what was going on. I found Joseph dancing about in an agitated state, and upon my entrance he told me that they plainly spoke of robbery, and would not let us leave. He advised the rather foolish expedient of attacking them; but, instead, I told him to say how I loved the mollah, and I patted that scoundrel so violently on the back to show my affection, that he could not go on speaking.

The Turkomans thought it very funny, and when I ran the mollah outside, they brought his horse, and he came along with us just as if everything had been arranged to his satisfaction. I forgot to mention

that, before the acute stage was reached, I was asked to give a letter for him to show in case of complaints. In it, I wrote that I expected to be robbed, and only hoped that any future traveller would have him punished, had he the chance. Before saying good-bye to our friend, who only accompanied us for a couple of miles, I offered to give him a second note. This he felt sure would not be as laudatory as he imagined the first to be, so he said that the former one would suffice, and I am confident that he considers it to be couched in the most complimentary terms. That night we were not asked into the village near which we halted; so, surmising from this pointed lack of hospitality that treachery was intended, we kept watch. At about 2 a.m. some six or seven Turkomans sneaked quietly out with their rifles, and approached the tent. Finding, however, that we were awake, they appeared to be surprised, and, after talking together, went quietly back to bed.

As we were close to the country of the Goklans, I decided to change my tactics, and on the following morning abused the Turkomans for their violation of hospitality, and threatened them with the vengeance of the Governor of Bujnurd, who was, I said, a great friend of the British Government. This bluff, which, I am sure, lost nothing when interpreted into Turkish, had its effect, and our guides, finding the game up, rode away, and, after firing a few shots at us from about half a mile off, to which we made no reply, left us in peace.

The Goklan Turkomans received us in quite a different manner, and said that Huck Nafass, our mollah, was not only "wanted" by the Persian Government for several acts of robbery, but that any Goklan would shoot him on sight, had he an opportunity. I was consequently delighted to feel that I had escaped from his clutches without harm, and can only put it down to the fact that, although I was without an escort, he imagined that I held some very strong cards up my sleeve. We were soon joined by Mustapha Kuli, who had been Captain Napier's guide in 1877, and it is, I think, thanks to him that I was so well treated.*

* NOTE ON THE YOMUT AND GOKLAN TURKOMANS.

(a) *Jafar Bai*.—This tribe inhabits the district near the mouth of the Atrek, and, as regards wealth, may be considered the most important division. They possess fisheries, and also cultivate more extensively; in addition to this, they engage in commerce.

The Jafar Bai have two divisions of Yarali and Norali, and number 2000 families to the south of the Atrek, and 1000 families to the north. They are generally on bad terms with the Ata Bai, their neighbours to the east.

(b) *Ata Bai*.—The Ata Bai include 2000 families to the south of the Atrek, and 1000 to the north. Although not as rich as the Jafar Bai, the Ata Bai have more power, as many of the smaller divisions are under their protection.

There is a subdivision called Ak Ata Bai. Ak = white.

(c) Friendly to, or perhaps under the protection of, the Ata Bai are the following divisions:—

We were told that the road to Bujnurd lay across the Hanaki pass to the south, and that we were to quit the Atrek, up which we had been marching hitherto. The cold was intense, although it was the middle of February, but once over the pass we descended rapidly, until, at Semalgan, two marches further on, we found the heat quite oppressive.

Before reaching the town of Bujnurd, we had to cross another range of hills, where the fresh snow was so deep that it took us

Ganyokmuz	400 families.
Bolgai	300 "
Daz	1000 "
Dovoji	1000 "
Badragh	200 "

These divisions are generally on terms of feud with—

Amir	100 families.
Kuchik	300 "
Tatar	100 "
Salak	100 "
Kujuk	1000 "

To summarize, of the Yomut tribe there are 8500 families in Persian territory, and 2000 in Russian territory to the north of the Atrek.

Perhaps 20 per cent. of the tribes on either side cross the Atrek in order to change their pastures; but this custom is on the decline, as a tax is charged on all the tribesmen who graze their flocks on the northern bank. All the Yomuts profess to be at feud with the Goklans, who are now a much weaker and quieter tribe than formerly.

GOKLAN TURKOMANS.

The following divisions inhabit Russian territory to the north of the Atrek, on the road between Kizil Arvat and Bujnurd.

Sorali	} 1500 families.
Toktamash	
Kek	
Kal Guzl	
Ak Kal	

The following subdivisions inhabit Persian territory:—

Kal Guzl	} 2500 families.
Toktamash	
Kai	
Tamak	
Eilyangi	
Ark Kali	
Karnas	
Dadi	
Kar Abali Khan	
Jan Ghur Balghy	

In former times the Goklan country was famous for its breed of horses, but, owing to its proximity to the powerful chief of Bujnurd, the tribe is now very quiet and weak, while its horses have shared in the general decline.

hours to accomplish even a few miles. Upon reaching the plain, whereon lies the city, I had my first experience of an "istakbal," or reception, a troop of Persian cavalry escorting us to the town, where we were lodged in one of the governor's houses. When we went to pay our respects, we were conducted up the winding staircase of a tower into the presence of the Sani-i-Dowleh, the redoubtable warden of the marches, who, for fifty years, has been warring against the



THE GOVERNOR OF MAGAS AND FAMILY.

Turkomans. His Excellency told me, that when he was a young man it was almost impossible to till the fields, and that at Bujnurd there were generally some hundreds of Turkoman prisoners, waiting to be ransomed or exchanged for captive Kurds. Nowadays there is comparative peace, cattle-lifting on a small scale having taken the place of the wholesale raids of the good old times.

My experiences among the Turkomans will show that they are still a somewhat wild and lawless race, but, from a reference to the pages of the great traveller, Vambéry, one can see how much Russia has

benefited Central Asia generally, and Persia in particular, by suppressing the Turkoman terror. These freebooters raided North-East and Central Persia down to the Dasht-i-Lut, while every man, woman, and child that was captured would be sold into lifelong slavery, and also endure religious persecution at the hands of their Sunni masters. Prof. Vambéry has told me that he observed such innumerable cases of cruelty towards Persian captives that, although he personally was well treated, he regards the Turkomans with abhorrence. I should have mentioned that both Bujnurd and Kuchan are peopled by Kurds, whom Shah Abbas (the contemporary of Queen Elizabeth) transported from his north-west to his northern frontiers, in order to form a buffer between Persia and the Turkomans. The experiment may be considered to have been a success, as the Kurds are splendid fighters, and have never been greatly worsted by the Turkomans.

The town of Bujnurd, which is situated on a fair-sized and well-watered plain at an elevation of 3800 feet, contains perhaps 20,000 inhabitants, and is increasing at a rapid rate. The bazaars are extensive and well stocked with Russian and English goods, sugar, hardware, and crockery coming from Russia, while the calico and muslin bore Manchester or Bombay labels.

From Bujnurd to Kuchan there was a choice of routes, so I selected that one which followed up the course of Atrek, as it had not been travelled over by either Captain Napier or Sir Charles MaGregor, both of whom had pursued the road which keeps further south. Shirwan, which we reached on the second day, is under Kuchan, and is nearly as large as Bujnurd, while the valley of the Atrek, which is here open and undulating, forms one of the most fertile districts of Persia. At Kuchan the walls were in the most dilapidated condition, owing to previous earthquakes, while within a very short time this terrible calamity was again destined to destroy thousands of lives, and then be repeated, to annihilate the remnant that had escaped. At the time of my visit there was a great deal of commercial activity owing to the opening of the road that has brought Meshed within easy reach of the Transcaspian railway at Askabad, while my eyes were gladdened by the sight of lines of waggons, which gave quite a civilized look to the place.

For the remaining 90 miles I hired a waggon, its owner agreeing to reach Meshed on the third day; and we started off with the pleasant feeling that this section of the journey was practically an accomplished fact. Unfortunately, at about 5 miles from Kuchan, one of the horses had a violent attack of colic; so we had to halt for the night, as the poor beast was quite unfit to proceed, and it was not until February 28 that I drew up at the consulate-general at Meshed, where I was warmly welcomed by Mr. Ney Elias, whose untimely death this Society is now deploring. In his obituary notice, mention was made of the kindness he showed to all his juniors, and of this I have received innumerable

proofs during the five years that have elapsed since I was first his guest.

Meshed, as is well known, contains the famous shrine of the holy Reza, the last of the twelve Imams, and is the religious centre of Persia. The mosque is of great magnificence, but has been so fully described by Mr. Curzon, that I would refer to his work in connection with this subject. I was much tempted to linger in the society of my fellow-countrymen; but, as every week's delay meant more heat in the Dasht-i-Lut, I had to hurry through with my preparations, and after a week's stay continued my southward journey. As far as Turbat I was on a well-known road, which had been travelled over by Dr. Bellew in the seventies; but between Turbat and Jumain I found that several villages shown on the map were in ruins or unknown, while the river, termed the Kal Salah, which is shown as flowing east, actually trends to the west, and is lost in the swamps to the north of Bajistan.

At Tun, I was on the northern edge of the great Dasht-i-Lut, which lay between us and Kerman, and which had not been traversed, in this particular portion, since the illustrious Marco Polo crossed it, in the opposite direction, when travelling from Kerman to "Tonocain" *via* Cobinan. As the great Venetian was not only a most accurate observer, but also wielded a graphic pen, I feel sure that I cannot do better than give his words, when describing the Dasht-i-Lut, which signifies the "Naked desert"—a most appropriate name. He says, "When you depart from this city of Cobinan, you find yourself in a desert of surpassing aridity. There are neither fruits nor trees to be seen, and what water there is is bitter and bad, so that you have to carry both food and water. The cattle must needs drink the bad water, will they nill they, because of their great thirst." Friar Odoricus, in the succeeding century, who was apparently struck by another phase of the desert, describes it in the following lines. He says, "Now, that sea is a wondrous thing, and right perilous. For it is all of dry sand, without any moisture, and it shifteth, as the sea doth when in storm, now hither, now thither; and as it shifteth, it maketh waves, so that countless people travelling thereon have been overwhelmed and drowned, and buried in those sands."

Our chief preparation consisted in engaging a few donkeys to carry forage for our mules, and, as there were said to be tanks with water on the way, we expected very little trouble. We soon left the Tun oasis behind, and entered the silent desert, where not even a crow is to be seen. At the fourth mile was a tank of sweet water, where I insisted upon filling up my private water-skin, and at night we halted near the well of Khushab, which means "sweet water." It was much too salt for me in spite of its name, so I was very glad that I had taken the precaution to fill my "mussuck." On the following morning, after drinking tea, only a pint remained; but we were promised excellent water

at the evening's stage of Chahar Gunbaz, and so commenced the march in hope. Throughout the day we approached a snow-clad range, which appears on no map, and, as we were at the end of March, I estimated its height at 7000 or 8000 feet. The heat and thirst were very trying and, to add to our discomfort, the water at the stage was simply green with salt. I attempted to drink it with lime-juice tablets dissolved in it, but in vain, and so I could only envy the others, who were able to swallow it with apparently no ill results.



THE FORT AT BAM.

We were only about 15 miles from Duhuk, which lay under the range referred to; so, after a sleepless night, we pressed on as soon as it was light, and by 10 a.m. we were able to enjoy beautiful water running down from the hills. The villagers were anxious to see the first European that had passed that way, and, considering their isolation, knew a good deal about what was going on in the world. We had to halt a day, as every one experienced such bad effects from the water of the day before, that I was most thankful not to have touched it.

Duhuk is built in a gap half a mile wide, which separates the Tabas Kuh—the general name for the chain of mountains between Tabas and Duhuk—from the Mur Kuh, which latter range runs south-south-east towards Naiband.

The onward journey lay through Arababad and Zenagun, where we saw palm trees for the first time. Another waterless stretch separated us from Naiband, so, warned by experience, we hired three donkeys to carry water, and marched to Ab-i-garm, where there are extensive salt marshes and groves of tamarisk. As we had still many miles to accomplish, I tried to push on at night, but we were afraid of losing the track, and so lay down to sleep until daylight. Our water was again exhausted, the skins having tainted it, so I rode on, in order to reach Naiband before the heat of the day. Fortunately the track was fairly distinct, but as hour after hour passed, and my pony began to be dead beat, I feared that I had lost my way, especially as there were two or three places where there was a choice of routes. Finally, however, I turned a corner and came upon a vision of fairyland. The hillside was covered with date palms, underneath which were glimpses of the bright green crops, and at the summit was an old fort in a state of picturesque ruin. Upon entering the grove, I saw streams in every direction, while huge natural grottoes completed the picture. My first care was to send off two donkeys laden with water, in charge of a man who knew the country, and in the evening the caravan crawled in, the water having reached them some 5 miles out, when they were all feeling too much exhausted to go another yard.

Two or three days were spent in climbing about the Naiband range, while the mules were recovering, and we then traversed another waterless stretch of 39 miles, to a well with forty steps, which was said to be a favourite spot for Beluchi raids. During the next stage to Darband, we passed ruins that I believe to be those of Marco Polo's "Cobinan," as the modern Kuhbenan does not at all fit in with the great traveller's description, and it is just as well to remember that in the East the caravan routes seldom change.*

We now skirted the western edge of the Dasht-i-Lut, and followed the main caravan road until at Ab-Bid we kept away to the east of the main road in order to explore the district of Kuhpayeh, which was then a blank on the map. We approached Kerman from the east, and I little thought that within so short a time it was to be my home. The city lies at the end of a low limestone range, and was once impregnable, to judge by the huge old forts that are still imposing in their decay. Its position on the confines of the great desert, and at the confluence of four important routes, has always rendered it of

* This question is dealt with more fully in a paper which I read before the Society of Arts on May 20.

importance, but, being on the frontier of Afghanistan, it has suffered terribly at each invasion from that quarter, as well as in the great fight for power that took place at the end of last century. Situated at an altitude of 5500 feet, its climate is extremely pleasant, while its inhabitants are particularly friendly to Europeans. At the present day, it is on account of its carpets that Kerman is justly renowned, although very few of the finer qualities are exported to London. These exquisite fabrics, woven in silk and wool, reproduce designs dating from many



KUBEH-I-SUBS OR "GREEN DOME" AT KERMAN.

centuries back, while the harmonious and lovely colours throw all other carpets into the shade. Among the buildings of interest now extant is the Kubeh-i-Sabs, or "Green Dome," which contains the following inscription:—"The work of Ustad Khojeh Shukr Ullah and Ustad Inayet Ullah, son of Ustad Nizam-i-Din, architect of Isfahan." The date is 640 Anno Hejrah, or 1242 Anno Domini. Our interest is considerably augmented by the fact that we know that Marco Polo was at Kerman shortly after this date. In the illustration it will be

noticed that there is but half of the building still standing; this is not the result of an earthquake, but is the handiwork of a former governor, who had heard a rumour that treasure existed under the great dome.

During my stay of a week I met several of the merchants of the place, both Mohammedan and Parsi, and I was particularly struck by their polished manners, which are, I afterwards heard, renowned throughout Persia.

About the middle of April, after a few days' rest, I determined to take a straight line to "Pasargardæ" *viâ* Pariz and Baonat, as thereby I could fill in several blanks on the map, while, owing to the altitude being fairly high throughout, I hoped not to suffer from the heat. When some five marches to the west of Kerman, I received a most cordial invitation to visit H.R.H. the Farman Farma, who was the Governor-General of Kerman and Persian Baluchistan, and, upon accepting it, was so hospitably entertained that I accompanied my new friend to Bahramabad. Among many other experiences, I was introduced to the sport of shooting gazelle off horseback, which consisted in the riders spreading across a plain with intervals of 500 or 600 yards between each, and driving the quarry off its feeding-ground. In time the gazelle break back, when the sportsmen gallop to cut them off, and shoot them with slugs, propelled by a heavy charge of powder. The Farman Farma, who is a great sportsman, on more than one occasion shot a right and a left at full gallop. I have also seen hyenas, lynxes, foxes, and hares bagged in the same way.

When, after being entertained right royally for about a fortnight, I resumed my journey, I had had an agreeable experience of Persian life, enjoyed by very few travellers, coupled with a warm invitation to return during the following winter. Upon entering the unexplored district of Baonat, we were followed by a band of seven nomads, who were evidently on the look-out to attack us. However, we took all precautions, and maintained a bold front, and, although both my rifle and gun were broken, we carried them in a very conspicuous manner. This band kept parallel to our march for three days, but they fortunately did not otherwise molest us. It is a remarkable coincidence that Captain Stotherd, of the Hyderabad Contingent, was set upon less than a month later, about 30 miles to the south of where I passed, and, although he had only a single orderly with him, he accounted for four of the brigands, killing their chief. It is more than probable that he was attacked by the same gentlemen who took so keen an interest in my movements, and it is satisfactory to feel that Captain Stotherd made so good an impression on them.

Upon arrival at Shiraz, after a visit to the world-renowned ruins at Persepolis, I was most kindly received by Dr. Soullly, who told me that I had come at an interesting crisis, as there was war to the death

between the townspeople and the nomads. The very next morning we were awakened by hearing volleys inside the town, and, climbing up to the roof of the telegraph garden, which is about half a mile from the walls, we saw a regular fight taking place at the gate nearest to us. Fortunately, we were at right angles to the line of fire, and so could look on without much risk, until the nomads, who were greatly outnumbered, finally retreated. During these very stormy times, it was wonderful to see with what utter contempt for danger the English telegraph officials behaved, and it was mainly owing to the confidence felt in their reports at Tehran, that the necessary steps were taken to patch up a peace.

It was now the end of May, so it was necessary to travel by night



PASS OF THE "OLD WOMAN" BETWEEN SHIRAZ AND BUSHIRE.

down the famous passes of the "Old Woman" and of her "Daughter," which have been so vividly described in Mr. Curzon's monumental work; and, after turning night into day for nearly a week, I was only too pleased to find myself on board the British India steamer at Bushire, where white bread and a whisky peg appeared to be delicious beyond expression.

Karachi was reached early in June, and the rest of the summer was spent in compiling my work and planning fresh journeys, until, in October, 1893, accompanied by Surgeon-Major Brazier Creagh and Lance Duffadar Sultan Sukhru, of the 3rd Punjab Cavalry, I landed at Chahbar, in Persian Baluchistan. This port was chosen, as since

Grant's journey, some ninety years ago, no European had travelled to Bampur by Geh.

Before entering Persian Baluchistan, however, a few words as to its character would perhaps not be out of place. The whole of the coast-line from Bashikird nearly to Karachi is spoken of as Makran, the district extending inland as far as the first important range of hills, thus including a strip of land from 60 to 70 miles wide. For some 20 to 40 miles from the coast there is a sand desert, with small hamlets, which draw their supply of water from shallow wells. Behind this is another belt of about the same size, consisting of low hills composed of mud or slate. Proceeding further inland, it will be noticed that there are continuous ranges of mountains running from east to west parallel to the sea, and so regular is this formation, that all attempts at opening up communications in these parts must be done either to the east or west, as any road direct to the coast will lead across range after range of rugged hills.

Thanks to the kindness of Mr. Possman, the director-general of the Persian Gulf telegraphs, we found camels awaiting us (at Chahbar), and, owing to the exertions of Mr. Lovell, in charge of the telegraph office, we were able to get twenty-seven of these uncouth beasts of burden loaded up the day after landing. The quarrels as to the partition of loads, and the interest taken by so many people in the camels, revealed to us the fact that several of these animals were divided into legs, each of which had a separate owner. The usual plan, we were informed, was for the driver to have one leg's interest in each camel, which was allowed in lieu of wages and rations.

Our first march brought us to Tez, the famous Arab port in mediæval times, but now no signs of departed greatness exist, except the innumerable tombs of deceased worthies, and we had to drink filthy water out of a shallow hole, and be thankful that there was enough for all our party. Although marching by day was terribly trying for man and beast alike, the Baluchis spent so long in wrangling over the loads, and in tying them on, that it was 10 a.m. before the last of our camels started off for the second march, and, as the heat was terrible, our horses very soon began to give in. We therefore halted for several hours in the shade, near some water-holes, riding on to camp in the evening. We there found only about half of our caravan, the other portion having halted 2 or 3 miles back, in a rage at being compelled to march some 12 miles, as they said that 7 miles is the limit of a march in Baluchistan. Travellers in this country should be provided with an inexhaustible fund of patience, as the only part that the Baluchi camel-driver plays is to try and prevent any load whatever being put on his camel, while, if at all discontented, he will decamp without giving any notice.

In order to attempt an earlier start, we halted for a day, and then pushed on at sunrise the following morning. However, the march was long, and by the time we reached Pesh Mant our horses had to be led, so utterly prostrate were they. Many of the party also suffered from sun fever, mainly because they got slightly chilled before the sun rose, and so felt the sudden change acutely. After four trying marches, we struck the Geh river, where we decided to make another halt. Just before reaching camp, I saw a couple of wolves, which fact is interesting, as they are not known to exist so near the coast. In the bed of the "kaur," the Baluchi term for river, we found isolated pools of doubtful water at this point; but a march higher up, we came upon a bright flowing stream, bordered by palm groves.

Geh is a large village, built in the fork between two branches of the river, and, with its palm groves, forms a delightful picture. As so many of our party had suffered from fever, we determined to leave the invalids and make a rapid march in light order to Fanooh, returning to Geh by a different route. This we did with great success, finding at Mokht, a village near our route, a remarkable kind of glass bangle, of which I have given specimens to the British Museum.

The pass below Fanooh must be a unique road. For 7 or 8 miles one has to scramble over boulders of the most varied hues, every colour of the rainbow being there, which gives an effect of great beauty. In the case of being overtaken by a "seelab," or spate, in this pass, the loss of the entire caravan would ensue, as the sides are precipitous almost throughout. The morning after our arrival, we set forth to climb the Kuh-i-Fanooh, also termed the Kuh-i-Sufeed, or "White mountain," the summit of which is reached at 4735 feet. After four hot hours spent in climbing, we stood on the top, and were able to look across to the unknown districts lying to the west, while to the north we could clearly descry the shapely Basman peak.

Upon returning to Geh, we retraced our steps down the pass, and then kept further north, striking the Sirha river at Ichan, called "Hochan" by Captain Grant. Both when going to and returning from Fanooh, we crossed the Maluran river,* which is shown as draining

* The following is the list of villages on the Maluran river:—

Matkun, right bank.	Shernani, right bank.
Kuchink, "	Yark, "
Abgah, "	Murdosmah, "
Nasperan, "	Maluran, left bank.
Ladgoju, left bank.	Chah Ali, "
Aband, right bank.	Wajbia, "
Margan, "	Korandab, "

into the Geh river, whereas it is really a tributary of the Kaur-i-Binth.* Along its banks, as well as those of the Sirha river, there are almost continuous lines of date groves. The Sirha pass, which lay between us and Bampur, beggars description, and I am still surprised that we got safely over it, as I should never have believed that laden camels could climb up the cliffs they did without accident. My companion's mare indeed fell, but luckily there was a deep pool below, so no harm was done.

At Bampur we found that Pahnra—the Pura of Arrian—was now the seat of government, and so pushed on there, where we were received by the Assad-i-Dowleh, who is a fitting ruler for such a wild race. He was civil enough, thanks to the Farman Farma; but when we informed him of our intention of touring in Sarhad, he tried to discourage us by every means in his power. Having engaged camels with extreme difficulty, we marched due east to Magas, where the kindest inquiries were made after the late Sir Oliver St. John. We then turned north into unexplored country, and, at the end of December, reached Khwaah, the capital of Sarhad. This word has been written and spelt in so many different ways, that I would mention that it is the Sarhaddi method of pronouncing “khosh,” meaning “sweet.”

We were now close to the giant range whose highest peak is the great volcano of Taftan, or the “boiling,” locally known as Chehel Tan, or the “Mountain of the Forty Beings,” and as we were afraid that snow might hinder our ascent, we marched up its valley, where

The following is the list of villages on the river Sirha from Ichan downwards:—

Kondel Mant, right bank.	Geladun, left bank.
Aband, left bank (opposite Deh Mullah).	Washkosh, right bank.
Deh Mullah, right bank.	Bandan, “
Khushk, left bank.	Pothan (opposite Bandan), left bank.
Gurani, right bank.	Mokht, right bank.
Mirabad, left bank.	Afzilabad, left bank.
Shah Karpad, left bank.	Hudian, “

Thence 4 miles to Naokinja, where I halted between Chahbar and Geh.

I crossed both of these streams at two places, some miles apart, so that I have reason to believe in the accuracy of the above list.

* There are five streams which make up the Kaur-i-Binth, as the Fanoeh river is called below the pass. Beginning from the west—

1. The main stream, up which runs the road to Ramishk. Mirabad is the only village of importance that we could see.
2. Kaur-i-Kantekon. This stream flows almost due north to south.
3. Kam Kaur, with village of Kam just above Fanoeh, and Haimini on an easterly branch.
4. Kaur-i-Magen, with two hamlets, Magen and Band-i-Bengi, on its banks.
5. Kaur Espate. This stream flows in just below Fanoeh, the hamlet of Espate being some few miles up it.

we camped at an altitude of 6550 feet, near a large cave, which protected our horses from the intense cold. My companion was unfortunately ill, so, as the weather looked very threatening, I decided not to wait, but to make the attempt on the following morning.

For 7 miles the track led up the valley, which then terminated in an extraordinary fissure, termed the Band-i-Gelu. Creeping up this, we found ourselves in a valley, which smelt strongly of sulphur, but the going was easy enough until we began to climb the actual peak. First of all, we had to scramble over boulders, but these at 11,000 feet were replaced by soft lava ash, so that it was 2 p.m., after eight hours' incessant climbing, when we reached the summit at 12,850



TOMBS OF THE KAJANIAN MALIKS AT JALK.

feet. We here found a plateau about 400 yards square, the northern portion of which is termed the Kuh-i-Ziarat, or "Sacrifice hill," while separated by a slight depression lay the Mader Kuh, or "Mother hill," which is still the actual object of worship for most Sarhaddis, although nominally they are Mohammedans. The volcano, which was belching out blinding clouds of sulphurous smoke, consists of two apertures, each some 3 yards in circumference, which apparently united a few feet below the surface, as there was only a yard or so of ground between them. With considerable difficulty, we extricated specimens of the sulphur and sal ammoniac, and then turned our attention to plane-tabling. At the elevation we were at, we could see Sistan and the lake of Zirreh, mentioned in Matthew Arnold's great poem, while to the north-west

the boundless Dasht-i-Lut stretched for hundreds of miles. The descent was easy, in comparison, and by 9 p.m. we were safely back again in camp.*

The whole of this valley is full of ruined villages, and opposite them are oval-shaped caves hewn out of the rock. These were some 8 feet in length, 6 feet in width, and 5 feet in height. No marks of smoke were visible, and, as they were very difficult of access, I would hazard the theory that they were humble imitations of the rock tombs at Pasargardæ.

After stopping long enough to allow my companion to scale the great volcano, on New Year's Day, 1894, we started forth to find the village of Basman, the whereabouts of which was uncertain to a degree. As we could buy nothing on the way, we ran out of both forage and flour, and were consequently delighted to reach our goal, which lies at the southern end of the range of the same name. Our camel-drivers here deserted in a body, but, as there was plenty to occupy us in exploring the hills, this did not prove to be a serious blow. It took us three days

* NOTE BY LIEUT.-GENERAL McMAHON IN A PAPER ON THE "VOLCANOES NEAR THE BELUCHISTAN-AFGHAN FRONTIER," READ BEFORE THE GEOLOGICAL SOCIETY ON MARCH 24, 1897.

"Since this paper was read the authors have been in personal communication with Captain P. Molesworth Sykes, now in England on leave, who ascended the mountain on Christmas Eve, 1893. After gradually ascending ravines in the hills around the mountain, the exploring party arrived at the foot of the actual cone at an elevation of 10,000 feet. Thence up to 11,000 feet the ground traversed consisted of boulders; but from 11,000 feet upwards it was covered with fine volcanic ash, into which the foot sank deeply at every step. From this point up to the top the smell of sulphur was unpleasantly strong. The summit consists of a plateau covering an area of about 400 square yards. On its northern and southern sides the ground is slightly elevated above a central depression. The northern elevation forms the sacrifice hill, where goats are sacrificed by pilgrims; whilst the southern portion is called *Mader Kuh* ('Mother hill'). On the latter were, at the time of Captain Sykes's visit, two apertures some yards apart, each apparently 3 or 4 yards wide, which appeared to be connected with each other. From both of these, dense white sulphurous smoke and some flames were issuing. So strongly sulphurous and suffocating was the smoke, that these apertures could only be approached from the windward side; and, owing to the heat and smoke issuing from them, they were approached with difficulty even from that side. Sulphur and sal ammoniac were extracted from the edge of one of the apertures.

"Captain Sykes has paid several visits to the burning petroleum springs at Bâku, on the western shore of the Caspian sea, and he is satisfied that the heat, smoke, and flames on the summit of the Koh-i-Taftân were not due to petroleum. There was no smell of petroleum, and the smoke was not dark and carbonaceous.

"Captain Sykes brought home a specimen of the rock found *in situ* on the Koh-i-Taftân, and this proved, on examination, to be a vesicular, andesitic lava. As the summit of the Koh-i-Taftân is still deeply covered with fine ash, this volcano must have been active during a comparatively recent geological period; but, as no fresh lava-streams were observed by Captain Sykes on his way up the mountain, it is not probable that the volcano has been active during the lifetime of the present generation.

"The authors infer, from Captain Sykes's observations, that the volcano is now in the solfatara stage of its existence. The flames seen by Captain Sykes are probably due to the emission of hydrogen sulphide (H₂S), a very common product of solfatara action."

to scale the great peak, from our camp at Basman village, but at last we arrived at the summit, and set up the plane-table at an altitude of 11,210 feet above the sea. We were on what is generally supposed to be an extinct volcano, and it is interesting to note that even here there is a legend of a saint called Kedr, who still lives in the mountain, just as in Greek mythology a giant is imprisoned beneath Etna. The mountain is locally termed Kuh-i-Zendeh, or the "Mountain of the Living Man."

Upon returning to Basman, we enjoyed excellent moufflon-shooting, until the Farman Farma sent some of his transport for our use, and we rejoined him at Bampur. In his company, we travelled along the



THE LAJJI VALLEY ON THE BELUCH-KALAT FRONTIER.

unexplored tract of country where the Bampur river and the Halil Rud mingle their waters in the Jaz Morian. Additional interest was felt by us, knowing it to have been the road that Alexander the Great used in his march from India.

Upon arrival in Rudbar, we turned northwards and left the Farman Farma, in order to explore the site of Marco Polo's "Camadi," where the china exhibited, together with the seals and other curios, were found. We came upon a huge area littered with yellow bricks 8 inches square, while not even a broken wall is left to mark the site of what was formerly a great city, under the name of the Shehr-i-Jiruft.

It was now late in March, so we were only too glad to traverse the Jabal Bariz range and gain the elevated plateau of Iran, and, just a year

after my first journey, I again entered Kerman. Here our party broke up, Surgeon-Major Brazier Creagh returning to India by Bunder Abbas, while I continued my journey towards Tehran. At Yezd I was most hospitably entertained by the manager of the Imperial Bank of Persia, and at Tehran, Mr. Coningham Greene, Her Majesty's *chargé d'affaires*, not only made me free of the Legation, but also presented me to H.I.M. the late Shah, who was interested at hearing about so remote a corner of his empire. I travelled to England in rather over a fortnight by the newly opened line from Petrovsk, on the Caspian sea, taking the faithful Sultan Sukhru with me as a reward for his excellent work, and reaching London late in June.

After four months at home, spent in compiling my second journey, I was appointed to be the first consul for Kerman and Persian Baluchistan, and, accompanied by my sister, who shared my future wanderings throughout, we reached Tehran at the end of 1894. We there spent a most delightful winter, enjoying the kind hospitality of Sir Mortimer and Lady Durand, so that it was a great wrench to leave all civilization behind and start forth on the long journey of 600 miles, which lay between us and my district. As far as Kashan, we followed my route of 1894, but for the onward march to Yezd I kept a good deal to the east, passing through Natunz and Kuhpa. Thereby I was able to fill in a large blank that has existed on the map quite close to Ispahan, while, as so often happens in Persia, I found the district to be quite as populous as the one bordering the main road.

Kerman was reached at the end of March, and for some months we were busy enough, what with consular work and settling down. When, however, it grew hot in June, I determined to explore Sardu, so as to trace out Marco Polo's route, and we had a most delightful trip while occupied with this task, during which we scaled the highest peak of the Lalazar range, 13,700 feet above sea-level—no mean feat for a lady to accomplish. There was also the best of moufflon-shooting, and we picked up several carpets woven by the nomads, while the climate at an altitude of over 8000 feet was perfection. However, we were forced to return home by quick marches to meet H.R.H. the Farman Farma, who was once again appointed governor of the province, and the autumn was spent at Kerman, as we found interesting occupation in trying to unravel the ancient history of that city. I cannot say we were unsuccessful, as our offers of a reward for old stones and curios produced a number of reflet tiles, and I am proud to state that we captured a wasp unknown to science, when collecting insects for a friend.

In January, 1896, telegraphic orders came for me to join Colonel, now Sir Hungerford, Holdich on the Perso-Beluch frontier, which instructions I should have been quite unable to obey, without considerable delay, had not my kind friend, the Farman Farma, lent me his own transport.

Thanks to this, we started off on the third day, leaving our household gods to look after themselves, and within a week we had reached Bam, until recently the frontier fortress of Persia. Everywhere I was shown the greatest courtesy, so that forage and supplies, which usually are impossible to collect, were ready at each stage, and from Regan, with only a day's halt, we were able to load up fifteen extra camels with all supplies, before crossing that portion of the Dasht-i-Lut which lay between us and Pahra. There my old acquaintance, the Assad-i-Dowleh, treated us well, and it only took two days to engage thirty spare camels and to load up supplies for twenty days, as the villages



THE WATER-MILLS OF SHUSTER.

to the east were too small to be counted upon to any great extent. As far as Magas, we followed the route that we had taken in 1893, after which we continued nearly due east, reaching the British camp at Kohuk on February 24, having accomplished the march of 600 miles, mainly across desert, in forty days.

Sir Hungerford Holdich * has already read an interesting paper about the geographical side of the frontier commission, during which we marched with our headquarters as far as Jalk, while excursions were made to the various points of interest along the frontier. Both at Jalk and Kohuk we found numerous tombs which were built by the Kaianian maliks, and which appear among the illustrations. On one

* *Geographical Journal*, vol. ix. p. 416.

of them I found a brick bearing the date of 1027 Anno Hejra, or 1617 of our era. This confederacy of chieftains appears to have ruled in Sistan and Baluchistan during the prosperity of the Sefavi dynasty, and, as far as we know, they were crushed by Nadir Shah about 150 years ago, although Pottinger mentions that they still owned villages early in this century.

We accompanied the British Commission on its long march to Quetta, so that my sister may claim to be the first lady who has ridden from the Caspian sea to India, a distance of nearly 2000 miles. While travelling up the valley of the Rakshan, through what is now a desert, we saw that for miles the country had been cultivated in terraces on such a scale that there must have been a teeming population, where now one can wander for 50 miles without seeing the slightest sign of life. We found many ruined sites, with numberless fragments of Arab pottery, beads, and bracelets, and felt that it was only deforestation that could have changed the country from a smiling plain of plenty to "a barren and dry land, where no water is." Daily, the thermometer registered over 90° in our tents, so it was with light hearts that we ascended on to the uplands of Baluchistan, until, at Kalat, we again reached a telegraph wire—that pioneer of civilization—and at the end of April we entered Quetta, where we were all most kindly entertained by the late Sir James Browne, whose name will live long on the Beluch country side.

We were on the way to Simla, when the sad news of His Majesty the Shah's death reached us, and it was quite touching to see how much our Persian servants felt the calamity that had befallen their native country. Nearly a month was spent in Simla, during which I was enabled to compile my work up to date, and at the beginning of June we were once again at Karachi, bound for the Karun valley. We were caught by the beginning of the "monsoon," and, as we were on board the worst roller that the British India Company possesses, we were very glad to reach the shelter of the Persian Gulf. For the first time, I visited Bahrein, when we rode on donkeys to the famous wells, and also saw the extraordinary phenomenon of a spring of fresh water bubbling up in the sea, which is very shallow indeed all round the islands. The pearl fisheries were in full swing, and it was a most picturesque sight to see the fleet of little vessels all busily engaged in fishing for oysters. The weather was too hot and our stay too short for a visit to the site of Sir E. Durand's and the late Mr. Theodore Bent's excavations; but there are few places so accessible that would, in my humble opinion, yield a richer harvest than this ancient home of the Phœnicians, where Erythras, the "Red King," lies buried.

Off Bushire we again experienced rough weather, but when once we entered the lovely Shat-el-Arab, the moist heat was overpowering, and as, at Mohamerah, we found that the fortnightly boat was not due to

start up the Karun for another week, we continued our journey to Busreh, where Captain Whyte, Her Majesty's consul, received us most hospitably.

Before entering the valley of the Karun, I would mention that that river was opened to the commerce of the world in 1888, and that ever since Messrs. Lynch Brothers have maintained a fortnightly service, in spite of much hostile intrigue on the part of some of the inhabitants of this district, who did their best to thwart the Shah's policy. However, the extraordinary tact of Messrs. Lynch's agents has overcome much obstruction, and every one is now alive to the advantages that they have conferred upon the district, so that we may soon hope to see this system of mutual benefit placed on a thoroughly sound and solid basis.

It is but 117 miles from Mohamerah to Ahwaz, but this occupied the best part of two days to accomplish, as we anchored at night. At Ahwaz, where a few years ago there were but wretched huts, warehouses and caravanserais of imposing appearance now line the bank, while great activity is everywhere visible. After spending a few days with Messrs. Lynch's agent, Mr. Parry, in his company I proceeded up to Shuster on the *s.s. Shushan*, the larger boat, the *s.s. Mal Amir*, not being able to surmount the natural barrage that crosses the river in five separate reefs. This is the crux of the Karun question, as, if the ancient dam were repaired, there would be water enough to fertilize millions of acres which now lie idle and useless. At Shuster, one of the dirtiest, hottest, and most fanatical towns in the world, we lived in cellars for the greater part of the day, as at 8 a.m. the thermometer regularly registered 108° Fahr., while at noon 129° was the average reading. As may be supposed, we were only too glad to return to the comparatively cool climate of Ahwaz, where I had left my sister, and here July was spent. In August, I was so weak from fever and pleurisy that I had to seek medical advice at Busreh, and again enjoyed every comfort at the consulate, for which I shall ever be grateful. The moist heat was so trying that the doctor ordered a sea voyage, so that early in September we returned to Tehran by the roundabout way of Bombay, Aden, Brindisi, and Constantinople.

I was very anxious to have the Ahwaz-Ispahan road properly mapped as far as its junction with the Shuster route, as, until quite recently, Ahwaz barely existed, and so there was no road running to it shown on the map. Here the great value of my faithful plane-tableer came in, as I was able to send him in charge of my caravan through the Bakhtiari country and feel quite confident that when we met again at Tehran, he would have an excellent route report to give in, in which hope I was not disappointed.

The winter was again spent under the same hospitable roof at Tehran, where I saw H.I.M. Muzzufur-i-din Shah more than once, who evinced

much interest in the photographs that I had taken on the Baluch frontier. Moreover, I had the opportunity of making the acquaintance of the leading Persian statesmen, one of whom, His Excellency the Nasir-ul-Mulk, is here to-night, having paid us the compliment of returning to England the moment his official duties on the continent were finished.

In conclusion, I would mention that, after travelling for many thousand miles in Persia, I still wish to travel there again, and, although perhaps the free open-air life and the glorious climate have something to do with this, I cannot but feel that it is also owing to the Persians themselves being so hospitable and friendly a race.

Before the reading of the paper, the PRESIDENT said: We have to welcome here this evening an officer who has seen a good deal of a very interesting part of Persia, and from whom we have received several letters of great interest, though I believe we have not before had the pleasure of listening to him in this room. I will now call upon Captain Sykes to read his paper.

After the reading of the paper, the following discussion took place:—

The PRESIDENT: I would now ask his Excellency, Nasir-ul-Mulk, to open the discussion by some observations.

His Excellency, the NASIR-UL-MULK: I am very pleased to have had the opportunity of being present at this meeting, and of listening to the very interesting lecture of Captain Sykes. As you have seen, Captain Sykes has shown himself a very active explorer, and has availed himself of the opportunities afforded him to give you new information about the outlying parts of Persia. I am afraid that all he said was about the outlying parts and the deserts, and that may give you the idea that all parts of Persia are the same. As you know, Central Persia is desert, but the borders are very beautiful and fertile places, and I am sure that Captain Sykes on another occasion will give you information about these parts also. I have to thank him for the kind allusion he has made to myself, and again to express the pleasure I have had in being present at this meeting.

Major-General Sir FREDERIC GOLDSMID: I am afraid that any remarks which I can make on the very interesting paper we have just heard would involve too distant a retrospect to warrant attentive consideration on your part. My knowledge of Persia goes back to so ancient a date, that anything I may now say on that country must be of comparatively little interest. About thirty-four or thirty-five years ago I had the honour of addressing this Society at a meeting presided over by Sir Roderick Murchison. I had then recently returned from the coast of Mekran, which I had been sent to explore under orders from Bombay. Although we, in Sind, were neighbours to Mekran, we knew very little of that province in those days. I was ordered to go along the coast as far as I could, and see whether the country was fitted for the setting up of our telegraph line, whether the people were fitted for protecting that line, and whether I could make any permanent arrangements for its protection. Accompanied by an escort of Sind horse, I reached Gwádar in about seven weeks, exploring and taking notes the whole way, and making my report to the Bombay government. From Gwádar I should have continued the exploration, but was directed to return, lest our little acquaintance with Western Mekran should lead us into political complications. Consequently, I put my camels and horses into boats, and returned to Karáchi. A few years later, I reached this very place, Gwádar, from the neighbouring port of Charbar,

having travelled thither by a strictly "overland" route from the Caspian. Later again I reached Gwádar direct, coming from the same starting-point in Northern Persia. When the late Sir Henry Yule kindly measured my journeys, and put them down at 7000 miles in Persia and Baluchistan only, I confess to a feeling of gratification; but I could not then foresee the work that was to be accomplished by other travellers in Asia during the second half of this memorable period of sixty years which we are now celebrating.

The paper we have heard read is an admirable one in many respects. It is simple, truthful, we all understand it, and, more than that, it shows what we have to do. The points which the writer has touched upon are points of very great interest indeed, and I only hope that, by further study of these particular regions, we may soon have a more complete map than heretofore. I do not like taking up your time further, but, as relevant to the occasion, will ask your permission to quote a few words from a lecture which I delivered at the Royal United Service Institution in 1877, when Sir Rutherford Alcock was in the chair:—

"We require consuls both on the east and west of Persia: good, well-trained men who are likely to promote, by their personal character, the honour and credit of our country. Kerman or Yezd in the east, and Kermanshah and Shuster in the west, Meshed in the north, and Bunder-Abbas on the seaboard, would all be points worthy of consideration in any scheme for the extension of the Asiatic consular service. . . . Holders of these posts, like the late worthy consul, Keith Abbott of Tabriz, might, by judicious local exploration and inquiry, be scientifically, as politically, useful." In referring to Consul Keith Abbott of Tabriz, I would interpolate the name of Colonel Stewart, also of that city, whose presence here to-night at once recalls his travels and services.

Let me add that in three of the places named, consuls or vice-consuls have in late years been appointed. I think I am right in saying that General Maclean was appointed to Meshed, one or two officers were appointed at various times to Yezd, and Captain Sykes is, we know, at Kerman. One word more, if I may be allowed to say it—and it would be ungrateful and ungracious if I did not do so—that is, that I agree in every word that Captain Sykes has said in regard to Persian hospitality. I can, from my own experience, testify most heartily and honestly to this estimate of the native character.

Sir MORTIMER DURAND: There are many here so much better fitted than I am to continue the discussion of Captain Sykes's lecture from a geographical point of view, that it is inadvisable for me to take up your time very long. I would only like to say that I entirely concur with everything Sir Frederic Goldsmid says about the credit due to Captain Sykes for his remarkable journey, and I wish a great many more would follow his example. I have often been struck by the small number of English travellers who visit Persia. I am sure my distinguished friend, the Nasir-ul-Mulk—whom I take this opportunity of congratulating upon the high honour conferred on him by Her Majesty—will bear me out in saying that the Persians, as a nation, very thoroughly appreciate, in more ways than one, any sympathetic interest which Europeans show towards them. I think it is in every sense desirable that more Englishmen should travel through Persia to learn something of the country and people. It is a most interesting country and people. There is one aspect of the question which has not been touched on to-night, and about which I should like to say a few words—I mean the interest of the country from an artistic point of view. I think it would well repay any one of artistic tastes to spend some months or a year in Persia. He would see that it is a very beautiful country. We have heard a great deal of the arid nature of the mountains. There is a very great deal of barren and bare country about the capital, but

if you could see the exquisite colours which the barren hills take at sunset, and at other times, you would agree that Persia has its beautiful side. I remember when I left Tehran on February 14, I was particularly struck with this. It was a typical Persian day, the sky cloudless, the sun bright. To the north stretched a long range of mountains of dazzling purity, covered with snow from the summit to the foot, and far away to the east, rose the mighty cone of Demavend. To the south we saw the great plain stretching into the blue distance, and rising out of it, range after range of snow-clad hills, the more distant being considerably over 100 miles away, yet, in the exquisitely pure dry Persian air, the farthest range was perfectly clear. The whole was one of the most beautiful things I have ever seen. Now, that is merely one aspect of Persia, but it is worth dwelling upon. From every point of view, I wish I could see more English travellers in the country, but they must be travellers of the right stamp, like Captain Sykes and the charming and intrepid lady who accompanied him in his wanderings. I hope I may live to see more Englishmen following their example, and that greater interest in, and knowledge of, Persia may gradually result.

Colonel C. E. STEWART: It is some sixteen years since I read a paper before this Society on Persia, where I spent many years, and I am now glad to listen to a paper by Captain Sykes on that country. Captain Sykes told you that on his way to Persia he came to me at Adessa and asked me for letters of introduction. I gave him one to a friend of mine, a chief of the Yomut Turkomans whose friendship I had gained some years ago. I am sorry my friend did not treat Captain Sykes better; at all events, I had found him most kind. It surprised this chief very much, when I was with him, to hear that I possessed a portrait of him. This portrait had been done by my wife, who had met him on board a Caspian steamer when he was an officer in the Russian service. Sixteen years ago, a man was scalped in my presence in this part of the world; but on the present occasion we had a good dinner, with knives and forks. Whatever else the Turkomans have done, they have advanced much in civilization, which is due to Russian example. This chief, after holding a commission as major in the Russian service, had entered the Persian service as colonel of cavalry. I must say I found him a most pleasant, intelligent host, and in every way I enjoyed my time with him. I am sorry he was not more civil to Captain Sykes.

In another part of Persia described by Captain Sykes, I have been as far as Naiband. He describes Naiband as a sort of Paradise, but I suffered a good deal in crossing the desert to get there. My recollections go back more readily to the Turkomans than to the desert, because they live in a beautiful green country, where, if it were not for the mosquitoes, one could spend a happy time. I remember on two occasions I could not see the colour of my hands, they were so covered by mosquitoes.

Mrs. BISHOP: My claim to be a Persian traveller is rather a slight one. I travelled in Persia for a year for about 1500 miles. The region in which I travelled was chiefly Western Persia, from Baghdad to Isfahan and in the Bakhtiari country, and the Karun region, from Dupulun to the source of the Karun, and then through what is sometimes called Persian Kurdistan to the Turkish frontier near Urumiah. I should like to ask Captain Sykes if in the desert, between Meshed and Kerman, he met with any traces of ancient irrigation, irrigation canals, ditches, or reservoirs, such as occur in immense numbers in some other parts of Persia now entirely desert. I should also like to know whether there was any desert vegetation, such plants as *assafœtida*, which is plentiful on the Upper Elam mountains, and also the *colocynth* gourd, which affects deserts. There is one more question: Has the road for which a concession was granted when I was in Persia, I mean from Ahwaz to Burujird, become an accomplished fact?

Captain SYKES: In reply to Mrs. Bishop's three questions, I do not think that there was ever more irrigation or cultivation in the Dasht-i-lut than nowadays; in pre-historic times there is reason to believe that the desert formed an inland sea, in support of which theory, Sir Frederic Goldsmid mentions that at Yunasi or Yunsj, on its north-west edge, there is a tradition that the prophet Jonah, or Yunas, was cast up there and hid for three days under a gourd. As to the second question, I am afraid that I am not much of a botanist, but I have seen assafetida growing in the hills near Kerman, but always at a higher elevation than any portion of the Dasht-i-lut, where, indeed, one only sees stunted camel-thorn bushes. Finally, I regret to state that the Ahwaz-Burujird road has not, as yet, been commenced.

The PRESIDENT: We have listened to a very interesting paper this evening, and as regards the journey from Khorassan to Kerman, I believe, from what Captain Sykes has told us, that we shall be able to make some not unimportant additions to the map of Persia which was brought out under Mr. Curzon's supervision a few years ago. I therefore think we may all look forward with great interest to the additions Captain Sykes will be able to give us. We have all noticed, I think, how very interesting it is for an accomplished traveller like Captain Sykes to travel over a country little known, but which has many geographical and many historical reminiscences connected with it, and I was particularly interested in hearing him refer to the routes of Alexander and to the identification of places mentioned by Marco Polo and Friar Odoric. It reminds me how very much we owe to our late associate, Sir Henry Yule, as regards this country and other parts of Asia. If it had not been for his elucidations of the great work of Marco Polo, and for his having first brought to the notice of Englishmen the very interesting narrative of Friar Odoric, we should not now be able to listen to the researches of those travellers who have benefited by what Sir Henry Yule has written. We have much to thank Captain Sykes for besides the paper he has read to us. We have all been extremely interested in looking at the very beautiful photographic sketches he has shown us on the screen, especially those buildings at Kerman, and the golden-domed mosques and tombs at Meshed. We also have to thank him for kindly bringing here, and placing in the next room for our inspection, a number of interesting products connected with the province of Kerman, also some tiles and other older remains. I feel confident, therefore, that you will all wish me to convey to Captain Sykes a very cordial vote of thanks for his communication this evening.

A JOURNEY TO SIWA IN SEPTEMBER AND OCTOBER, 1896.

By WILFRED JENNINGS-BRAMLY.

THE famous oasis of Siwa, which lies about 300 miles west of Cairo, cannot be said to have fallen from its high estate, for it is probably much as it was when Herodotus, Strabo, Diodorus, Plutarch, and Pliny thought it worthy of mention; only it has stood still while the world went on. What it was in the days of its fame before the reign of Cheops it is still—the first halting-place on the great desert high-road to the west. Alexander the Great visited it, and it was well known in the Roman occupation of Egypt, but it was not until 1792 that its fame reached Western Europe through the visit of Alexander Browne. Mehemet Ali sent an expedition which gathered much knowledge of the place, and enabled him to fix the taxation

of the oasis at £2000. Several modern travellers have visited Siwa, including Dr. Rhofis, M. Bricchetti, and a journalist, Mr. Ward, who did not succeed, however, in gaining admission to the inner town. As circumstances favoured me in this respect, and as my return journey lay through new country, an account of my expedition may be of interest.

As the safest way of undertaking a risky expedition is to take so small a party that you excite neither attention nor alarm, I limited my equipment to the barest necessities, for the important thing is not to look worth robbing. One night, encamping at the Arej or el Bahrein—that hunting-ground *par excellence* of the robbers of the desert—a Beduin who joined us said he wondered I was not afraid of being murdered and robbed. "The laugh would be all on my side when I found you looking in my empty pockets," I said. The Beduin, after a moment's thought, remarked, "But you would be dead then;" upon which, suddenly impressed with the excellence of my joke, he laughed long and loud. My guide's sense of humour, which lay dormant on most occasions, was so thoroughly roused on this, that it never quite fell asleep again, and he was for ever reminding me I had said I would laugh after I was dead.

Besides this guide, my only companions were my servant Abdulla and three camels to carry us and our slender outfit—a sack of rice and of flour, three goatskins of water, tea, sugar, coffee, ten tins of desiccated soup, two of porridge, and a few apples and lemons. Two skins of water would with care last us five days, without allowing any for cooking or washing.

Mr. C. W. Ward has given so graphic a description of the road which he followed in his unfortunately fruitless attempt to enter Siwa, that I feel I have nothing new to say about the route, except that at Moghara I was fortunate enough to find some bones partly embedded in the sandstone, partly lying on the sand, which, on being examined at South Kensington, proved to belong to the precursor of the horse. Mr. Ward has described Ghara, that strange town built on the summit of a rock which rises some 40 feet out of a low damp plain surrounded by hills. It is supposed never to contain more than forty men at one time, but I fancy that I saw a good many more. When we arrived, every inhabitant was within the walls. At sunset the gates are shut, as in other towns, such as Siwa, and until sunrise none may either leave or enter. We shouted for food, and a basket full of dates was let down by a rope over the walls. Having to encamp in the low damp ground, we should have been bled as a preparation for the Siwa fever we should be exposed to, but the barber could not come out that night, and next morning he was too busy to attend to us. My guide was much disturbed, and the attack of fever I suffered from on the return journey was always attributed to this omission. Mosquitoes did their best to fulfil the barber's duties. They swarm in sufficient numbers to prove annoying even to the Arabs.

I was in a hurry to get on to Siwa, for the demands of the people for provisions were extortionate, and my resources small. We filled our goatskins, and pushed on. The water of the well of Ghara has a most abominable taste. It is, in fact, scarcely drinkable until it has been at least a day in the skins. Even then it is a wise precaution to hold your nose for some seconds after drinking.

Between Ghara and Siwa, old Dau, my guide, was terribly alarmed by our meeting a party of Uled Ali ("sons of Ali") Beduins. Their reputation as robbers is bad—but presumably they did not think us worth robbing, except in the friendly way of drinking up all our coffee, which Dau, in his relief at finding them friendly, obsequiously made and offered them.

I have until now been lucky enough to get on with the Beduins I have met.

Happily for me, the heat doesn't knock me up, and I can walk in the desert as long as in England. I heard that the Beduins gave me the name of the walking Englishman, and once or twice were kind enough to say that I was one of themselves. Trifles like these are important when dealing with men who have the minds of children. With them whether you are to live or die depends so often on a trifle that it is as well to have as many trifles as possible in your favour. I wore their dress in my trip to Siwa, not with the idea of taking any one in at close quarters, but of making myself unnoticeable at a distance. I generally walked some way in front of my men and camels. I did this because the incessant drone of the Arab songs became intolerable to me, and as I found Abdulla couldn't possibly get on without his eternal song, I used to put a mile between us when the track was clear.

Once or twice, on reaching the brow of a sandhill, I would find myself in sight of a string of camels. The first thing the Beduins would do was to load and hold their flintlocks at the ready. They meant no harm; it is the ordinary etiquette of the desert, at which no one dreams of taking offence. Then I would have to sit down to show I meant no mischief, and conversation would be carried on in shouts. I generally asked them for a bowl of camel's milk, which they always gave if they had it. On one occasion I came upon a solitary Beduin watching his herd of camels grazing. That man had probably not seen a human being for weeks. He was squatting on the ground. He neither moved nor turned his head. I asked him for milk, and he pointed to his camels and said, "Take it." As the art of milking camels never formed part of my school curriculum, this invitation was of little use to me. But I could not rouse that man to more active hospitality. He probably looked upon my appearance as an impertinent intrusion.

After a long tramp my Arab garments were in a disreputable condition, and as we drew near Siwa I saw little prospect of entering the town in any other character than that of a beggar. Little guessing what honours were in store for me, I put off my entry till dusk. On foot as usual, and some way in front of my men, I passed through the mile and half of gardens. The vegetation was magnificent. Each garden was surrounded by a mud wall, over which the foliage of the palms drooped most invitingly. But with the uncertainty of my reception before me, I do not pretend to say my mind was in a state fully to take in the peaceful beauties of the scene. At that hour not a soul was about, and I was not observed until I had crossed the bridge that spans the narrow canal running through the outer square, and was well into the middle of the further half of the square. Then the men assembled in the booths in front of me suddenly became aware of my presence, and came forward in a mass; I was soon surrounded. We exchanged greetings. Of course they soon heard that I was a stranger, though my shawl was so arranged that they could see nothing of my face but my left eye; but that is, unfortunately, blue. One man tried to pull my shawl aside—a liberty I resented, and he kept his distance; but things were becoming unpleasant. Dau hurried up just then, and told me not to lose a minute, but push through into the inner square by an open gateway I had not seen. This inner or Government square, as it is called, is reserved for the deliberations of the aristocracy of Siwa—the thirty-five or forty landowners. The rabble have no right to enter its precincts without leave, but the excitement of my arrival destroyed all rules of etiquette, and the noisy and unfriendly mob followed me in.

I looked round. There were tents in the middle of the square, and some dozen Egyptian police were strolling about—a comforting sight to me. On my left there was an out-jutting building, afterwards known to me as Government house. On a

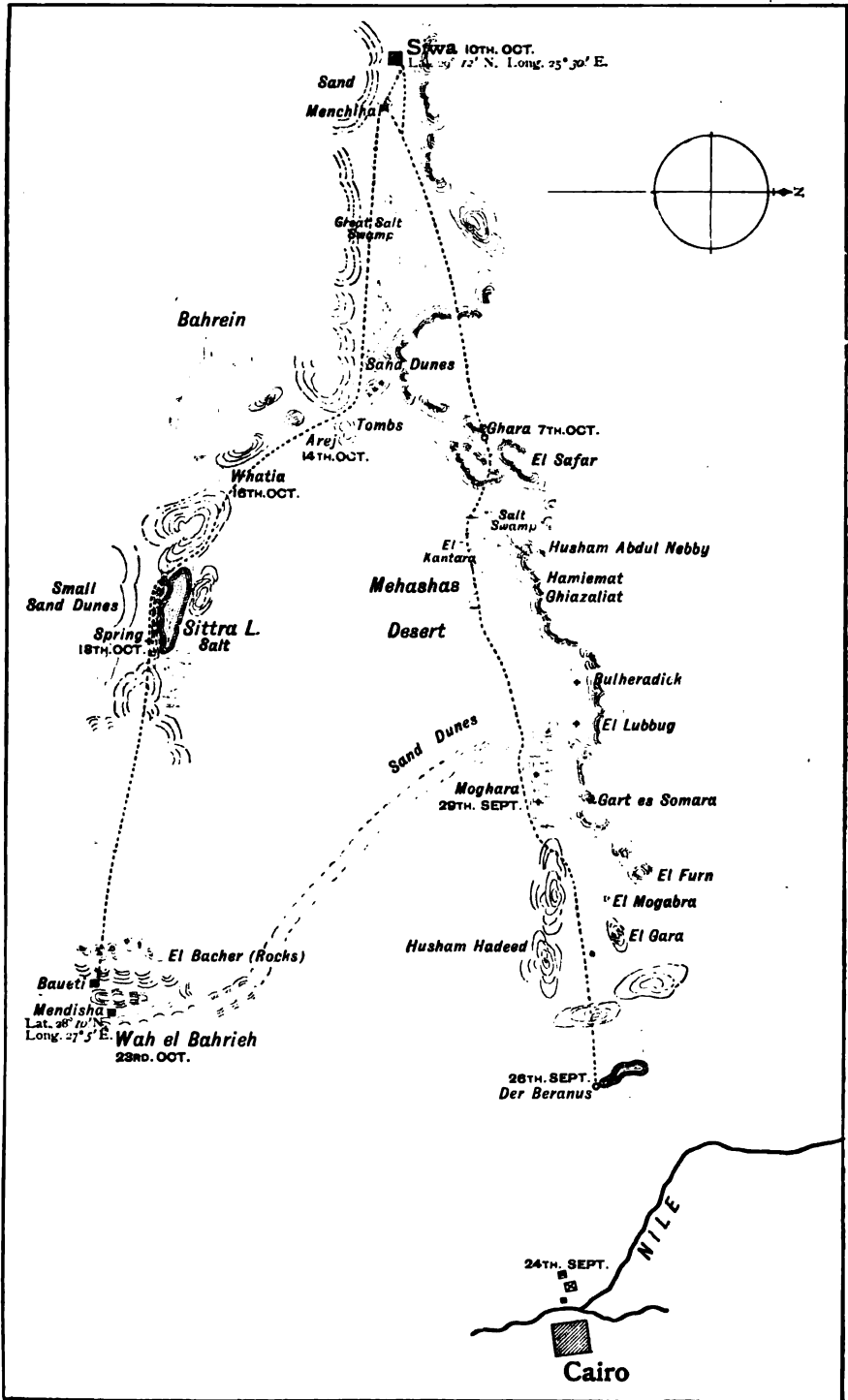
bench running along it I saw a grave assemblage of sheiks, sitting in conclave. In the centre sat a man in European clothes. This I knew must be Maha Bey. There was only one thing to do: I went up to him, and, speaking in English, addressed him by name, and asked if my presence was likely to increase his difficulties. Luckily for me, my rags and tatters, and my face burnt black, were not too much for his presence of mind. Hearing me speak English, he rose to receive me, and I believe his courteous reception saved me from much unpleasantness. Seeing the Mudir rise, the sheiks all stood up. My sudden appearance had silenced the mob. All eyes were turned on me. There was no time to explain, and with any one less quick at seizing the situation than Maha Bey, the danger I was in might have assumed alarming proportions. Speaking in the deliberate way in which Arabs exchange greetings, Maha Bey told me in English that if I would be guided by him, he fancied my arrival might be turned to some use. "I must talk with the sheiks for a minute," he said; "my orderly will take you to my tent, where I will follow you in a few minutes and tell you what to do."

Just then I remembered I had about me a passport. It was on parchment, and had an undeniably official look about it. With all the dignity I could assume, I produced the precious document and handed it to Maha Bey as my credentials. Not a ghost of a smile played on his face as he read it and returned it to me with a bow. He told me afterwards it had struck him then what to say about me. He soon followed me to his tent, and informed me I had become a colonel in the British army. The Government, he had told the sheiks, tired of waiting for the payment of the taxes, now three years overdue, had sent me to see what answer they were giving to his demands. I had hurried along alone, not wishing, unless absolutely forced to do so, to alarm Siwa by bringing my armed escort with me. As soon as I knew who and what I was, we returned to the sheiks, who in the mean time had been deliberating.

Maha Bey placed me at his right hand. I announced the fall of Dongola—an important piece of news to them, as the only help they could ever expect, if they meditated rebellion, must come from there. A change now came over them. From having absolutely refused to pay anything, they begged for a few days' respite before giving a final answer, and, before the assembly broke up, I received an invitation to attend that evening's feast in the inner town, given by Sheik Ekman Haboun, the leader of the Senoussi, or fanatical party. Maha Bey refused to accept until Ekman Haboun had promised to use his great influence towards having the taxes gathered. I was invited because Maha Bey took it for granted that I must be, as his guest, but I fancy my host thought it a bitter pill to have to consent to my entering the rock-hewn walls of the inner town at his invitation, for I believe I am the first Christian who has penetrated so far.

As we waited to go in, and afterwards as we sat in his tent, Maha Bey told me all he knew of the place. The people are in the habit of exchanging their dates for tea and sugar, and sometimes other small luxuries they can afford. No money ever passes. It is needless to say they are shamefully cheated, and, never receiving payment in money, they have none to give to the tax-gatherer. Maha Bey had interviewed the caravan of merchants just arrived, and informed them he had forbidden the Siwans to accept anything but money for their dates. As the merchants had brought everything but money, affairs were at a deadlock, and Maha Bey intended to stay in Siwa until money was forthcoming.

Mahomet Saïd leads the Government party. Not being such a fanatic as Hatoun, his attitude was naturally more friendly towards me. He and his party have the support of a Mahmoor and two policemen sent from Cairo—individuals



MAP OF SIWA.

Walker & Bontal's sc.

whose influence is *nîl*, and who, recognizing the fact, do not struggle against the inevitable.

Their monetary values are those of the adjacent countries—Egypt and Morocco—but they give them names of their own—

14 ghuerdas	=	1 freena
1 freena	=	2½ piastres
8 freena	=	1 real cinco
1 real cinco	=	19½ piastres.

But far more trade is done by direct barter than by cash purchase. They do not refuse money when it is tendered, but most of the merchants only offer them goods for the dates—chiefly green tea and sugar, both of which they consume in large quantities.

They cultivate five kinds of dates. The best, the *ghrasali*, is too juicy to be exported; the *faraghi*, which will keep from three to four months, is exported to Alexandria. The *saïedii* is the common Arab food, of which every Beduin keeps a store, as it will keep good for a year. Out of it is made the paste called *ar-gool*, or *moona* (mortar). The dates are trampled upon until they adhere together into a paste, the sugar in the fruit crystallizing and helping to preserve them. The *sultani*, of which Siwa possesses but a few trees; it is chiefly grown in the small oases. The *gargha*, the least valued of all, and therefore kept for home consumption and camel food. All these dates are dried on the sand of the date-yards, and carry away with them a good deal of the soil, but to the Arabs this does not seem to detract from their excellence.

They are packed for sale in long flat baskets made of palm branches called *sâa*, which is the recognized measure for dates, so that you buy half or quarter of a *sâa*. Two *sâa*, one slung on each side, are a camel-load.

The staple food is cheap enough, but all imports, such as green tea, sugar, and scents for the two or three inhabitants rich enough to buy them, are enormously expensive. They only care for green tea, and the best is sent to them. I saw them smell the packets with the air of connoisseurs. Not knowing this, I had given a packet of my black tea to one of the sheiks, whose manners were so good that he concealed the contempt he must have felt for it and probably threw it away as soon as my back was turned.

He who shall make the tea is selected for reasons I was unable to penetrate. Whoever he may be, he for the time being is called sultan, and ranks highest in the company. Sometimes it takes so very long deciding who should be tea-maker, that the water gets cold, but Ekman Hatoun being the proud possessor of a real French urn, the water could boil away while points of etiquette were being settled. A teaspoonful of tea, then sugar up to the brim, a sprig of mint placed in the lid, and as much hot water as the teapot will hold, makes what to our taste is a sickening concoction; but, as common politeness to the host demands it, you have to drink glass after glass, each more nauseous than the last, as the void is filled up with sugar until the teapot contains nothing but a thick syrup. You can always recognize an oasis man in Egypt by his preferring tea to coffee. Berber is the common language spoken among the inhabitants. The Arabic spoken differs here as with the Beduins—their *g*'s are all soft, and they clip their words of the last syllable; for instance, *mafîsh* ("it is not," or "there is not") becomes *mâfi*, with a long *a*; *moya*, *mâ*. Every salutation has its proper answer, and to fail to give it betrays the stranger at once. *Katerherak* ("thank you") should never be said; thanks must be expressed by calling down some blessing on the donor. When time is no object, Arabs will sit together muttering welcomes with as much expression as an ordinary school-

boy displays in reciting his lessons. Strangers meeting are so suspicious of one another that they prefer this to any conversation in which they might be led to betray their past or future movements. If one or the other is in a hurry and wishes to get to business, he says "Salimt," which is understood to close salutations; but even then it is difficult to maintain a satisfactory conversation with people who, as they have told me, consider it imprudent to speak the truth on any subject unless forced to by adverse circumstances. If asked where he has come from, a Beduin will generally say nothing, only jerk his head in the wrong direction, or point with two fingers and click softly with his tongue. The click against the palate means "yes;" against the teeth, "no." They also express "no" by jerking the head back alightly. The camels are spoken to in a series of sounds, not words. To make them lie down, they produce much the same sound in their throat as may be considered a fair imitation of a saw; to urge them along, they suck up all the air in their mouths; to stop, they hiss a long *siss*.

Each oasis has its own song "ramie," which the caravans on leaving intone and keep up for hours with a persistence perfectly distracting. I noted down two, those of Moghara and Siwa—

"Gour el Helab ou
Gart el Somara
Ya doun ya rase
Kaheel el andara."

While Siwa sings—

"Aween ya Siwa!
Yalla fi tamar
Oues zeit waggad,
Ya Siwa?"

"Where art thou, O Siwa,
Where the dates
And oil are plentiful,
O Siwa?"

Siwa possesses a fever of its own, and, as I have said, travellers are bled on arriving at Ghara. Onions are said to be an antidote. However, neither bleeding nor onions are certain cures, for they told me a large number die in the year of this fever. It is accompanied, as I found in my own case, with constant vomiting. They call fever humma, and use quinine when they can get it.

Maha Bey told me of the superstitious dread the Siwee had of cannon, and how the absurd report that he kept one under his bed had been most useful to him. His fifteen soldiers, when he reviewed them, had caused a stampede of over a thousand into the inner town, where from the battlements they watched the evolutions with a calmer sense of security. My military title was of great use to me, and Maha Bey assured me I should be quite safe if I could rely on my men. Of Abdulla I felt sure, and Dau was easily hoodwinked. I might have been commander-in-chief, and it would not have astonished him. The Kadi knew an officer in Cairo with whom I was well acquainted, which made a bond of friendship. This added to my prestige, and Maha Bey was not slow to make what capital he could out of the military romance he had wound around me by pointing out now and then that the Government would not leave him unaided, and that they had best decide and pay, and not force me to return with an army.

At sunset we were summoned to the feast, and led by a long tortuous passage cut in the rock and lighted by men bearing torches. The passage led up higher and higher, until we reached a large room, which must have been somewhere in the upper town.

Before entering I had to take my shoes off, and when I saw my toes barely covered by my ragged stockings, I felt I scarcely did justice to the British army.

The manners of my host and his guests were, however, if not cordial, perfectly courteous.

There were several round tables placed down the middle of the room, candles burned in candlesticks, all of which had been imported from Cairo at a fabulous cost. Lamps of olive oil were also about the room. The food was more than abundant. A whole sheep stuffed with rice, raisins, and pistachio nuts; soup, chicken, vegetables, succeeded each other. Then came trays of delicious fruit—the trays made of woven date-fibre; the fruit, delicious black grapes, figs, a small variety of water-melon, sweet lemons, pomegranates, and mandarins. Our host did not sit down, but directed the servants, who were most likely slaves. There is still some traffic in slaves from Kura, the price of one of these being a small roll of blue and black cloth, such as the natives wear. I fancy most of the Siwans' dislike of admitting Christians to their town is the dread that their slave trade will be interfered with. There was no conversation during the meal, for any one to talk would have meant a disregard for the other more important function of eating.

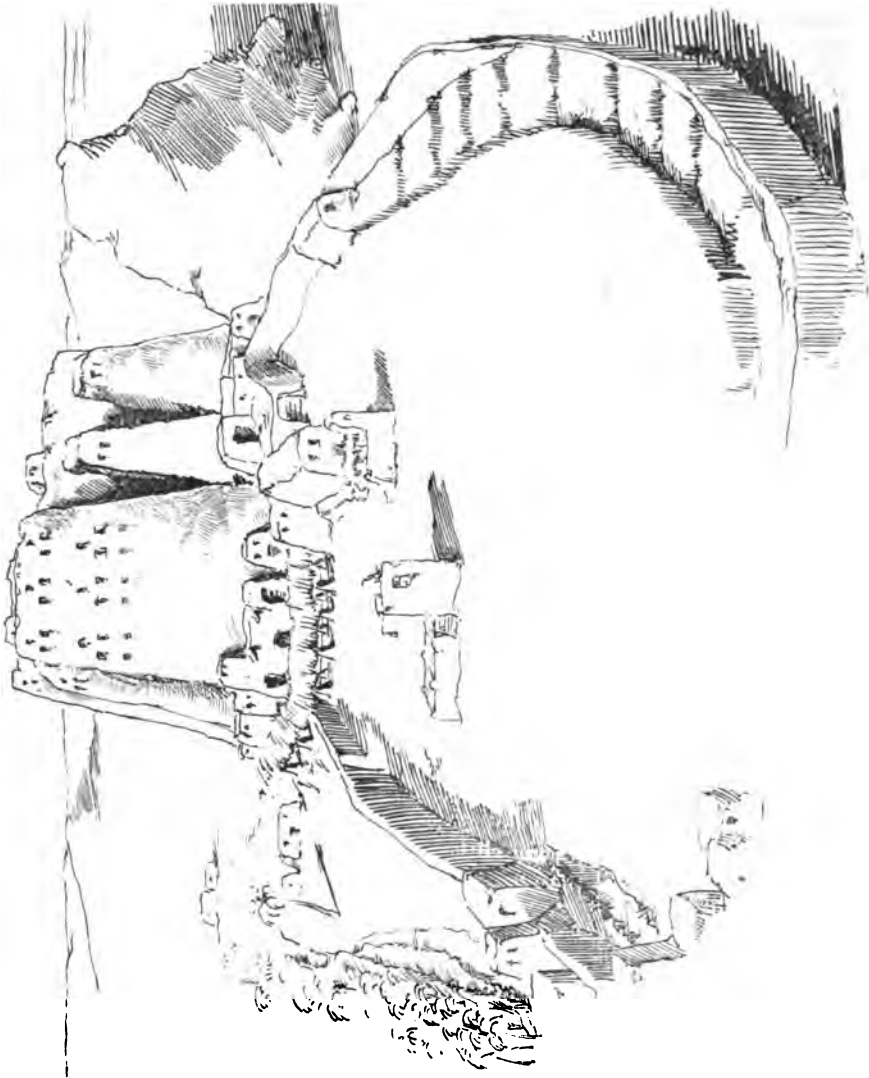
After a long dinner we rose and washed our hands in brass basins, with water poured out of ewers. Then all sat on the divans round the room. A servant then walked round, showering rose-water over us so liberally that another had to follow with a towel and wipe us dry, and while he did this a third stifled us with incense. This unpleasant ceremony cost our host a large sum, for rose-water imported from Egypt becomes of fabulous value, and the servants were unpleasantly liberal in dispensing it. The conversation was carried on in Arabic when they addressed either Maha Bey or me, but in Berber—of which neither he nor I understood a word—when they spoke among themselves. We had English to fall back on when they were sufficiently engaged to leave us alone. My tent meanwhile had been pitched close to Maha Bey's, and I slept in all security, watched over by his sentinels. Next morning Maha Bey, kindly wishing to show me as much of the place as he could, found a reason to visit the tombs and the villages of Menchiha, some $1\frac{1}{2}$ mile from Siwa. As we crossed the canal beyond the first square, I caught some of the small fish. They positively swarm, even in the puddles on its side. Once a year the poor of Siwa have a grand fishing, and catch enormous quantities to feed on. Threading through the outskirts of the town, I saw a few poor houses. The children I saw, and one woman, who came out of a doorway and gave me water kindly enough, were all black, and I suspect these are slaves.

The Siwans themselves, though darker than Beduins, have nothing of the negro about them. They are of Berber race, and their faces are long and lean, cheek-bones very prominent, eyes dark. Their expression is forbidding; lank and wiry, they look as if they could endure any hardship.

We reached the tombs first. They were hollows cut in the rock, said to be made by the Romans. They were quite empty, though a few bones could still be seen lying about. Maha Bey had found these tombs the resort of all that was disreputable in Siwa, and had had them emptied. From report, Siwan morals are of the lowest, even in native eyes; so we will hope that he did good work. We went on to the village Menchiha, a curious little town built high up on a rock some 50 feet high. As at Ghanhara and Siwa, at night the gates are shut and the inhabitants safe within the walls. Their gardens spread out all round in lovely vegetation. Five springs of different temperature flow from the rock and irrigate the gardens. This water is quite sweet, and the women come down and carry it up into the town above—an arduous task.

The sheiks received us most kindly, showed us their beautiful gardens—of which they were justly proud—and then gave us a luncheon of fruit, most delicious

and refreshing, and even lent us donkeys for our ride back to Siwa, which we reached in time to rest before the hour for the decisive meeting at Sheik Suleyman's tomb that evening. On very important occasions such as this, the sheiks assemble on the saint's tomb, and he is supposed to preside over and direct their counsels.



DATE-DRYING YARD, SIWA.

It all passed off satisfactorily. They decided the taxes should be paid if time were given them. In the mean time, no merchant might give goods in exchange for dates; everything had to be paid for in money, and the Government share deducted. Of the inner town I saw nothing but the room in which we dined. The women are

shut up within its walls, and all they see of the world is from slits at the top of the harem town walls. Rock and wall rise some 50 feet above the plain. The gates and passages leading up into it are cut in the rock. The women never come out, and after sunset every man has disappeared within.

At the foot of this wall—in the first square through which runs the canal—are the booths where the men spend most of their day, that is, such time as is not taken up by the cultivation of their gardens. The archway by which I entered the inner or Government square is close to the wall; between this and the square runs a narrow street, in which are the few shops of Siwa. Behind Government house—a building which juts out into this square—a doorway in the circular wall leads up the rock-cut steps into Eckman Haboom house, which is then reached by a passage cut upwards through the rock. This square is surrounded on three sides by small square yards fenced in with palm branches. Here the dates are heaped up after having been dried in the square. As you face south with the town before you, a conical-shaped rock rises to your right. The gardens stretch to the east, and at some little distance stands Mahomet Said's country house, where I should have been entertained had I stayed another day; but as under no circumstances could I see the inner town, and that by staying I laid myself open to the most constant questionings, I preferred leaving the next day, and returning by a different route. I wandered about the rest of the afternoon, spending some time in the outer square, where all commercial business is transacted. Here the merchants (Tugars) from Alexandria bring their tea and sugar, those of Banegharsi their dried meat and balra (Arab shoes), for exchange.

I gave as a reason for starting the next morning, that it was important I should stop the advancing army by carrying to it as speedily as possible the good news of their submission; but I had some difficulty in getting off, and was glad to find myself fairly on the road.

Our way took us back across the lowlands covered with "halfa" grass, which stretches 3 miles across from hills on the north to sand-dunes on the south. We had chosen the northern track by the hills going into Siwa; we now returned by the southern. At about 4 p.m. we reached the Salt plain. The salt lay about in great white slabs that might have been mistaken for ice. The ground was broken up into small pools of clear water glistening on beds of crystallized salt as white as snow. The great dried blocks on all sides spoke of a time when the whole plain must have been under water.

That evening we encamped near one of the Senoussi gardens. These sauva of Senoussi are to be found in almost every oasis. They are cultivated by blacks, slaves of Senoussi. They form little colonies of about a hundred, and are bound to provide food for any passing member of the sect. The dates lie in heaps under the trees ready for those who will help themselves. Every Arab may *take* food for himself and his camel, but is not allowed to buy them for sale in Egypt.

We filled our skins at a rush-covered spring. The smell of the decaying vegetation around is terrible, and taints the water, which would otherwise be good.

While we were filling our skins, one of the blacks passed by driving cattle to one of the grass-covered hollows, of which we passed many on our onward journey. He seemed astonished to see me, but said nothing. It was on this, our second day from Siwa, that Dau admitted his ignorance of the route for which I had engaged him as guide. He implored me to return the usual way, but it would have been awkward if the English colonel had reappeared on the scene, having missed his army; so I decided to push on, trusting to our being able to follow the track of

seventeen donkeys," which shortly before had been driven from the Wah el Bahrieh, or small oasis, to Siwa.

We reached the sand-dunes before night, and followed the track by moonlight as long as we could, encamping at midnight. The next day we travelled across flat rock and dunes. Three conical hills, known to Dau as landmarks, happily kept us straight, for the track was difficult to follow on rock, though Abdulla found it here and there by a turned stone, which showed white on its newly exposed side.

We reached the Arej that evening, walking down a steep passage in the rock. The sand slips under your feet, and the camels had a bad time coming down. Once at the bottom, we found ourselves in a valley surrounded by almost perpendicular cliffs of limestone, some 140 feet high. We could see nothing beyond. The Bahrein ("two rivers") with its date-palm forest stretching as far as the eye could see, visible from the tableland above, had now entirely disappeared. Abdulla brought us in some excellent dates, which proved that the palms in the Arej are looked after, though common property.

In the morning I saw the tombs, thirty-six of which have been opened and robbed. A row of squares gape black on the side of the rock. I climbed into many, but found nothing but bodies lightly covered with sand, and some mummy cloth. The walls in some were decorated: one had the hooded snake, others had been scribbled over by Romans with rude scratchings, and Arabs of a still later date had in some cases added their names. These tombs were evidently once closed by slabs of rock carefully built in with smaller bits, till the whole looked uniform. In places the rock sounds hollow, and other unopened tombs may be there; yet it is difficult to believe that Arab robbers left any unrifed.

The mosquitoes of the Arej were terrible, as they are wherever there is vegetation, and therefore water. We dared not light a fire, lest it should serve as a beacon to the robbers that infest the place. We suffered so that we decided not to pass another night in misery, and at sundown next day started onwards. Some Ghara men came up an hour or so before we started, to fetch dates. The Arej bears so bad a reputation that strangers are looked upon with suspicion; but these turned out to be friendly and harmless enough.

Our road was easy to find; landmarks known to Dau seemed to abound. From the Whatia, which we reached the next morning at ten, an abrupt descent took us straight down to the level of Lake Sittra, which we reached the day after. In the trees of the Whatia I noticed some small night-herons. I believe them to be a new variety, but unfortunately I missed the one I shot at. Their cry is not absolutely the same as that of the ordinary night-heron, and they are much smaller. They flew back in the direction of the Bahrein. There must, therefore, be some open water there; that of Lake Sittra is far too salt to make it possible fish can live in it, and I saw no living thing either in, or on, or near this southern side.

The lake is about 14 miles long and 3 wide. On the west, stunted bushes grow near the shallows; on the south—where we stood—sand drifting against the palm trees had formed miniature cliffs. A range of low white sandhills ran along the northern shores.

The palms on the banks bear a good deal of fruit, but it is of little use except as food for the camels. The road is too little used to make it worth while to tend the trees.

A spring of fresh water rises among the rushes at the east end of the lake. So difficult is it to see where salt ends and fresh water begins, that I hesitated before tasting it, when I found it far sweeter than that we had drunk in the Arej.

The ground, as we left the lake to the east, was covered with bushes, and I saw quantities of the spoor of hares.

From here to the smaller oasis there are five days' travelling across the most desolate waste, destitute of water, and even of the usual desert vegetation, so the camels had to live on the dates we carried for them. On leaving the lake there is a long track of wackla, or swamp, encrusted with salt. The track has to be carefully kept by the camels, for it is easy for them to flounder into depths from which it would be impossible to extricate them.

The only difficulties of the road began now. Dau lost his way on the evening of the next day, and as we could only carry just enough water to take us to the oasis without any delays, things looked rather black. We were not cheered by stumbling upon a man, woman, and child, and their donkeys, all lying dead—evidently of thirst. They were not all together. The woman, her child in her arms, had died first; near her lay one donkey. The man had struggled on some little way, and lay on the sand face upwards, his clenched hand stiffened in a last convulsion. The poor wretches had tried to quench their thirst with lemons, the skins of which lay scattered on the ground.

We went on climbing sandhill after sandhill, always hoping for the sight of some Al-haman, or landmark. Dau became very melancholy. I tried to take a cheerful view of things, though I cannot say that I felt in high spirits; but my attempts were considered irreverent by Dau, who thought the Prophet would be more likely to help us if we acknowledged the straits we were in. We still had some water, but we dared not drink it. Not knowing in the least where we were, we could not judge what chance there was of getting to the oasis before it was exhausted. On the late afternoon of the third day we suddenly came upon the Bacher, a group of rocks which we knew to be near the small oasis. Our difficulties were then at an end, and that night saw us encamping with my old friend the Omdeh of Mindescha.

ANCIENT TRADING CENTRES OF THE PERSIAN GULF.

By Captain ARTHUR W. STIFFE, R.I.M.

IV. MASKAT.*

THIS place is still an important place of call, and of trade with India, the Red Sea, and Zanzibar, chiefly only transhipment. It is the capital of the Arab country of Omán, and the residence of the prince, now designated Sultan or Seyyid, but formerly called the Imám of Maskat.† The country has long been in an unsettled state, owing to civil wars and dissensions, and has declined in importance, especially since the separation of the Zanzibar dependencies. It is now under British influence, and a Political Agency is established there. The town lies in a cove, one of a series close together on the north-east point of Arabia, which are all surrounded by precipitous rocky hills rising to several hundred feet abruptly from the water's edge. At the inner end of each cove is a small sandy beach, at the mouth of the little valley, or wadi, which forms the inland continuation of the

* The accent should be on the first syllable. Map, p. 660.

† This title has a religious significance, and is not now assumed by the sovereign of Omán.

cove. The rocks are dark-coloured serpentine, here and there showing foliation well marked,* and it is part of an area of depression, the coves being submerged valleys, which had been excavated by subærial agencies before the submergence took place. The bed of the sea sinks rapidly to a depth of upwards of 2000 fathoms at a distance of 10 or 12 miles from the coast.

The appearance of the coast from the sea is extremely picturesque, the rugged dark hills rising one range above another, until apparently joining the great back range, elevated about 6000 feet. Although from seaward the country appears utterly barren and desert, without any sign of vegetation, the valleys lying among the hills are more or less fertile where irrigated, which is done by means of wells, with so-called Persian water-wheels, and kanáts, or subterranean aqueducts. It produces fruits and vegetables, and many date-palms are grown. The coves abound with fish of excellent quality. The small cattle of the country are noted, and flocks of sheep or goats are numerous.

The map of the group of coves is from a survey by the author. Each one has a village or town at the head, built on the sandy beach close to the water's edge, so that the sea even washes the base of the houses, which extend back as far as the rugged ground will permit. They all may be considered suburbs of Maskat. The intervening hills are so rugged that, although there are some passes over them, much of the intercourse is carried on by water in large canoes. The houses fronting the water are mostly of two or three stories, and coated with white cement. The hills and passes are all crowned by small towers or forts for defence, with walls and gates across the passes. Maskat itself and Matrah, the place next in importance, are enclosed on the land side by walls, with towers at intervals. From Matrah only is there any pass into the interior of the country.

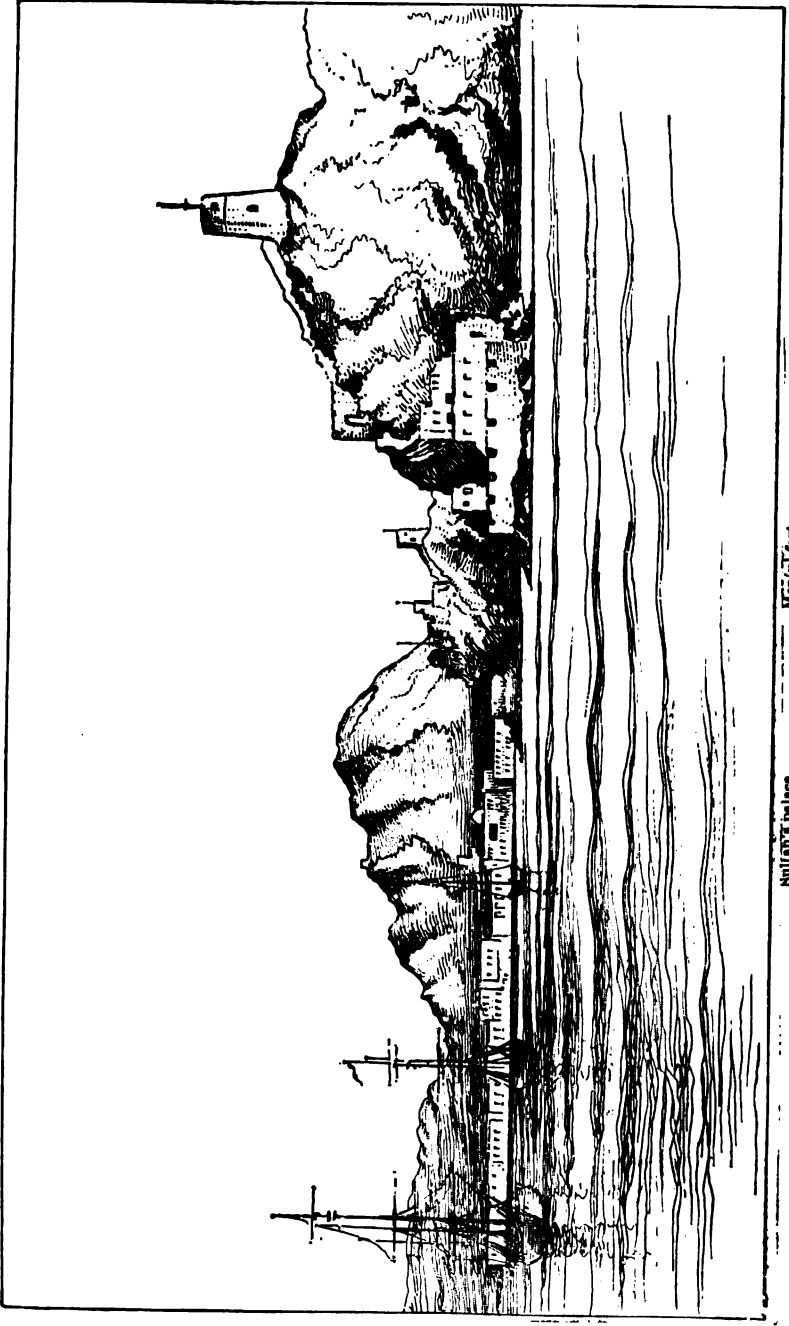
There are two large forts, built by the Portuguese, one on each side of the cove, on the summits of the hills overlooking the town, and two outer and less important, called Sírah, on the next projecting points of the cove; they are all in a very ruinous condition. The east side of Maskat cove is formed by three detached masses of rock; the outer, commonly called Maskat island, rises 350 feet above the sea, and can only be climbed with difficulty at a few points; it is much the largest, being 1400 yards in length, and is separated by a shallow strait, only a foot or two deep, from the second and smaller hill, and this again by a still shallower passage from the third, which is crowned by one of the great forts (Jaláli), and has a low sandy isthmus between it and the rocks surrounding the town, on which isthmus now stands the British Residency.

Outside the wall of Maskat there is a large suburb, occupying all the available ground in the valley, and consisting of huts of the usual material of Arab villages, viz. matting made of the stems and leaves of palm fronds.† Here there is a bazar, which is a busy scene in the morning. A curious kind of auction goes on constantly. Men walk about calling out the last bid made for some article they carry for sale, which seems to go on until some offer is made which they will accept.

Of the two principal forts, the eastern, Jaláli, already mentioned, occupies the whole of the top of the rock on which it stands. Its front is a long curtain wall with two tiers of embrasures, with a round tower with flagstaff at each end, the only access being by a flight of steps cut in the rock on the harbour side. This

* W. T. Blanford, 'Records of the Geological Survey of India.' 1872.

† Of the date tree, and largely of a dwarf palm called pish, brought from Makrán.

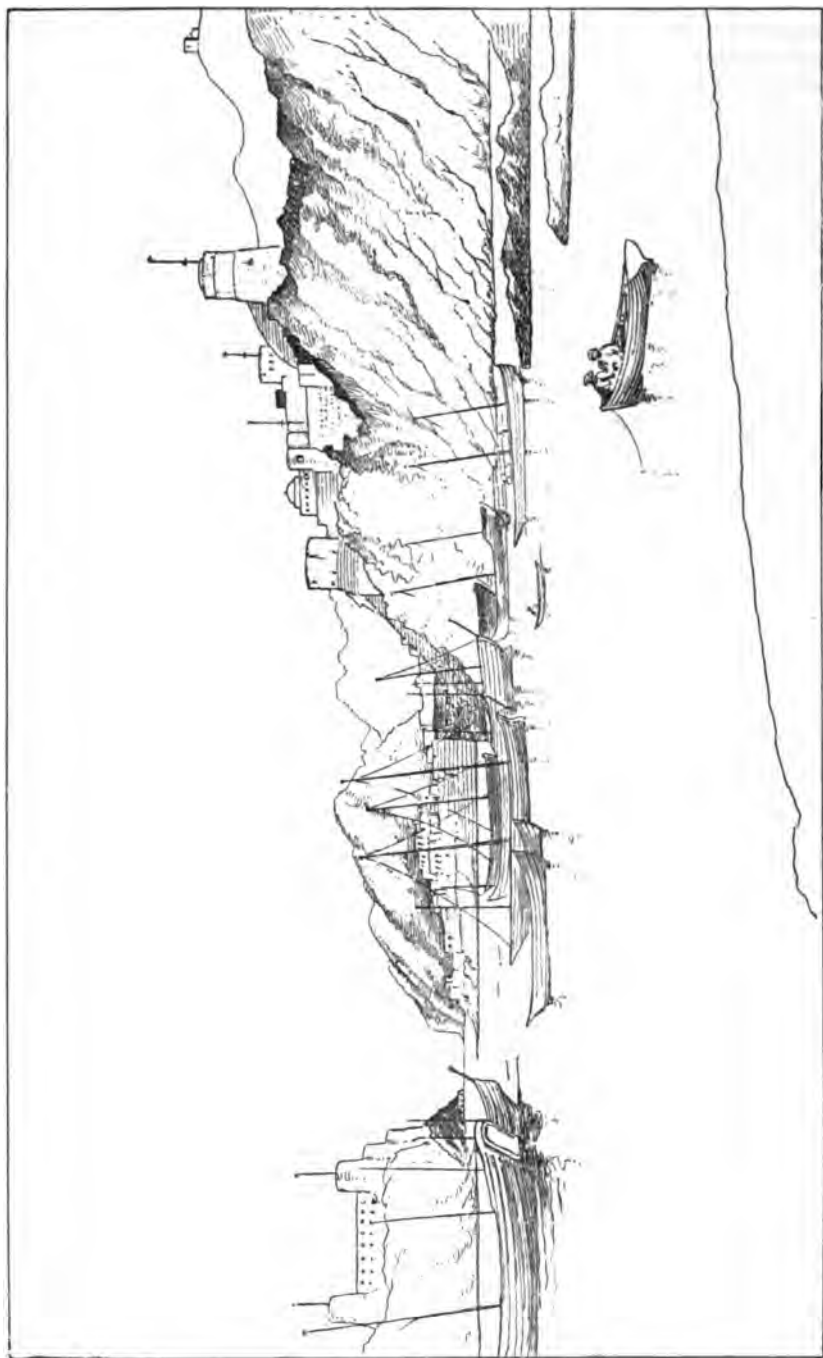


Sultan's palace.

Merin's fort.

MARKAT, FROM THE ANCHORAGE OUTSIDE THE PORT.

S'rah fort, the western or el-Quarbi.



Jaldil fort.

Merani fort.
MASKAT, FROM MAKALLAH BAY, THE ANCHORAGE FOR SMALL VESSELS.

fort was much damaged by artillery fire during a civil war some years since (about twenty, I believe), and remains in a most dilapidated state, as the Arabs appear never to repair anything. We had given the Sultan of that time two guns of position—24-pounders, I think—and these were used with great effect by one side in the quarrel—I think, by the rebels, i.e. the unsuccessful party. This fort was built by the Portuguese in 1587, and called by them San Joao.

Opposite to this, on a hill overhanging the town, stands the other principal fort, now called Meráni. It has a ruined battery near the water, above which rises the body of the fort, occupying the top of the hill. It is an irregular structure adapted to the available space, and has two large round towers, with tall flagstaffs, as in all Arab forts, the higher tower being connected only by a double wall with the

REINA ODHOMVAE FOHE POE O.
 RORO·F·PRME ROES ENOME·R·
 HE·S·NOSONOH OV KVOANOED·
 SEVRENA DONACROADEPOR V
 QMANDOVPOR DNBAR EEM
 ENERESSEWROR·R·DN DIA RE SEFI
 RESE·ESA FOR TLE R MAE S EICH R
 QSVPRME RO QPIA OEFND DR ISS 8

INSCRIPTION OVER GATEWAY IN FORT MERANI.

main fortress. The guns mounted are very old, mostly Spanish or Portuguese, and the carriages dropping to pieces. The iron guns are all dangerously unserviceable. The brass guns are in better order; one bears the inscription, "Don Philippe rey de Ispaña," and another the inscription, "Don Juan de Acuña de su consejo de cuera y su Capitan general de la artilleria año 1606." This fort was built in 1588, according to an inscription over the inner gateway in old Portuguese, which has been rendered for me as follows: "Reigning the most high and most faithful Henry, powerful and first of that name. King Henry our lord, in the eighth year of his reign on the crown of Portugal, ordered by Don Duarte de Menezes, his viceroy of India, that should be erected this fortress, of which Belchior Caleça was its first captain and founder, 1588."*

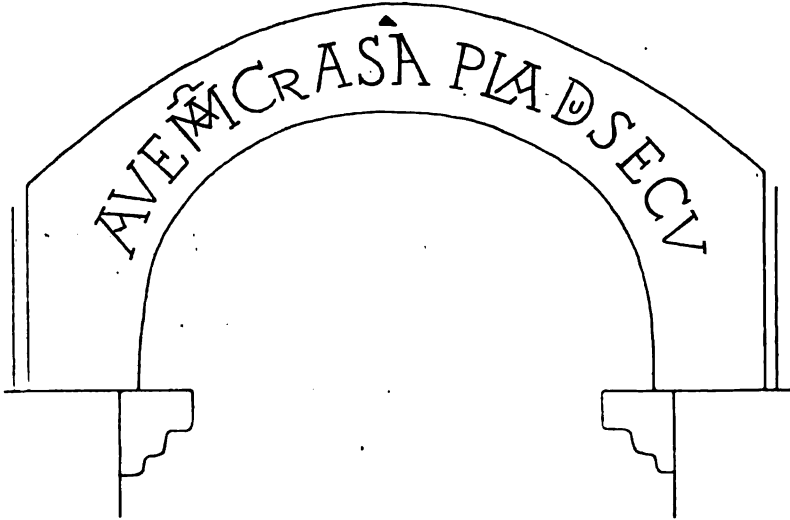
I cannot understand this date (unless it is the date of *completion*; it may well have taken many years to build, being so extensive), as Henry died in 1579, and did not reign eight years. It was named by them Fort Capitan.† In 1581 the news of the seizure of Portugal by the Spaniards reached India. The fort is only strong from the difficulty of access, and the old entrance gates, one within the other, are still carefully guarded. Over an arched window, 30 inches span, cut out of one stone, is carved, in letters 3½ inches long, an Ave Maria (copy attached). The two smaller outer forts, which had also batteries near water-level, are still more ruinous.

* A facsimile is attached.

† A fort was commenced on this site by Da Lisboa thirty years previously, in 1552.

The Sultan's residence is a large three-storied building near the centre of the town, a quite plain, rectangular block. It is a relic of the Portuguese occupation, having comprised the governor's residence, factory, chapel, warehouses, and barracks. The Arabs call it El Jereza, a corruption of Igreja (church). On an old wooden gate of the custom-house is cut "Anno 1624."

The wadi extends up behind the town for a mile or more, and is cultivated in patches, with vegetables and a few date trees. The wells, worked by bullocks, are about half a mile from the town wall, and are defended by a square tower or fort, loopholed for musketry. A small cemented aqueduct, generally out of repair, has



INSCRIBED OVER A WINDOW IN FORT MERANI.

been made to bring the water down to the landing-place for shipment. The water-course draining this valley passes through a culvert under the town wall into the sea. It is quite dry except after rain.

From Matrah there is a track or way winding through the hills into the interior, and, after following it about half a mile, you come on a plain among the hills with a small village, called El-Felej, where there is a castellated country residence of the sultan, very dilapidated, with a grove of date and other trees, and some cultivation. The water is brought from the upper part of the valley by an underground channel, or *kanát*. This is the only approach by land to Matrah, whence Maskat is generally reached by water.

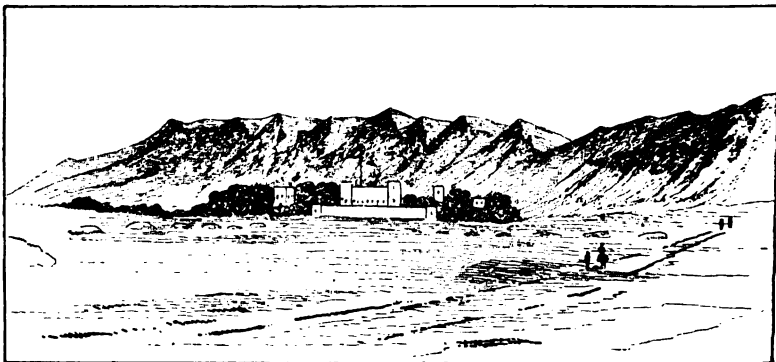
As regards the actual productions of the place, they are unimportant; it being chiefly a port for transfer of trade. The speciality is the manufacture of *halwah*, a sweetmeat much in request, and of which large quantities are exported. It is made chiefly of the gluten of maize. Large quantities of dates brought from the coast of Batinah are exported. It is a port of call for the Gulf mail steamers, and some English merchants are established here, also many Hindus (Banians), all traders.

The climate of Maskat is extremely hot, even in the winter, and there is but little rain, which falls in the winter. It is out of the track of the cooling south-west monsoon, which is cut off by Ras-el-Hadd; but in that season light south-

easterly airs at times temper the heat. Abd-er-razzak,* 1442, says that in May "the heat of the sun was so intense that the sword in its scabbard melted like wax," etc. I can almost pardon him his exaggeration.

HISTORY.—Turning to the history of the place, it is only speculation to inquire whether the Moscha and Omana mentioned in the Periplus † are the Maskat and Omán of the present day. Dean Vincent argues that they are not, but it is possible they may be intended for these places, and misplaced in the itinerary, some confusion in the application of names having arisen. The description given of the places seems more applicable to Maskat, than any other part.

We have a brief glimpse of the place ‡ in the ninth century, indicating it as the last port of call for the Arab vessels proceeding to India, which is all I have been able to trace of its earliest history.



FORT OF FELEJ.

Colonel Taylor, formerly political agent in Turkish Arabia, and, I believe, a great Arabic scholar, gives a short account of the history § of Omán "from authentic sources of Arabian tradition," but does not specify any authorities. He says nothing about the period between the eighth and seventeenth centuries, and does not mention the long Portuguese occupation. His account says that the first native Arabian who entered Omán was one Malik bin Fakham of Nejd, four centuries before the Christian era, || who, with some hundred followers of the Hiuávi tribe, settled at Jaalan or Bahla, two towns in the interior some 70 miles to south-westward of Maskat; and fortified Rastag, an ancient city in the mountainous district of Omán, 30 miles westward of Maskat. Successive additions to the numbers of these Arabs enabled them, after obstinate resistance, entirely to expel the Persians from the province. His successors continued in power until the mission of Mohammed.

* Hakluyt Society, vol. 22, 'India in the Fifteenth Century.'

† 'Periplus of the Erythrean Sea.' W. Vincent, D.D. 1800.

‡ *Geographical Journal*, vol. vi. No. 2, August, 1895, p. 169.

§ 'Bombay Government Records,' No. 24, New Series, 1856.

|| Colonel Ross says the probability is that Malik bin Fahm entered Omán in the early part of the second century A.D., and that the part he played is probably exaggerated. The country up to his time was under the Persians, the date of whose conquest is not known.

In 571 A.D. a powerful prince of the dynasty, named Jalanda, equipped a fleet and seized Hormúz island, which was established as a rendezvous of a piratical fleet. They were converted to Islam in 621 A.D. by invitation of the Prophet.

Dr. Badger (Hakluyt Society, vol. 44, 1871) gives a translation of an Arab history of Omán, containing the period between 661 and 1856, by Salih-ibn Razik.

I propose here, however, to touch chiefly on the Portuguese occupation of the seaboard of Omán. The above Arab author gives only a short space to the period 1154 to 1557, and does not mention the Portuguese conquests; nor is there any record of the overlordship of Hormúz, which existed at the time of the appearance of the Christians. He admits a hiatus in the annals from 1154 to 1429, and these are also said to be obscure up to 1560.* His account of the recapture of the places from the Portuguese will be referred to later on.

Marco Polo (1260-95) does not mention Maskat by name, Kalatu † (Kalhát) is mentioned as frequented by numerous ships from India, and as "subject to Hormos." "Many good horses are exported to India; the number from this and the other cities is something astonishing." The probable reference to Maskat is that "the Melic of Hormos has a castle which is still stronger than this city (Kalhát), and has a better command of the entrance of the gulf." Abulfeda (1273-1331) also does not mention Maskat by name. Ibn ‡ Batuta (1324-25) went by sea to Omán, and arrived at the city of Kalhát, "which is situated at the foot of a mountain. The inhabitants are Arabs and schismatics, which they keep secret, because they are subjects to the king of Hormúz, who is of the Súnni sect." He mentions the markets and a fine mosque, "whose walls are covered with coloured tiles."

Edrisi (1153) mentions in Omán, first Kalhat and Súr, and then Sohár, which he says is one of the most ancient cities of Omán, and of the richest. Maskat is mentioned as a populous town.

We may, I think, gather from all this, that in the thirteenth and fourteenth centuries Maskat was a less important place than Kalhát.

The first appearance of the Portuguese on the coast of Omán was that of D'Albuquerque,§ who with six ships left Socotra on August 10, 1507, and sailed up the coast of Arabia. He anchored, says the chronicle, at Calayate (Kalhát), an anchorage on the coast, about 25 miles to north-westward of Ras-al-Hadd, and there got some supplies. It was badly populated, with many old edifices, the sea beating against it; on the land side was a wall, about the height of a lance, reaching to the sea, not a single tree, and all supplies came from the interior. It was under Hormúz,|| and they fished as far as Ras-al-Hadd, and it was the seat of the

* In Colonel Sir E. C. Ross's 'Annals of Omán' (translation of Kishf-al-Ghummeh. Calcutta: 1874), there is a similar hiatus from 1153-1406. Nor is there any mention of the Portuguese conquests, or of Hormúz.

† Colonel Yule's 'Marco Polo,' vol. ii. p. 448.

‡ 'Voyage d' Ibn Batouteli. Trad. de C. Depémery et B. R. Sanguinetti.' Paris: 1895. The translation of Rev. Sam Lee (1829) appears less accurate.

§ The Commentaries of the great Afonso D'Albuquerque, translated from the Portuguese edition of 1874 (Hakluyt Society, 1875-84), from which I abstract largely.

|| Confirmed by Marco Polo, 1271-94 (see ante). Colonel S. B. Miles says the supremacy existed since 1270. Colonel Miles was Political Agent in Maskat, and wrote a valuable report on the Portuguese in Eastern Arabia in the Administration report for 1884-85, printed in No. ccvii., 'Selections from the Records of the Government of India, Foreign Department' (Calcutta: 1885). He does not always quote the authorities he has consulted. I have quoted in one or two places from this report.

chief governor from Hormúz. They next anchored off Curiate (Karyát), stormed and took it, and put all to the sword who tried to escape, including women and children*; they plundered and burnt it, "so that not a house was left standing, not even the mosque, one of the most beautiful ever seen." They cut off the noses and ears of the prisoners, and sent them to Hormúz. Thirty-eight ships, great and small, were burned. It was a large town, and contained about 5000 to 6000 men, an entrepôt of ships which came to collect dates.

Thence the squadron went to Maskat, where the people submitted to be vassals of the King of Portugal, being aware of the destruction of Curiate, and agreed to pay tribute and furnish supplies. A "captain" having arrived with 10,000 men from the interior, hostilities ensued, and the town was taken after a stout resistance. D'Albuquerque put men, women, and children to the sword, sacked the town, and burnt it to the ground, including the large and beautiful mosque, and thirty-four "ships" in all. Some men and women who had been taken alive had their ears and noses cut off, and were then released. "It is," says the account, "a large and populous city, supplied from the interior with much wheat, maize, barley, and dates for lading ships. It is part of the kingdom of Ormur."

The unhappy "Moors" returned when the Portuguese embarked, to try and put out the flames. "The Moors call the interior the *island of Arabia*.† It is a very small land (!) governed by a king called the Benjabar"—this is the name of a tribe in the vicinity (Beni-jábar).

At Maskat the Portuguese got "Moorish" pilots, and, passing six desert islands—the Daimániyah group—came to Soor,‡ where they were at first defied by the "Alcaide;" but who, on the Portuguese preparing to attack, submitted to be vassals of the King of Portugal. They took possession of the fort, hoisted the Portuguese flag on it, and left the "Alcaide" in charge. The fort was of a square shape, with six towers round it, and two very large towers over the gate. There were about six thousand inhabitants and one hundred "cavaliers," the greater part "armed with steel armour: plates arranged after the manner of a roof tiled with slates. The fore quarters of the horses were similarly defended."

The last place in Omán they visited was Orfacão (Khor-Fakáo), which was attacked and taken with the usual mutilation of captives and merciless slaughter, after which the place was burnt. It was a large town, with a wall on the land side, and lies at the foot of a very high mountain. Now it is a small fishing-village, and I saw no remains of the old town; it lies in a small cove at the northern end of the Bátinah district.

So much for the first visit of a Christian power to this country. The invaders thence sailed to Hormúz.

In August, 1508, Albuquerque returned to the coast *en route* to Hormúz, "intending to attack Calayate," which had been spared the previous year. It was taken after some fighting, and the town sacked and burnt, including the mosque, "which the Moors took much to heart, for it was a very large building with seven naves, all lined with tiles, and containing much porcelain hung upon the walls." It was burnt to the ground; twenty-seven ships, large and small,

* I must express my horror at the barbarous cruelty of the "great" commander, both here and throughout this cruise, towards people whose only offence seems to have been that they were of a different race and religion. The details are stated in the Commentaries in a matter-of-fact manner.

† As they do now, Jezfret-el-'Arab.

‡ Sabár, still the principal town on that part of the Omán littoral, called Bátinah.

were also burnt; and then Albuquerque ordered them to cut off the noses and ears of all the Moors whom they had captured, and left them on the shore and returned on board, "giving many thanks to our Lord." They then apparently proceeded to Maskat. Faria y Souza * says Calayate was burned "to be revenged for some injuries done to some Portuguese." Albuquerque also touched at Maskat, on his way to Hormúz, in 1815.

In 1522 † a concerted rising took place simultaneously at Hormúz, Bahrain, Maskat, Karyát, and Sahár. Many Portuguese were killed; the number is given as one hundred and twenty. It was, however, suppressed, and Sahár destroyed with "fire and sword" by Dom Luis de Menezes, who was sent from Maskat with two ships to relieve Hormúz, then closely besieged. In 1526, Lope Vaz de Sampayo, on his way to Hormúz with five ships, reduced the "towns of Calayate and Muscate, which had revolted;" but no particulars are given. In 1550-51 "the great Turk," being offended at the proceedings of the Portuguese, fitted out a naval expedition ‡ consisting of sixteen thousand men, in "strong galleys" and other vessels, under the command of Pirbec (Pir Beg), who is described by our author as an "old pirate," but who was apparently the Turkish admiral, who attacked and took Maskat after a siege of a month; and, having failed in his siege of Hormúz fort, was beheaded after his return. He did not attempt to hold Maskat permanently, but sacked the place and removed all the ordnance. The garrison were made to work in the galleys, but were mostly released at Hormúz.

In 1581 § another Turkish expedition under Alibec (Ali Beg), "a Turk used to robbing," consisting of three galleys, was fitted out at Mocha, and surprised Maskat. He landed his main force at Siabo, || while "the galleys entered the port with those that remained, and began to 'play' their cannon furiously, so that he might come in on their backs; which succeeded, and he entered and plundered the town." His land force advanced through the narrow pass from Sudáb to Maskat, "so narrow that two men cannot pass it abreast; no one imagining he would attempt it." The Portuguese fled to Matero (Matrah), a town a league distant, and, not thinking themselves safe there, went to Bruxel, ¶ a fort 4 leagues inland. They returned to Maskat after the departure of the Turks.

It was in 1588, according to the old inscription referred to already, that the fortress now called Meráni was completed, which strengthened the hold of the Portuguese on the place and country. Sahár, which had been taken and burnt by the Portuguese in 1522 (see *ante*), appears to have revived, for in 1616 its trade "much lessened the customs of Ormus and Mascate;" and an expedition was despatched from Maskat, which, with the aid of twelve hundred Arab auxiliaries, took and plundered the place, and left a garrison in the fort. It was retaken by the Imám in 1643.

After the loss of Hormúz in 1622, Maskat became the most important place held by the Portuguese, and was the headquarters of their fleet.

* 'The Portugues Asia.' Translated by Captain Jno. Stevens. In 3 vols. London: Printed for C. Brown, 1695, at the Sign of the Gun, at the west end of St. Paul's.

† 'Manuel de Faria y Souza,' *ante*.

‡ This expedition came from Egypt. Colonel Miles (*op. cit.*) calls him Pir Pasha, and says he was Capudan of Egypt, and that the expedition consisted of thirty sail

§ Faria y Souza, *op. cit.*

|| This must be Sudáb, which answers to the description in the chronicle.

¶ This may be Boshar, a place visited by the author in December, 1859 (*Trans. Bombay Geog. Soc.*, vol. xv.).

In 1640, the garrison of Maskat, which had been much reduced, repulsed an attack on the place by the Imám's* forces. In 1648 Maskat was again besieged, and the Portuguese had to accept humiliating terms, being confined to Maskat, and giving up their other possessions in the country. Finally, in 1650, after another siege, Maskat also was surrendered, and the Portuguese finally expelled from Omán.

In the account given by Dr. Badger's author (already quoted), a detailed account is given, showing that the loss of the place was due, in part at least, to treachery on the part of a Hindu trader, "a worshipper of the cow," † whose daughter had attracted the attention of the Portuguese commandant. In a note to Colonel Ross's book (*op. cit.*), he says, "One story current is that the Arabs entered Maskat in the guise of peaceful peasants, hiding their arms in bundles of firewood, and that they took the opportunity of the Portuguese garrison being assembled without arms at chapel to attack and massacre them."

Captain Hamilton, ‡ in his 'New Account,' gives a long and circumstantial account of the final scene, which he had "from a very old renegade who was at the tragedy, being then a soldier, who reckoned himself about a hundred years old, and by his aspect could not be much less." This story gives as the cause of the final hostilities a gratuitous insult offered by the commandant to the "king of that province." He says only those of the garrison were spared at the final surrender who "consented to embrace" Mohammedanism. §

During the reign of Nadir Shah, between 1736 and 1741, the Persians occupied Omán, || having, in the first-named year, gained a footing under the pretence of assisting one of two rival claimants to the Imámate, but they appear to have been finally driven out in the latter year.

The subsequent history of the country is not of sufficient general interest to relate at length. The fortunes of the country culminated under the great ruler Seyyid Said-bin-Sultan, 1804-56, ¶ since whose death it has rapidly declined, owing to intestine wars and the loss of the African dominions (Zanzibar, etc.), which fell to another son, and has since remained a separate state.

About 1800 the French attempted to gain over the Imám in furtherance of their designs on India, but this was frustrated by the British. Seyyid Said continued throughout his reign our loyal ally, and co-operated with our forces in the expedition against the independent piratical ports in 1819, and in the disastrous Benu-bu-'Ali affair in 1820.

* Nassir bin Murshid, who appears also to have recovered Karyát, and all Omán except Maskat and Matrah, and was one of the strongest rulers Omán ever had.

† Colonel Miles (*op. cit.*) says that one of the several objections to this romantic story is that the Banians have never brought their wives to Arabia, much less their unmarried daughters.

‡ 'Pinkerton's Voyages,' vol. viii.

§ Wellsted gives the date of the final capture of Maskat as 1658, which is incorrect. He was not an accurate observer. The date has been the subject of controversy, but is now fixed by Mr. Danvers from Portuguese records ('The Portuguese in India,' by F. C. Danvers. 1894).

|| As well as Bahrain and other islands in the gulf.

¶ Dr. Badger's author. Colonel Hamerton says 1807, and is more likely to be correct ('Bombay Government Records,' No. 24, New Series, 1856).

POTAMOLOGICAL AS A BRANCH OF PHYSICAL GEOGRAPHY.*

By Professor ALBRECHT PENCK, Ph.D.

Of the different departments of physical geography treating of the hydrosphere, none has advanced more slowly than the science of rivers. Oceanography has developed in a wonderful way. The limnology advocated by Forel at the London Congress of 1895 has become a separate flourishing branch; only the hydrology of running water is still in a very unsatisfactory state. The fact that it has not a name of its own corresponding to oceanography or to limnology, indicates its neglected position, but there can be no doubt that it must gain equal rank and follow the same evolution as the two other above-named branches of hydrology.

The science of rivers, which may be called potamology, must be treated under five different heads—

1. The physics of running water.
2. The volume of water and its fluctuations.
3. The action of water on its bed.
4. The distribution of running water on the Earth.
5. Rivers as a scene of organic life.

As to the physics of running water, hydrotechnologists have recognized the dependence of velocity on the declivity of the water surface and depth. But all formulas based on these elements alone are not satisfactory. Thus neither the old formula of Chézy, the newer of Bazin and Darcourt, nor the complicated one of Ganguillet and Kutter can be accepted. The problem is, in fact, more complex than has been generally supposed. If we have a body of moving water, its motion will depend—

- (i.) Upon its own mobility, changing with its temperature.
- (ii.) Upon the forces of gravity and rotation acting upon it.
- (iii.) On the resistance caused by the form of its bed and by its surface.

The mean velocity of a river may vary—

- (a) With its temperature.
- (b) With its volume, height of the fall, and geographical latitude.
- (c) The width and declivity of the river bottom and the area of the river surface.

Some physicists have commenced to treat the question in a theoretical way, and have shown how complicated the movement of each water-particle is—how it moves in very intricate spirals. But a more empiric way can be followed also, by establishing relations between the factors just named and the results of stream-measurements. We must not forget that the only way of determining the mean velocity of a stream is by measuring the volume of water which passes through a given channel in a given time.

In treating of the volume of water, potamology comes into intimate relation with climatology. All river water (with the very inconsiderable exception of the water which comes from volcanic vents) is derived from the sea. No part of the water which is evaporated from the sea and has fallen as precipitation on the land is fixed there, for we see no general sinking of the sea-level, which should happen if any measurable part of the rainfall were permanently held by the soil. The quantity of river water is therefore equal to the quantity of sea water which is carried as moisture in the air to the land. The first rough estimation of the quantity of river water pouring into the sea by Dr. Murray shows that it is

* Paper read in Section E (Geography) at the Toronto Meeting of the British Association, August, 1897.

considerably (four or five tenths) less than the amount of precipitation. We must assume, therefore, that only a part of the rainfall on the land is derived directly from the sea. The other comes from the evaporation of rain-water already fallen on the land. The proportion between the total rainfall of the region and the quantity of river water escaping from it shows how many times the water of oceanic origin has been precipitated and reprecipitated in that region. Taking, for example, Bohemia, where the yearly rainfall is 17.3 inches, and the height of run-off is 4.8 inches, we must assume that 4.8 inches of water have been brought during the year from elsewhere to Bohemia, and have fallen there three and a half times as precipitation. Therefore high scientific interest is attached to the knowledge of this proportion. On the other hand, the proportion between river water and the rainfall of a region has high practical value. It allows one to determine the quantity of river water from the precipitation.

Hydrotechnologists have laid much stress on this proportion, the so-called "coefficient of run-off," and it is generally thought that this might be a constant factor for a distinct river. This is not correct. Recent investigations by Mr. Newell, of the Geological Survey of the United States, and by myself have shown that the coefficient of run-off varies not only from river to river, but also from year to year for the same river. It varies with precipitation: the higher the rainfall is, the higher also the coefficient of run-off.

In Central Europe the height of run-off is zero up to a certain height of precipitation. That corresponds to the well-proved fact that many dry countries have no rivers. Over that height (nearly 17 inches), the height of the run-off grows with that of the rest of precipitation, and is nearly three-quarters of the latter. This rule holds good for different kinds of rivers, for those coming from impermeable soil (Moldau in Bohemia, Enns), as well as for rivers from permeable regions (Traun, upper Elbe in Bohemia). It is correct for rivers coming from woodlands (upper March) and for rivers coming from steppes (lower March); the quantity of run-off seems thus to be independent of the soil and of the covering of a land with vegetation. This is contrary to the ruling opinions, and the quantity of river-water of a certain region seems only to be dependent on its climate, and especially on its rainfall.

This rule has been established only for a very limited part of the land surface. Our knowledge of the quantity of water running in the rivers is restricted to the smaller rivers in Central Europe and North America and to the Mississippi. The huge volume of water in the St. Lawrence has, so far as I know, never been exactly measured. We know nothing about the water masses in the Amazons and Congo. It would be very desirable if geographical investigations were extended in this direction, and if river-gaugings were made at the mouths of the larger watercourses. This will not only be of scientific interest. The bulk of water in a river multiplied by its fall-height gives a measure of its energy. The more electricity will be used, the more the watercourses will gain value as motive powers, and every measurement of their volume will help to determine a force of nature.

The fact that the quantity of river-water changes with the climate is very well known. Prof. Woeikof has worked out a valuable classification of the rivers based on the dependence of their high water on rainfall and the melting of the snow. This classification is mainly based on facts taken from European and Asiatic rivers, and it would be very desirable if data on the annual rise and fall of the rivers of other continents would be gathered. Prof. Brückner has shown how the mean annual height of rivers changes in a cycle of thirty-five years. Indeed, the height of a river may be taken as corresponding to its volume, but it is also influenced by the condition of its bed. Climatic changes will be shown more clearly by the

variations of the quantity of water than by variation of the heights of a river. Not all rivers are constantly flowing; a great many of them dry up in dry seasons or dry years. It is very hard to separate those two types on maps, in order to gain true conceptions of the water-supply of different countries. Those rivers which are covered with ice during the winter, as all great rivers of higher latitudes are, deserve special interest. Mr. Rykatscheff has arrived at important conclusions as to climatology based on the time of the closing of rivers by ice, and it needs no words to say how great are the practical advantages of an exact knowledge of the length of time during which our great waterways are ice-bound. Dr. Forster has shown, in his discussion on river-temperatures, how one can get a forecast of ice-formation by an observation of the river-temperatures, and he thus proved the necessity of measuring the river-temperatures, which, as we have already seen, play an important part in the movement of the water. Numerous rivers lose their water in limestone districts showing Karst phenomena. They have for several years attracted interest, especially in Austria. Other rivers lose their water in their own gravels, and the number of such blind-ending rivers is rather great.

Dealing with the action of water on its bed, potamology comes in close contact with geology and geomorphology. It is now a nearly generally accepted theory that valleys have been dug out by rivers, and may be regarded as widened river-courses. Prof. W. M. Davis has worked out the general system of evolution of river-basins, but the action of rivers on their beds cannot yet be traced out in all directions. There seems to be a correlation between the quantity of water, the width and depth of a river, but which is the normal relation between the two quantities is not determined, and there has been established no delimitation between deep and shallow rivers, the former deepening their courses, the latter shifting from side to side. The conditions under which the river begins to wind, forming meanders, are not cleared up. Even the way it pushes its detritus forward is not sufficiently known. Very flat mountain rivers permit us sometimes to recognize how small stones are transported. They are rolled and pushed forward considerably slower than the water itself runs; with increasing velocity, the whole bottom of such a river begins to move, and this is also the case with larger rivers. When they are in flood, then all the bottom gravel is moving; whilst in general every pebble goes separately on its way from one gravel bank to the next. Thus the gravel banks move downward. The changes of the river-bed produced in this way can only be stated by comparing exact maps of the river bottom made at different times. Maps of the rivers, in a very large scale, with indications of the depth, are as necessary as bathymetrical maps of lakes. The maps of some river-mouths made for nautical purposes, and the excellent maps of the rivers of Holland made by the Water-statt, may be regarded as very good examples. It must be hoped that they will be imitated elsewhere. The fine river descriptions which have been published in Germany show in general a want of maps of the river-beds.

No less attention than to the bottom material of the rivers must be attached to the suspended material they contain. It is the waste of land carried into the sea. It affords the means, as Dr. J. Croll and Sir Archibald Geikie have shown, for determining the duration of geological time, and considerable scientific interest must therefore be attached to its evaluation. The river Nile shows how great the practical value of river mud is; Egypt owes its existence to the regular inundations and refreshing of the soil by the Nile. Careful determinations of the quantities of river mud have been undertaken here and there merely for economical purposes. Finally, the materials dissolved in the river water require attention and examination. Rivers coming from old gneissic and granitic rocks have everywhere a dark colour, owing to dissolved humic alkaline salts. These are the black rivers

whose colours contrast sharply with those of the milky or white rivers full of suspended material.

The distribution of running water on the Earth's surface has been the chief object of mere geographical research. The river courses have been mapped; their basins are clearly shown on our maps. The general state of the cartography of a land represents, in general, the state of our knowledge of the distribution, length, and width of its rivers. Each evaluation of these quantities can be made on the special maps of most of the states of Europe and North America, but it must be said that many of the data given us in our handbooks are not sufficiently accurate. They are often of very old dates, and differ very much from one another. It is very necessary, therefore, to determine them anew. Attempts in this direction show the cause of many of the discrepancies. The lengths of many rivers and the areas of their basins depend very much upon the assumption that is made on the site of their mouth. Take, for example, the St. Lawrence river. If you assume the mouth at Quebec, or at Grosse Isle where the waters become marine, you will get different values of its length and catchment basin. It will be necessary, therefore, for exact data, to indicate the point which is taken as the river's mouth. As to the river-lengths, it must also not be forgotten that their measurement gives very different results on maps of different scales; and as to river-basins, every one who has tried to follow their boundary in nature knows very well how difficult it is to trace them. Sharp watersheds are very rare. In general they are very indistinct, and areas of considerable extent near the water-parting have subterranean drainage. The exact determination of the lengths and areas of the basins of the rivers, even of well-mapped countries, seems to be, therefore, a pure geographical task of potamology which, to a great extent, remains still to be done. As to the other rivers, it must be borne in mind that every new exploration will influence our knowledge of their length and catchment basin, and that we, therefore, can only gain approximate values for them. Many of the Asiatic, African, and Australian rivers, being more or less temporary, will vary with climatic changes, and their lengths and basins evaluated in wet periods will be far greater than in dry periods. For those rivers it will be of value to give upper and lower limits for the above-named quantities.

Considering rivers as a scene of life, potamology comes into an intimate connection with biology; the river water has its inhabitants, which are confined to it. Every river-basin is in this way a distinct zoogeographical or phytogeographical province. By establishing the relations of fauna and flora of different rivers, geographical changes on the Earth's surface may be detected; *e.g.* by the affinities between the fishes of the Danube and the Caspian sea, it can be shown that the Black sea between them is of comparatively recent origin. Rivers are also the most common agents of geographical distribution. They carry with them the seeds of the plants of their borders and their basins, on natural rafts they transport land animals, and thus in a wider sense river-basins become geographical provinces; while the rivers are for their own inhabitants the means of voluntary migrations, of involuntary for the non-human inhabitants of their shores. Their function for man varies with his evolution. In times of a very primitive culture, they may cause involuntary migrations, carrying the savage along on a floating tree. They may check those great migrations of peoples which are confined to the land, and they become ways of communication between different lands and nations, when man has attained such a degree of civilization that he masters the forces of nature.

In this state of civilization men attach special attention to rivers, in order to make use of them or to prevent the damage they do. Thus in the last few years, several States created hydrographic departments with the special purpose of practical investigations on rivers. The Dominion of Canada and the United States have

their hydrographic bureaus for the study of irrigation; Germany, Austria, and Hungary have their hydrographic bureaus for studying river-floods. But if much is already done as to investigation for practical purposes, more still remains to do in order to develop potamology to a well-founded branch of physical geography.

THE TOPOGRAPHICAL WORK OF THE GEOLOGICAL SURVEY OF CANADA.*

By J. BURR TYRRELL, M.A., B.Sc., F.G.S.

Most of the difficulties encountered in making a geological survey of Canada have arisen from the want of good topographical maps. In the absence of an ordnance or similar survey, the Geological Survey, as the only organization charged with the mapping of the Dominion as a whole, has had to undertake, concurrently with the geological work, extensive topographical surveys from its very inception to the present time. The surveys in Canada that are available for topographical maps are, in general, Dominion Lands and Crown Lands surveys. The former is based on an accurate system, but applies only to Manitoba, the North-West Territories, and a narrow belt along the Canadian Pacific railway in British Columbia; and its operations have, thus far, been confined to a portion of the railway belt, and to the country south of the North Saskatchewan and lying between the Rocky mountains on the west and the boundary between Ontario and Manitoba on the east.

The Crown Lands Departments of Ontario and Quebec have made cadastral surveys in the southern portions of their respective provinces from time to time, to meet the requirements of advancing settlements. As these townships are surveyed independently, and sometimes not very correctly, extensive surveys have to be made to check and correct them, and to add roads, railways, etc., that have been constructed since they were surveyed. The other provinces have made no surveys available for mapping purposes except in isolated areas.

Again, the Geological Survey, as the pioneer preceding the lumberman, the miner, and the settler, has frequently to make explorations and surveys in districts that are subsequently cadastrally surveyed by the Dominion Lands or Crown Lands. The maps issued by the survey may conveniently be divided into—

(1) Preliminary maps on scales varying from 8 to 25 miles to 1 inch. These are usually the results of reconnaissance and exploratory surveys in the great areas of Northern Canada.

(2) Detailed maps on scales of 1, 4, and 8 miles to 1 inch. These maps are published in sheets of standard size and on standard scales, and their publication must obviously proceed more slowly than those of the first class.

As the topographical work of the survey is for mapping purposes only, it is necessary to strive after no greater accuracy and no greater detail than is required for the scale of the map in view. The methods of survey used are therefore of an elastic nature, varying with varying circumstances, and are usually a combination of two or more of the following:—

- (1) Transit or compass and chain surveys or triangulation.
- (2) Micrometer or, if on roads, odometer surveys.
- (3) Paced surveys.

* Paper read before Section E (Geography) at the Toronto meeting of the British Association, August, 1897.

The author of the paper on the "Topographical Work of the Geological Survey of Canada," is not J. Burr Tyrrell, but James White, Chief Draughtsman of the Survey.

(4) Track or time surveys checked by sextant latitudes, and sometimes by longitude observations.

The order of description is by provinces, commencing with Quebec and Ontario, the two provinces of Canada till confederation in 1867, and then the others in succession from east to west. While the work on the standard sheets is not less important, and does not require less ability or diligence on the part of those engaged in it than the exploratory surveys of the north and west, yet, as a description would be largely a recital of the number of miles of roads, lakes, and streams surveyed in each year, it has been abbreviated, and the sheets in each province dealt with *en bloc*.

QUEBEC.—In 1844 and 1845 Messrs. Logan and Murray made a triangulation of the peaks in the hills that form the watershed of Gaspé peninsula. They also made micrometer surveys of portions of the Chatte, Great Cascapedia, Bonaventure, Matane, St. Anne, and St. John's rivers, in all 299 miles. In 1857 and 1858 the work in this district was continued by Mr. Richardson, who surveyed the Magdalen, Restigouche, Patapedia, and Great Metis rivers, and several tributary streams and lakes, in all about 200 miles. In 1862 Mr. Bell surveyed portions of the Dartmouth, York, Malbaie, and Grand rivers, for an aggregate distance of 106 miles. In addition, about 100 miles of traverse-lines were measured with the micrometer. In 1858 Sir W. E. Logan surveyed the upper part of the River Rouge and thirty-two tributary lakes. Dr. Ellis in 1881 to 1883, and Mr. Low in 1882 and 1883, completed the information required for the mapping of Gaspé peninsula, 15,100 square miles, on the 4-mile scale. Dr. Ellis made a chained survey of the shore-line road from Little Pabos, on the bay of Chaleurs, to Grand Metis, on the St. Lawrence, and micrometer surveys of the Salmon branch of the Cascapedia, Grand Pabos, and upper portion of the Bonaventure. Other roads and the coast-line were measured by pacing; Mr. Low triangulated the peaks in the Shickshock mountains, and made micrometed traverses of the south branch of the Ste Anne, Little Cascapedia, and west branch of the Magdalen rivers.

In 1858 Sir W. E. Logan surveyed the upper portion of the river Rouge and thirty-two tributary lakes in the Grenville district. These surveys, with the subsequent measurements, in the same district, by himself and Mr. J. Lowe, amount to about 2600 miles, and form the basis of the so-called Grenville map, covering an area of 1200 square miles.

The work on what is known as the "Eastern Townships" map-area was commenced by Sir W. E. Logan in 1848, and continued by himself, at varying intervals, up to 1871; by Mr. Richardson in 1850 to 1852, 1854, 1855, and 1863 to 1868; and by Mr. Webster from 1870 to 1876. The paced measurements of roads and exploration lines by Messrs. Logan, Richardson, and Webster amount to about 17,000 miles, and cover an area of 26,380 square miles. The publication of the three sheets thus far issued was delayed by the uncertainty as to the exact horizon of some of the members of the Quebec group, so called. The additional surveys, to bring them up to date, necessitated by this delay, were made by Messrs. Ellis in 1886 to 1890; Garoux in 1886 to 1894; Adams, 1886 and 1887; A. R. Low in 1889 and 1891; and McConnell and Ord in 1880; in all about 8600 miles.

In 1857 Lieut. Ashe determined, telegraphically, the longitude, as compared with Cambridge, of Quebec, Three Rivers, Montreal, Ottawa, Kingston, Toronto, Collingwood, Windsor, and Chicago. So uncertain were the longitudes at that time, that an important place like Chicago was placed by the two best authorities as in longitude $88^{\circ} 23'$ and $87^{\circ} 28'$ W. respectively, whereas Ashe's observations gave $87^{\circ} 37' 44''$, a difference of $9' 44''$ in one case, and of $45' 16''$ in the other. Signals were interchanged with Cambridge which had been determined by the interchange of several hundred chronometers with Greenwich.

In 1870 Mr. Richardson made a micrometer survey of the canoe-route from the upper portion of the Ashuapmouchouan river, by Nikobau River Lake, Abatagamaw and Chibougamoo lakes, to Lake Mistassini, and of the shore-line of the latter for 30 miles. His provisions failing to reach him, he was forced to abandon the survey of Mistassini and return to Lake Nikotau, where they were stored. From Nikobau he carried his traverse by the Foam-fall and Clearwater rivers to the St. Maurice, which had been surveyed previously by the Crown Lands Department. From Kirkendach, on the St. Maurice, a survey was made of the route by the Hair-cutting river and south-east branch of the Gatineau, and the Gatineau to the Desert. Of the surveys thus made, 274 miles were measured with the micrometer, and 300 miles were track survey.

In 1871 Mr. McQuat carried a micrometer-traverse in a north-westerly direction for 90 miles from the Mistassini river to the lake of the same name, and thence along the lake-shore to the end of Mr. Richardson's survey of the previous year. He also surveyed 150 miles of the coast-line of the lake to a point on the main north-west shore, about 70 miles from the extreme south-west point.

In 1885 Mr. A. P. Low commenced at the terminal point of Mr. McQuat's survey, carried his traverse up the west side to the north end, and down the east side to Big Narrows, where he connected with McQuat's survey 139 miles. He found the average length of the lake to be about 100 miles, and average width 12 miles. From the outlet of the lake he made a track survey of the Rupert river to Hudson bay, 300 miles.

In 1891 to 1894 Dr. Ellis made about 3200 miles of odometer and 400 miles of paced surveys in the Grenville and Pembroke map-areas, 6900 square miles.

LABRADOR PENINSULA.—In 1887 Mr. A. P. Low surveyed Agumaska, Weston, and other islands, in James bay. In the following year he made a track-survey of Big river from its mouth upwards for 160 miles, of the canoe-route by the headwaters of Bishop Roggan river to the south branch of Great Whale river, and of the latter to the main stream, and thence to Hudson bay, 350 miles. He also made a micrometer survey of the route from Richmond gulf to Clearwater lake, 63 miles. In 1892 Mr. Low made a micrometer traverse from Lake Mistassini by the Rupert, Kawashagami, and East Main rivers to Hudson bay, 326 miles, and of the East Main between the Kawashagami and Ohegami branches. In 1893 and 1894 Mr. Low, with Mr. Eaton as topographical assistant, continued his explorations in the Labrador peninsula. The micrometer traverse was continued from the mouth of the Tshegami branch, where it connected with the surveys of the previous year, up the East Main river, 104 miles, to where the route to Nichieun leaves the main stream. From this point a track survey, checked by sextant latitudes, was made of the route by way of the headwaters of Big river, Nichieun, and Kaniapeskan lakes, and the Kokoak river to Fort Chimo, upwards of 600 miles. In February, 1894, having wintered at North-west River Post, a micrometer survey was carried from the post up the Hamilton river to Sand-girt lake, thence up the Attikonak branch to the Height of Land, down the Romaine river for 115 miles, thence by portage-route to the St. John river, 702 miles. From this point a track survey was made to the mouth, 72 miles. From Sand-girt lake micrometer surveys were made of the Ashuanipi river, Petitsikapow, and other lakes, 293 miles, and track surveys of the canoe-route to Lake Michikamau, and of the lake itself, 269 miles. Total in the two years, 1100 miles of micrometer, and 940 miles track surveys. In 1895 Messrs. Low and Eaton made a micrometer traverse from the head of Lake Mouchalagan by way of the headwaters of the Manicugan and Outardes rivers to the Height of Land, and thence by a chain of lakes to Naokokan lake, on Big river. In 1896 Mr. Low continued his micrometer survey of 1888 from the outlet of

Clearwater lake, surveying Clearwater and Lower Seal lakes, and Laro and Kokoak rivers, to Mugava bay.

In 1887 Mr. Cochrane made a track survey of Twenty-mile bay of Grand lake, of a chain of lakes and streams to Shabogama lake, and of the Mekiakan river to Red Flower-hill portage.

In 1895 Dr. Bell made a micrometer survey of the Mekiakan from the end of Mr. Cochrane's survey to Mattagami lake, of Mattagami lake and Nottaway river, and of the shore-line of Rupert bay to Rupert House. A track-survey was made of Waswanipi lake and river between the Hudson's bay post and Lake Mattagami. In 1896 Dr. Bell, with Mr. Brock as assistant, made track surveys of the Mekiakan river between Shabogama lake and where the route to Waswanipi leaves it, and of the lower portions of its principal branches; of the route from Waswanipi post to Lake Nemiskan on the Rupert river, and of the route by way of Waswanipi river from the post of the same name to Wakanichi lake, where it connected with Mr. Richardson's traverse of 1870.

NEW BRUNSWICK.—The topographical work in New Brunswick, commenced by Mr. Robb in 1868 and 1869, was continued by Dr. Eells in 1873-78, and by Mr. Broad in 1878-82 in the southern portion of the province. The north-eastern portion was surveyed by Dr. Eells and his assistants in 1879, 1880, and 1881, and the north-western and adjoining portions of Quebec by Mr. McInnes in 1884-89. It is difficult to give an estimate of the distances measured, but Dr. Eells in 1877 to 1880 surveyed 2950 miles with chain odometer and pacing, an average of nearly 750 miles a year. These surveys, with the topographical information available from other sources, furnished the material for mapping the province—27,200 square miles on a scale of 4 miles to 1 inch.

NOVA SCOTIA.—Sir W. E. Logan in 1868, and Mr. Hartley in 1868 and 1869, made a survey of the Picton coalfield; in the Springhill coalfield, Mr. S. Barlow in 1871 to 1877, and Mr. McOuat in 1873 and 1874, made chained surveys aggregating over 1300 miles. The survey of the island of Cape Breton, commenced in 1872 by Mr. Robb, and continued by Mr. Fletcher after the death of the former in 1874, was completed in 1882. Since 1882 Messrs. Fletcher and Fairbault have extended these surveys westward on the mainland to Windsor on the Bay of Fundy and Halifax on the Atlantic coast. Thus, with the island of Cape Breton, 13,180 square miles have been surveyed in detail for mapping on a scale of 1 mile to 1 inch. Messrs. Fletcher and Fairbault estimate the measurements made by themselves and their assistants at 34,600 miles. In 1881 Mr. W. B. Dawson made a topographical survey of the Laurencetown, Montagu and Waverly goldfields, the coast being borne in equal proportions by the Survey and Provincial Government. In 1884 Messrs. Eells, A. E. Barlow, and Giroux made chain, micrometer, and paced surveys aggregating 1003 miles, to complete for publication the Cumberland coalfield map, begun by Mr. S. Barlow some years previous.

ONTARIO.—In 1845 Sir W. E. Logan made a micrometer survey of the Ottawa river from the Joachim rapids to the head of Lake Temiscaming, and of the Mattawa river from its mouth to the Lake Nipissing portage, in all 280 miles. The work in this district was continued in 1847 and 1853-56 by Mr. Murray. During these years he surveyed Lake Nipissing, the French, Sturgeon, Wahnapiat, Spanish, Maganetawan, Muskoka, Petawawa, Bonnechere, and York rivers and numerous tributary streams and lakes. In 1857 and 1858 he surveyed the Thessalon, Missisanga, Goulais and numerous other streams and lakes between Blind river and Lake Superior. Mr. Murray's surveys in 1847 and 1853-58 amount in the aggregate to 2780 miles measured with the micrometer, besides between 300 and 400 miles by pacing. In 1846 Mr. Murray surveyed the Koministiguia for 40 miles; and in

1852 a number of lakes and streams between Kingston and Balsam lake, 400 miles. In 1869, 1870, and 1871 Dr. Bell surveyed Nipigon and Long lakes, White, Black, Nic, English (East) and Kenogami rivers, the canoe-route from Lake Nipigon by way of Ombabika and Albany rivers to the confluence of the latter with the Kenogami, and numerous lakes and streams between the Nipigon and the Pictou, 1865 miles of micrometer, 181 miles of paced, and 367 miles of track surveys.

In 1872 Messrs. Selwyn and Bell made a joint track survey of the canoe-route from Hawk lake by the English river (west) to Separation lake, where they separated, Dr. Selwyn continuing the survey down the English and Winnipeg rivers to Lake Winnipeg, 461 miles from Hawk lake; and Dr. Bell by Sandy portage and the Winnipeg river to Rat portage, 29 miles from Separation lake. In 1872 Mr. McOuat made a micrometer survey of Lake Abitibi and of the river of the same name to the first fall. In 1877 Mr. Cochrane surveyed the river from the end of Mr. McOuat's survey to its confluence with Morse river.

Dr. Bell, in 1875, surveyed the upper portion of the Montreal (west), the Mattagami, Missinaibi, Michipreston, and lower portion of the Moose rivers; in 1885, Lakes Wabatongwashens, Oba, Esnagami, and other lakes and streams in the vicinity; and in 1885 Lake Seul, Lake Joseph, the Attawapishkat river from Lake Lansdowne to Hudson bay, the shore of Hudson bay between the mouths of the Attawapishkat and Albany, and the Albany, except the portion surveyed by himself in 1870. In 1887 Dr. Bell made a track survey of the canoe-route from the great bend of the Montreal (east) river to Raish-ko-chagami lake on the Frederick House river.

Messrs. Lawson and J. W. Tyrrell in 1883 and 1884, and Messrs. Lawson, A. E. Barlow, and Smith in 1885, made a detailed survey of the Lake of the Woods, Rainy lake, the Winnipeg river from Rat portage to the Dalles, and other lakes and streams in the vicinity, for publication on a scale of 2 miles to 1 inch. This work has been extended to the north and east over the Rainy lake, Hunter's island, Seine river, Shebandowan and Manitowish sheets, by Dr. Dawson in 1886 and 1887, Mr. Smith 1888 to 1891, and Mr. McInnes 1890 to the present time. These sheets are published on the 4-mile scale, and cover an area of 19,230 square miles. They are full of lakes and connecting streams, the water-routes thus formed being the only means of communication through the greater part of the district. Of the larger lakes, the Lake of the Woods has an area of 1770 square miles, Rainy lake 345 square miles, Lac des Mille Lacs 105 square miles.

Messrs. Bell and A. E. Barlow in 1888 to 1891, to complete the information for the Sudbury and French river sheets, made micrometer surveys of the upper portion of Spanish river, Pansch and Rogomasing lakes, and Veuve and Vermilion rivers, the shores and islands of Bay of Islands, and McGregor bay and peninsula. In 1892 Dr. Bell surveyed Key, Henvey, and Byng inlets. Mr. Barlow in 1887 made a micrometer survey of Lake Temagami, and in 1892 and 1893, with Mr. Johnston as assistant, surveyed the western portion of Lake Nipissing, Abashing and Keepawa lakes, canoe-route from Temagami to the mouth of Temagami river, and made paced surveys of the roads in the Nipissing and Temiscaming sheets—in all 1080 miles of micrometer, 170 miles of paced, and 45 miles of boat-log surveys.

In 1895 and 1896 surveys of roads, amounting in the aggregate to about 5100 miles, were made by Dr. Ellis, Mr. Grioux, and Messrs. Adams and Barlow in the Pembroke, Cornwall, and Haliburton map-areas respectively. In the same years the writer made a traverse with transit and chain across the province from Georgian bay to Kingstown. In 1893 Mr. Dowling made log surveys of Red Trout and Gull-rock lakes, and track surveys of the connecting streams, of the Mattawa, and upper portion of Berens river.

MANITOBA AND NORTH-WEST TERRITORIES.—In 1873 Dr. Selwyn made a track survey of the Saskatchewan river from Rocky Mountain House on the North Branch to Cumberland House, 798 miles. In 1878 and 1879 Dr. Bell made track surveys of the shore of Lake Winnipeg between Dog Head and Drunken river; of the Nelson, Hayes, and Grass rivers; of the canoe-route from Split lake on the Nelson to the Churchill and lower portion of the Churchill, in all 1710 miles. In 1879 Mr. Cochrane, Dr. Bell's assistant, surveyed Gode and Inland lakes, the eastern portion of Oxford lake, and the connecting streams, 585 miles. In 1880 and 1881 Mr. Cochrane made track surveys of—

(1) Canoe-route from Cross lake by Pine, Moose, and Saskatchewan rivers to Cumberland House, 242 miles.

(2) Canoe-route by Grassberry river to Thog portage, thence by Churchill and Deer rivers to Reindeer lake, and Reindeer lake, 763 miles.

(3) Route by Cochrane river, Hatchet lake, and Black river to Lake Athabasca, and north shore of the lake, 625 miles.

(4) Athabasca river from the mouth to its confluence with the Clearwater, thence by the Clearwater and Churchill rivers to Thog portage, 760 miles.

(5) Route from Pelican lake to Cumberland House.

Total measurements, 2390 miles.

In 1881 and 1882 Dr. Dawson, with Mr. McConnell as assistant, made 2315 miles of odometer, and 110 miles of paced and track surveys in the country between Medicine Hat and the Rocky mountains on the east and west, and the 49th parallel and the Red Deer river on the north and south respectively. Dr. Dawson, with Mr. Tyrrell as assistant in 1883, and with the writer as assistant in 1884, made a reconnaissance survey of that portion of the Rocky mountains lying between the parallel of 49° and $51^{\circ} 30'$. These surveys were continued northward to the North Saskatchewan by Messrs. McConnell and the writer in 1885, and by Messrs. McConnell and Russell in 1892.

In 1883 and 1884 Mr. McConnell, with Mr. Dowling as assistant in the latter year, made 1800 miles of odometer surveys of trails and exploration lines, and 250 miles of river traverse in the country between Medicine Hat and the eastern end of the Cypress hills on west and east and the 49th and 51st parallels. Mr. Tyrrell in 1885, and Messrs. Tyrrell and Dowling in 1886, made similar surveys and explorations in that portion of Alberta and the adjoining districts, lying between 110° W. and 115° W. and $51^{\circ} 30'$ N. and 54° N.

The above-mentioned surveys of Messrs. Dawson, McConnell, and Tyrrell have been published, on the scale of 8 miles to 1 inch, in the Bow and Balby, Cypress hills, and Northern Alberta maps, and cover an area of 100,000 square miles.

In 1882 Mr. Cochrane made track surveys of Berene, Big Black, and Poplar rivers, and of the headwaters of Severn and Pigeon rivers, 287 miles. In 1886 Mr. A. P. Low made a micrometer traverse from Lake Winnipeg to Hudson bay by way of the Buens river to Family lake, thence by the headwaters of Poplar river and the middle branch of the Severn to Severn lake, thence by the Fawn and Severn rivers to Fort Severn, 882 miles.

In 1887 to 1891 Messrs. Tyrrell and Dowling surveyed, with micrometer or boat-log, Winnipegosis, Dauphin, Red Deer, Waterhen, and other lakes and portions of Lake Winnipeg; also made track surveys of the Bad-throat and other rivers to the east of Lake Winnipeg, and odometer surveys of trails and exploration lines in North-Western Manitoba. In 1895 and 1896 Mr. Tyrrell continued the work in this district, and surveyed the Gunisso, Black, Pigeon, Blood, Pine, and Wolf rivers, the Playgreen lakes, the canoe-routes from Sipi-weak lake to Nelson House, and from Paint lake to Sturgeon river.

In 1887 Mr. McConnell surveyed the Liard river, from the mouth of the Dease to the Mackenzie, and the lower portion of Hay river. In the winter of 1887-88 track surveys were made from Fort Providence northward to Fort Rae, and southward to Lake Bischo. In 1888, as Mr. Ogilvie had been instructed to make a micrometer survey of the Mackenzie river and Peel river portage, a sketch traverse of the river and mountain features only was made of this portion of the route. A detailed running survey was made of the Porcupine river from the mouth of Bell's river to the Yukon. In 1889 and 1890 Mr. McConnell made track surveys of the route between the Peace and Athabasca rivers by the Pelican, Loon, and Wabiakaw rivers, 400 miles; of the Red river from its mouth upward for 200 miles; of the trials to the Buffalo-head hills and Trout lakes, and of the tributaries of the Athabasca below Fort McMurray. In 1892 Messrs. Tyrrell and Dowling made traverses of the Beaver, Mudjatick, Cree, Black, Geikie, and Whitefish rivers, of Black and Reindeer lakes, and of the south shores of Athabasca and Wollaston lakes. Distances were estimated, except on lakes and quiet reaches, which were surveyed with boat-log. They also made micrometer surveys of Black and Deer rivers, and of the Churchill between the mouth of Deer river and Frog portage.

In 1893 and 1894 Mr. J. B. Tyrrell made exploratory surveys in the "Barren Lands." In 1893, with Mr. J. W. Tyrrell as topographer, he made a traverse from Lake Athabasca to Hudson Bay. A survey of the north shore of Lake Athabasca from Chipewyan to Fond du Lac was made with boat-log and solar compass. From Black lake the survey was carried by the Chipman and Dubaunt rivers to the head of Chesterfield inlet, 905 miles. Of this distance 290 miles were on rivers, where the distances were estimated, and 615 miles were through lakes, where the distances were measured with a boat-log, and bearings taken with solar or prismatic compass. As the tides prevented the use of the log with any degree of accuracy, the traverse of Chesterfield inlet and west coast of Hudson bay to lat. $61^{\circ} 32'$, where the severity of the weather compelled the abandonment of the survey, was a time survey. A similar survey was made of the 200 miles between Fort Churchill and York.

In 1894 Mr. J. B. Tyrrell carried another traverse from Du Brochet post on Reindeer lake by the Cochrane, Thlewizaa, and Kagan rivers to lat. $63^{\circ} 7'$, thence eastward by chain of lakes and the Ferguson river to Hudson bay, 815 miles. From the point at which he abandoned his survey the previous year, he continued it southward to Churchill. A time survey was made of the route between Churchill and Gull lake. Total distance surveyed in 1893 and 1894, 2900 miles, of which 1073 miles were log, 1312 track in canoes, and 515 part track survey on foot and part pacing. The distances thus obtained were checked by numerous observations for latitude.

BRITISH COLUMBIA.—In 1871 Mr. Richardson made paced surveys of roads in the country between Yale and Quesnel, aggregating 428 miles. From 1872 to 1874 he was surveying stream trails and exploration lines in the Comox and Nanaimo coalfield. In 1875 Dr. Selwyn made a time survey of the trail from Quesnel to McLeod's lake, of the canoe-route from McLeod's lake by the Pack, Parsnip, and Peace rivers to Smoky river forks, and of Pine river from the "forks" to its mouth. During 1875 and 1876 Dr. Dawson surveyed trails, lakes, and streams in the country between the Fraser river and the coast range on the east and west, and Bella Coola valley and Francois lake on the south and north respectively. In 1878 Dr. Dawson surveyed the islands, channels, and inlets of the north and east coasts of the Queen Charlotte islands. In 1879 Dr. Dawson made a traverse from the Skeena river to Edmonton. From Hazelton the survey was carried by the trail from Hazelton to McLeod's lake, thence by the valley of the Parsnip and the Pine

river pass to the "lower forks" of Pine river, thence across country to Dunvegan. From this point side traverses were made through Grande Prairie and southward to Smoky river, and of the lower portions of the Wapiti and Smoky rivers. From Dunvegan an exploratory traverse was made to the Athabasca river, near the mouth of Marshhead creek; from this point the survey was carried down the Athabasca, with a side traverse of Lesser Slave lake and river, to Athabasca landing, and thence by trail to Edmonton. The trail from Smoky river "forks" to old Fort Assineboine was surveyed by Dr. Dawson's assistant, Mr. McConnell. In 1885 and 1886 Mr. Bowman triangulated the peaks in the Cariboo district, and measured 255 miles of roads and trails.

In 1887 Dr. Dawson, with Messrs. McConnell and McEvoy as assistants, made an exploratory survey of the region of the headwaters of the Yukon, Liard, and Stikine rivers. Mr. McConnell made a micrometer survey of the Stikine from the end of Hunter's survey to Telegraph creek. A carefully paced traverse was made from Telegraph creek to Dease lake by Mr. McEvoy. From Dease lake Dr. Dawson made a detailed track survey, following the lines of the Dease, Upper Liard, and Pilby rivers to the confluence of the latter with the Lewes, about 900 miles. He also carried it up the Lewes to enable him to add the mountain features and make some additions to the lakes as surveyed by Mr. Ogilvie. Numerous points were fixed in latitude by sextant observations, and a number of chronometer longitudes were obtained. In 1877 Dr. Dawson made a general reconnaissance of the southern interior of British Columbia. In 1882, 1883, and 1884 Mr. Bowman, the importance of the district having been increased by the completion of the Canadian Pacific railway, extended the work of 1877.

The geological intricacies of the region, however, necessitated the doubling of the scale of the original map, and, consequently, the re-delineation of the topography. Of the four new sheets which now cover the old map-area, the north-west or Kamloops sheet was re-surveyed in 1888 to 1890 by Dr. Dawson and his topographical assistant, Mr. McEvoy. A loose network of triangles, based on the Canadian Pacific railway and other surveyed lines, was carried out between points, each of which was occupied as a transit station and sketch-point, elevations being determined barometrically and by angles of elevation. Other details of topography were filled in from paced and track surveys checked by latitude observations. The north-east or Shuswap Sheet was surveyed in the same way by Mr. McEvoy in 1891, 1892, 1894, and 1895. This, with the Kamloops sheet, forms a contoured map of 12,800 square miles of rugged mountainous country on a scale of 4 miles to 1 inch. The topographical work for a similar sheet to the south-east of the Shuswap has been in progress since 1894. This, the so-called West Kootanie sheet, is under the direction of Mr. McConnell, who has been assisted in 1894 and 1895 by Mr. Russell, and in 1896 and at the present time by Mr. McEvoy. The latter has completed for publication a detailed plan of Trail creek mining district on a scale of 1 mile to 1 inch.

In 1889 Dr. Dawson made surveys with boat-log of the Upper and Lower Arrow lakes and northern portion of Kootanie lake, and track surveys of the intermediate portions of the Columbia and Kootanie rivers between Revelstoke and Nelson. In 1893 Mr. McConnell, assisted by Mr. Russell, made a track survey of the Finlay river from its confluence with the Parsnip to Lake Thutade, 220 miles; of the Omineca river from its mouth to the Omineca-Stileka pass, 113 miles; and of the trail from Old Hogem to Tacta lake, 42 miles. In 1893 Mr. McEvoy surveyed 300 miles of the Nasse river and its tributaries, and made 230 miles of exploratory traverses on foot.

HISTORY AND LITERATURE OF THE KLONDIKE REGION.

THE literature of the upper Yukon, on a tributary of which the Klondike gold-fields are situated, is unfortunately still of a very meagre character. The adventurous agents of the Hudson's Bay Company, by whom the very existence of the great river within British territory was first made known hardly more than fifty years ago, appear to have been little given to writing accounts of their journeys, except in the form of reports to the Company, few of which have been made widely known. The actual discoverer of the upper Yukon was Mr. Robert Campbell, who, after exploring the region of the Liard river, pushed on to the Pelly, establishing on it the post known as Pelly Banks, and, at its confluence with the Lewis, that of Fort Salkirk (1840-52). The Porcupine, one of the principal tributaries of the Yukon, was also explored by him to its source. Little notice seems to have been taken by geographers of these discoveries, to which no allusion is made in the publications of the Royal Geographical Society. A brief account of Mr. Campbell's journeys is to be found in Begg's 'History of British Columbia' (p. 181). The identity of the new river with that of which the mouth had been discovered by the Russian Glazunov in 1833 was not at once suspected, many maps of the period showing it as the upper course of the Colville, which empties itself into the Arctic ocean. Although the treaty between Russia and Great Britain in 1825 (Hertslet, vol. iii. p. 362) had fixed the 141st meridian as the boundary between their respective territories, Fort Yukon, in about 145° W., was founded by the Hudson's Bay officials in 1846. This post was reached in 1860 by the American naturalist, Mr. Robert Kennicott, travelling under the auspices of the Smithsonian Institution for the purpose of making natural history collections; he had journeyed by way of the Mackenzie, Peel's river, and the Porcupine. No detailed account of this journey appears to have been published, and brief notices only are to be found in the 'Reports' of the Institution (see especially that for 1862, p. 39). Although devoting their chief attention to the lower river, several more recent American expeditions have explored the part of the stream within British territory, the most important being those of Schwatka (1883) and Everett (1884). In 1885 the former published an account of his journey under the title 'Along Alaska's Great River.' But the most important explorations in the region of the upper Yukon and its tributaries were those of Dr. G. M. Dawson, of the Canadian Geological Survey, and his associates, who in 1887-88 traversed the whole region, and for the first time executed accurate surveys of its natural features. The Geological Survey published the reports of Dr. Dawson (1888) and Mr. McConnell (1889), whilst an account of Mr. Ogilvie's surveys was published at Ottawa in 1890. The last-named has since continued his surveys, and his latest report was issued during the current year. Mr. Warburton Pike's book, 'Through the Sub-Arctic Forest,' published in 1896, gives the account of a canoe-voyage down the Pelly and Yukon rivers to the Bering sea; whilst the geological results of an expedition under Mr. E. J. Spurr, sent down the Yukon in 1896 by the United States Geological Survey Department, have lately been given in outline in a report to the United States Senate (*Journal*, vol. ix. p. 667). The recent rush to the gold-diggings has already begun to swell the literature of the region, in the form of magazine articles and larger works. Articles have appeared in the September numbers of the *Fortnightly* and *Contemporary Reviews* and the *Nautical Magazine*; and quite recently an account of two years' police-service on the Yukon, by M. H. E. Hayne and H. West Taylor, has been published under the title 'The Pioneers of the Klondyke' (Sampson Low). A small handbook entitled 'All about Klondyke,' edited by H. A. Belcher (Simpkin, Marshall),

may also be mentioned. For the general geography of the region, Reclus's *Géographie Universelle* (vol. xv.), and the lately issued volume of the new edition of Stanford's 'Compendium,' by Dr. S. E. Dawson, may be consulted. A good general map of the region, including the results of the latest surveys, seems still a desideratum, though it may be hoped that such may soon be published by the Canadian Survey Department. Sketch-maps are given in most of the books and papers above mentioned, and in particular Mr. McConnell's report is accompanied by a large scale-map in nine sheets. A general map of the north-west parts of the British territory on a large scale was also issued by the Canadian Ministry of the Interior in 1888, and this shows clearly the results of the surveys of Dr. Dawson's party. As one of the routes to the goldfields is by the lower Yukon, it may be of use to refer briefly to the literature dealing with that section of the river, which is far more voluminous. Mr. F. Whympers's 'Travel and Adventure in the Territory of Alaska' (1868) describes the journeys made by him as a member of the American Expedition in connection with the proposed Asiatic-American Telegraph. Mr. Dall, in his book 'Alaska and its Resources' (1870), gives both the results of his own travels and a summary of our knowledge of the country at that time. Mr. H. W. Elliott's work, 'An Arctic Province' (1886), has also a chapter on the Yukon region, the history of which is treated of in Bancroft's 'History of Alaska' (1886). With regard to the region of the passes leading to the upper Yukon, Mr. Seton Karr's paper published in the *R. G. S. Proceedings* (vol. xiii.), and Dr. Aurel Krause's work, 'Die Tlinkit-Indianer' (Jena, 1885), may be mentioned. Finally, it may be of interest to note that prospecting for gold was carried on by the Russians in the southern parts of the region during their occupancy of Alaska (cf. E. man's *Archiv für Wissenschaftliche Kunde von Russland*, vol. xxv. (1867), p. 229).

THE MONTHLY RECORD.

EUROPE.

Oceanographical Researches in Loch Fyne.—The results of Dr. Mill's further investigations on the circulation of the water in Loch Fyne have recently been published.* The observations were carried out on board the Fishery Board's cruiser *Garland*, on two occasions, the first from April 2 to 6, and the second from September 3 to 11, 1896. The results of his earlier observations, undertaken between 1886 and 1889, are fully discussed in his paper on the 'Clyde Sea Area,' published by the Royal Society of Edinburgh (see also the *Geographical Journal* for October, 1894, pp. 344-349). The general results of the work on Loch Fyne in 1896 are summarized as follows: The flood-tide brings in water from the upper and deeper layers of the Arran basin, which is thoroughly mixed in passing Otter spit before high water, and fills the Gortans basin with a nearly homothermic mass, which is passed on through Minard Narrows into the Upper basin, where it does not sink through the cold deep water in summer, but only mixes with the upper layers above 20 fathoms, becoming more superficial in its effects as the tide passes upwards. In the ebb there is, at the upper end of the loch, only a superficial movement, but at the platform between Furnace and Minard the rush of the surface current into the Gortans basin, while it is strongest at half-ebb, draws up the deep cold layers to a slight extent, causing a slight mixture with the warmer water. The homothermic mass pours out into the Arran basin, acting on the ebb probably in the same way

* Part III., 'Fifteenth Annual Report of the Fishery Board for Scotland,' pp. 262-273.

as at Furnace on the flood. Thus there is always in progress a gentle mingling of the deep waters of the two deep basins through the intermediate shallow basin. The rapid surface current of the ebb carries out the excess of fresh water from the Arran basin, while the small underflow from the Arran basin passes in water of higher salinity with the flood. This circulation is liable to be accelerated or checked by the influence of wind.

The Development of the Peninsula of the Apennines.—In notes on this subject which Dr. Th. Fischer contributes to the August and September numbers of *Petermanns Mittheilungen*, he points out, among other things, that, while north of Campania transverse breaches in the mountains of the peninsula do not occur on a great scale, and scarcely affect the regions of the Apennines at all, south of that province they form a very marked feature. Straits, closed only in geologically recent times, connected the Campanian gulf with the Adriatic, and the Tyrrhenian sea with the Ionian, both at the isthmus of Catanzaro, and further south at the constriction immediately to the north of Aspromonte, while a marginal breach isolated the heights of Poro on the west, and a longitudinal channel severed Gargano and the Apulian tablelands from the Apennines; so that there existed here, probably in middle Pliocene times, six islands in place of the continuous stretch of land reaching to the straits of Messina. Extending his view to neighbouring countries, Dr. Fischer confirms, from his own observations, the accuracy of the view of Suess, that the Apennines are continued in the folded mountains on the north margin of "Little" Africa, and he describes the north-west basin of the Mediterranean as bordered on the east and south by a series of folded mountains stretching from Genoa, through Sicily, along North Africa to Melilla, and then back to Gibraltar and the south coast of Andalusia, on the inner side of which there is a vast area of sunken land, which he calls the Tyrrhenis, characterized almost everywhere on the marginal faults adjacent to the mountains by volcanic activity, and still represented by fragments rising above the surface of the water. Speaking of the terraces of Calabria and Sicily, he states that recent investigations have clearly established the fact that, at least in Calabria, a prolonged elevation, interrupted by periods of repose, and hence indicated by the formation of terraces, has taken place in quaternary time. This elevation apparently increased in intensity towards the straits, towards which part the elevation that may almost everywhere be shown to have taken place in Sicily also seems to have reached its greatest amount. From the south-west angle of the Sila to the straits, Cortese has demonstrated the existence of five terraces, all characteristic shore formations, increasing in height towards the south. In a special note on Gargano and Apulia, Dr. Fischer points out that recent geological observations tend to establish the intimate relationship of these tracts to the Apennines, notwithstanding the existence of the Pliocene channel above referred to. The hippuritic limestones of Gargano are exactly similar to those of the Apennines; and in the Neapolitan Apennines numerous more or less tabular masses of limestone, not unlike the tablelands of Apulia and Gargano, have been discovered. The result of the investigations hitherto made would seem to be that Gargano and Apulia are portions of the pre-Miocene Apennines less affected than the central parts of the system by the folds accompanying the elevation of those mountains, afterwards separated from the central mass by a series of faults, and behaving as a rigid mass during the last decisive post-Eocene movements of the Apennine system. Dr. Fischer makes light of the phytogeographical evidence in favour of a supposed recent land-connection bringing these parts of Italy into closer relation with the opposite coasts of the Balkan peninsula than with the Apennine peninsula. Some of the plants common to the Dalmatian coast and Gargano, but not met with in the rest

of Italy, might, he thinks, have been introduced by winds and currents; and as for the Valonia oak (*Quercus ægilops*), which occurs here and there in Apulia, but nowhere else in Italy, that might have been planted by man on account of its valuable acorn-cups.

The Rainfall of Western Europe.—In the first part of the newly issued volume of the *Annales du Bureau central Météorologique de France* (Année, 1895; Paris, 1897), Dr. Alfred Angot publishes a paper on this subject, which supplements that on the rainfall of the Iberian peninsula, which appeared in 1895. In both Dr. Angot calculated the mean annual and monthly rainfall for the thirty years 1861–90, and reduced the returns from stations which were not active during the whole period to the thirty years' means, by means of interpolations. In this way comparable results have been obtained, a matter of great importance in the case of rainfall which varies greatly from year to year, and we may regard this paper as the most important contribution to the climatology of Central, Western, and Southern Europe that has appeared since Dr. Hann's classical discussion of the mean pressure for the same region, also studied on a thirty-years mean, from 1851 to 1880 (*Penns Geographische Abhandlungen*, ii.: Wien, 1887). Some general laws of rainfall distribution are beautifully illustrated in the maps which accompany Dr. Angot's paper, and tables of rainfall for 271 selected stations. At the first glance, the influence of mountains in deflecting the water-vapour upwards into regions of lower temperature, and so cooling and condensing it, is so apparent that one is inclined to say that relief and rain maps are congruent. But a closer study of the great mountain regions on the rainfall map shows that the central areas receive less rain than the periphery, and the windward slopes more than the leeward. An area of minimum rainfall is usually found not far from the foot of the lee side of the high ground; for instance, in the upper Rhine plain, the upper valley of the Loire, and in the east of our own islands. The winter rains are mainly cyclonic, and, owing to the low temperature, are rarely heavy, save in the extreme western mountains, and rapidly diminish towards the east, where even such lofty regions as the Alps receive comparatively little rain. In February least rain falls over Europe as a whole, even when due allowance is made for the shortness of the month. In spring the cyclone tracks are often directed to the Mediterranean region, which receives abundant moisture, while North-Western Europe has its minimum precipitation. As the summer advances, and the temperature increases and permits large supplies of water-vapour being formed in the lower regions, the mountainous districts, especially in the heart of Europe, have very heavy rains. But the whole Mediterranean region is exceedingly dry, and in July we have a most striking contrast between the wet Tyrol, where the rainfall is at its maximum, and the dry north of Italy, where it is at its minimum. The need for maps of mean monthly rainfall, and not merely seasonal ones, is clearly demonstrated in Northern Italy, where June is wet while July is very dry. Autumn is rainy everywhere, especially along the Mediterranean littoral. In October the régime of cyclonic rains begins, and the winter conditions become apparent, but the vertical temperature-gradient is slightest about this season, and so the atmosphere can hold much water-vapour, and the rains are heavier than in the corresponding spring months.

Mode of Formation of the Dunes of Gascony.—M. E. Durègne, who has been engaged for some years in careful investigations of the dunes which occur in the coast region of the south-west of France, outlines the chief results of his conclusions respecting their mode of origin in the *Comptes Rendus* (vol. 124, p. 1041). The dunes with which his remarks are more specially concerned are those of the Teste-de-Buch (Gironde) and of Messanges (the Landes), and his surveys have shown that these are incorrectly drawn on existing maps. Instead of forming

continuous *chains*, the dunes occur in the form of interlacing curves, usually taking the outline of a truncated parabola, and enclosing spaces comparatively level. The one branch of the parabola represented may have its curvature (which corresponds with the steepest slope) either towards the north or the south; but the apex, which is usually the highest point of the dune, is always at the east, the axis running always east and west. Dunes of this nature appear characteristic of the primary series, not being found among those of recent date. M. Durègne's conclusions are as follows: The mean direction of the winds to which the primary dunes were due was from west to east. Their present form seems to be due solely to atmospheric currents acting on undulations originally parallel to the meridian, and, from the time of their fixation in that form, they have been entirely uninfluenced by littoral deposits. They may thus be considered as *continental* dunes, a conclusion supported by their comparison with some of the interior dunes of the plateau of the Landes. M. Durègne holds that it is these primary dunes which have obstructed the courses of the streams of this region, and that the lakes thus formed have therefore existed without important alterations since the beginning of the historic epoch.

ASIA.

Bogdanovitch's Exploration of the Stanovoi Mountains, Eastern Siberia.—The *Geographische Zeitschrift* (1897, No. 11) gives a brief account of Bogdanovitch's expedition in Eastern Siberia, from a communication made by the traveller to the Russian Geographical Society (*Izvestia*, 1897, No. 1). Leaving the coast at Nikolaievsk at the end of 1895, the explorer and his party made their way by land into the valley of the Uda, the thermometer remaining for weeks at from 40° to 50° below zero Fahrenheit. The depth of the snow made progress extremely difficult. Chumukan, at the mouth of the Uda, was reached in February, 1896, and the journey was continued through the north-eastern part of the Stanovoi range (locally known as Jugjuru), important additions being made to our knowledge of these mountains, which are composed of three parallel chains, and are rich in gold-bearing rocks. Traces of gold are also seen in the watercourses. The programme of the expedition, which is to occupy three years, includes the meteorological and geological investigation of the whole of the borderlands of the sea of Okhotsk, including Western Kamchatka.

AFRICA.

The New Franco-German Boundary in West Africa.—An agreement settling the conflicting claims of France and Germany in the *Hinterland* of the Gold and Slave coasts was signed at Paris on July 9, 1897, and ratified on July 23. The boundary is clearly indicated upon the accompanying sketch, which is based upon the map attached to the treaty. Concessions, as is usual in such cases, have been made by both parties to the dispute. The boundary, as fixed in 1885 and 1887, ran along the meridian passing through Bayol island as far as lat. 9° north. It still starts from the same point, but, on reaching the lagoon at the back of the coast, it is drawn to a point 100 metres to the eastward of Bayol island, which is thus ceded to Germany, and then follows the central channel of the lagoon, as far as the Mono river, along which it is carried to lat. 7° north, after which it returns to the old meridian of 1887, and follows it to the parallel, which is halfway between the villages of Basila and Penesulu. The remainder of the boundary is clearly indicated upon the map. It terminates in long. 1° 32' west of Greenwich. France is permitted, for four years, to make use of the routes connecting Kuande and Pama with Sansanne Mango, and the latter with Gambaga, for the despatch of troops and munitions of war. It will be understood that this agreement merely settles matters

also the French claims to Sansanne Mango and Gambaga. All the places mentioned lie outside the "Neutral territory" agreed upon between Great Britain and Germany, in 1888, and distinctly shown on our sketch-map. As to Gambaga and Sansanne Mango, it should be borne in mind that the British claims date back to 1894, if not to an earlier period, whilst the treaties producible in support of French and German claims are not older than 1895. Germany, on her side, surrendered, by implication if not explicitly, all claims to Borgu, Gurma, and Gando.

German-Portuguese Boundary in East Africa.—The third number of the *Mitteilungen aus den Deutschen Schutzgebieten* for the present year contains a map by Dr. F. Stuhlmann, showing the boundary between the German and Portuguese possessions in the neighbourhood of the lower Ruvuma, as laid down by the commission of 1895, together with the country on either side between Tungi bay and the Ruvuma (such, according to Dr. Stuhlmann, is the correct spelling of the name). The boundary leaves the coast at Ras Lipuu, about a mile north of Cape Delgado, running roughly parallel to the northern shore of the Cape Delgado peninsula until it strikes the parallel of 10° 40' south. This it follows westwards to about 40° 17' east, but before striking the Ruvuma diverges somewhat to the north, and on again reaching the parallel of 10° 40' runs parallel to the Ruvuma as far as a point opposite the upper end of Nyenyere island, leaving to Germany a strip 1 kilometre wide on the south bank of the river. Dr. Stuhlmann gives some notes on the general nature of the country traversed by the boundary, which he divides into the coast belt, the plateau, and the Ruvuma valley. The coral reef which fringes the shore at low-water level, he considers to have once formed a raised shore-line, but to have been worn away to its present level by the waves. Dunes now fringe the shore at high-water mark. The plateau, which is mostly covered with impenetrable bush, is of no great elevation, but its well-marked escarpment towards the Ruvuma valley is due to the action of the river in wearing down its bed. Forests occur hardly anywhere but on the plateau-edge and along the banks of the Ruvuma. The Ruvuma plain, which has its principal extension south of the river, is covered with grass of moderate height.

Explorations in the Congo Basin.—Commandant Brasseur, whose explorations on the Lualaba and Luapula rivers have already been alluded to (*Journal*, vol. ix. p. 560), contributes an article on the countries of Urua and Katanga to the *Mouvement Géographique* (1897, Nos. 35-38), accompanied by a map, on which his various itineraries are laid down. In addition to the explorations already mentioned, the geographical work performed by M. Brasseur includes an examination of the whole country lying to the west of the upper Luapula (including the Kundelungu plateau), which he has covered with quite a network of routes. Several tributaries of the Luapula have for the first time been laid down with accuracy, one of them; however—the Lushipuka—having been mentioned by the "Pombeiros" as far back as 1806 (as "Lutipuca"). M. Brasseur's delineation of the southern end of Lake Mweru differs much from that of Mr. Alfred Sharpe and other previous travellers, the mouth of the Luapula being placed far to the south-east of Kilwa island, the shape of which also differs considerably from that given to it by Mr. Blair Watson. The Belgian traveller states that the lake is yearly diminishing in size. The Luapula, after leaving Mweru, seems to bend further to the west than has been previously supposed, the junction with the Lualaba being placed by M. Brasseur some distance to the south-west of the position assigned to it in Captain Hinde's map. Although holding to the view that the Lualaba is the true head-stream of the Congo, he allows that in point both of length of course and volume of water the Luapula has the advantage, and his opinion, based on geological grounds only, can hardly be considered satisfactory from a geographical point of

view. M. Brasseur, who has twice extended his term of service in Katanga, having first reached that country in 1893, hopes, before returning to Europe, to complete the exploration of the Lubudi, the western tributary of the Lualaba. Minor explorations have also been carried out recently within the great bend of the Ubangi, and several tributaries of that stream in this neighbourhood have been laid down (*Mouvement Géographique*, No. 38, with map). The principal of these seems to be the Lua, which, rising, it is thought, in the neighbourhood of the station of Banzyville, on the upper Ubangi, and flowing across the region comprised within the bend of that river, may possibly supply a means of communication towards the upper poste. The chief tribes of this region, which is very populous, are the Bwaka, the Gobu, and the Banza. Finally, we may briefly note the journey lately made to the capital of the Muata Yanvo (*Mouvement Géographique*, No. 40) by Lieut. Michaux, the first European to visit the central portion of Lunda since Dr. Buchner (1878). The present ruler is the nephew of the chief visited by the German traveller, and his capital is situated on the Luele, a left-bank tributary of the Sankuru, in about 8° S. lat. It is an immense town of 30,000 inhabitants. Lieut. Michaux obtained an audience after some difficulty, and found the Muata Yanvo friendly disposed.

Explorations in the Cameroons.—The third part of the *Mittheilungen aus den Deutschen Schutzgebieten* for the current year contains an account by Lieut. Baron von Stein of the discovery of a small lake named Lungasi, or Osea, lying to the north of the lower Sanaga, and connected with it by a narrow tortuous channel. The point of junction of this with the main river lies a few miles below the Edea falls, and the idea is entertained by the German officer that the lake may mark the position of a former course of the Sanaga towards the Cameroons estuary, which had on other grounds been supposed to have once existed. Proceeding along the connecting channel, which is deep, but varies in its flow according to the level of the Sanaga, the traveller, after about 3 miles in a direct line, emerged into the most open basin of the lake, which afforded a view of great beauty. The northern, western, and in part the eastern shores are remarkably indented, the tongues of land which project into the water rising steeply from its surface. Towards the south-east the shores are low, which, Baron von Stein thinks, may possibly point to a former connection with the Sanaga in this direction. The water-arms which run towards the north ended in swampy ground overgrown with vegetation, and had the appearance of having once extended further, but, at the present day at any rate, there is no open-water route from the Sanaga to the Cameroons in this direction. The shores of the lake are clothed with thick forest, abounding in elephants, wild pigs, antelopes, etc., while the surface is frequented with an unusual variety of water-birds. The geological formation appeared to be gneiss with a covering of laterite. Among recent journeys in the interior of the country, that by the Imperial governor to the Yaunde station and upper Sanaga deserves mention. An account of it appears in the *Deutsches Kolonialblatt* for June 15 last. The river was struck in the neighbourhood of the Nachtigal falls, and some advance towards the opening up of the route hence to southern Adamawa was made by the defeat of the powerful slave-raiding chief Ngila. A colony of Hausas settled at his town was, at their own request, brought to the Cameroons, where they were settled in a village of their own. The governor was anxious to explore the still unknown country further east, but was obliged to leave the task to Lieut. von Carnap, who was placed in charge of the Yaunde station. This officer is already known for the part he took in Dr. Grüner's expedition in the Togo Hinterland.

The Uchungwe Mountains, German East Africa.—A short description of the Uchungwe mountains, situated in Uhehe, to the east of the lesser Ruaha

river, is given by Herr von Bruchhausen, in the *Deutsches Kolonialblatt* for October 1, chiefly from the point of view of their suitability for colonization. The writer divides the country surrounding and including the mountains, which forms the part of Uhehe most suitable for settlement, into three zones, viz. (1) That of the grassy treeless plains, with a laterite soil and little humus; (2) that of transition between the grass and the bush; (3) the bush zone with a luxuriant vegetation. Both of these last have an excellent soil; the summits of the hills are chiefly cultivated by the natives, but good alluvial soil is also present in the valleys. The hills are unusually well watered, the numerous ravines and valleys all possessing springs and streams of excellent clear water. The climate is temperate and bracing, and fever is little to be feared. The rainy season proper lasts from November to May, but rain falls in the hills throughout the year. The grass-lands are pre-eminently suited for cattle-rearing, and herds have already been successfully sent down to the coast. With steamers on the Rufiji above and below the Pangani falls, communication with the coast would be easy.

Antidote to African Arrow-poison.—Major Ternan, who commanded the British forces during the late fighting in Uganda, has now arrived in England, and during the course of an interview has described the successful use of an injection of strychnine solution as an antidote to the native arrow-poison. It was tried by Dr. Macpherson during Major Ternan's operations against the Kamasia tribe on the Mau mountains, with the result that the wounded men so treated recovered in a couple of hours, whereas previously people wounded with the poisoned arrows had always died. Should this remedy prove generally successful, one of the chief risks of savage warfare in Africa will have been removed.

AMERICA.

The Jessup Expedition to the North Pacific Coast.—*Science* (October 8) contains a short account of the results of the work performed during the past season by the expedition despatched by Mr. M. K. Jessup for the investigation of the ethnology of the regions bordering on the North Pacific. The field chosen for work during the present year was British Columbia, whither Dr. F. Boas, Mr. L. Farrand, and Mr. H. T. Smith proceeded in May last; Messrs. Teit and Hunt joining the party later. The investigations included the examination of archaeological remains—which, though dating from periods preceding the arrival of Europeans, mostly appeared capable of reference to the immediate ancestors of the present inhabitants—the study of the traditions and languages of the Bella Kula and other Indian tribes, and of the physical types of the tribes of British Columbia generally. One hundred casts were obtained, representing four distinct types.

The Geology of the Bermuda Islands.—The Bermudas are still vexed by discussions amongst geologists as to their structure. The latest contributor to the subject is Mr. Ralph S. Tarr, who publishes a paper in the *American Geologist*, reviewing a number of the older arguments in the light of some original observations. The history of the Bermudas, Mr. Tarr concludes, is somewhat as follows: A base rock was at first formed by the waves on the flat volcanic summit by the pounding up of shell fragments on the beach; the shell sand was then consolidated into a dense limestone, eroded in the air, and finally attacked by the waves. This stage would involve elevation and subsequent depression. Next follows the partial covering of this base rock by beach deposits of pebbles and shells: this must have occurred in comparatively recent times, so far as appears from fossils. Then came an uplift, during which land-shells lived on the beach deposits; but these were soon covered by blown sand, and through this sand accumulation the outline of the Bermuda hills was perfected. This action occurred when the land was certainly

40 or 50 feet higher than it is at present. The last stage has been one of depression, which has caused much land to disappear and made the outline of the area very irregular. The land has now been carried down very nearly to what it was when the beach was formed and before the sand-dunes were built, and the present excavation of sea-caves and other appearances show that the land is now undergoing little or no change of level. Mr. Tarr discusses the denudation of the base rock, and the unconformity between it and the overlying strata, with some care, and is of opinion that the history of the Bermudas is more complex than has been supposed, extending back into Pleistocene or even Tertiary times.

American Expedition to Patagonia.—The expedition despatched to Patagonia from Princeton University in February, 1896, returned in August last, having been successful in adding considerably to our knowledge, both of the geology and geography of the regions traversed (*Science*, October 8). The expedition landed at Port Gallegos on the east coast of Southern Patagonia, and its field of operations included both the coast region from Sandy point, in the Straits of Magellan, to Port Desire; the little-known interior lake region about the headwaters of the Santa Cruz river; and a quite unknown region of the Cordilleras further north. Many new glaciers and streams were discovered here. Botanical and geological collections and observations were also made in Tierra del Fuego and neighbouring islands.

AUSTRALASIA AND POLYNESIA.

Successful Boring at Funafuti.—The renewed attempt made this year by Prof. David, of Sydney, to carry out a deep boring in the atoll of Funafuti has met with complete success. Telegrams from Sydney early in October announced that a depth of 643 feet had then been obtained, and that the base of the coral rock had not yet been reached. It will be remembered that the object of the boring is to throw light on the vexed question of the origin of coral islands, and the result supplies a striking confirmation of Darwin's theory that such islands occur chiefly in areas of subsidence.

POLAR REGIONS.

Norwegian Andrée Search Expedition.—Owing to a report brought to Norway by shipwrecked sailors that cries of distress had been heard by them when off the Dammands isles, on the west coast of Spitsbergen, the Norwegian Government promptly decided on the despatch of an expedition to investigate the truth of the matter. The s.s. *Victoria* was at once chartered and equipped, and started for Spitsbergen on November 5, the arctic explorer, Paul Bjorvig, accompanying the expedition. The story of the Norwegian sailors, as telegraphed by the German vice-consul in Vardö, is as follows: On September 22 and 23 they were passing the Dammand isles at the mouth of Ice fjord, when they heard a cry for help, but the smallness of their boat and the high sea that was running made it impossible to do anything. Afterwards they proceeded further up the fjord, where they were taken up by the Tromso sloop *Malygen*. On repassing the same spot the cry was again heard, but the Tromso captain was unwilling to search, believing it to be the cry of a bird. The Vardö fishermen declare that on September 23 a driving reddish-brown object, which they took for a capsized ship, was seen, a mile from land, about 8 miles north of Dammands isles, and it is suggested that this may have been Andrée's balloon. Experts are, however, of the opinion that neither this nor the supposed cries of distress can have been in any way connected with Andrée's expedition. The expedition returned to Tromsö on November 20 without success, the examination of the coast of Spitsbergen having revealed no trace of the balloon or of the explorers.

Swedish Polar Expedition determined on.—The persistent efforts of Dr. Nathorst to obtain the despatch of a Swedish polar expedition have now been successful, as sufficient funds have been provided by the king and several private persons to enable the idea to be carried out. Dr. Nathorst himself will be the leader of the expedition. The plans brought forward a year ago by Dr. Nathorst were briefly described in the January number of the *Journal* (vol. ix. p. 95), but it has not yet been stated whether these will be adhered to.

The Belgian Antarctic Expedition.—The *Belgica*, with the antarctic expedition under Commander de Gerlache on board, arrived at Rio de Janeiro on October 22. The explorers were there joined by Dr. Cook, a former companion of Lieut. Peary. The ship was shortly to proceed to Punta Arenas, where the serious work of the expedition may be said to begin. Scientific collections and observations have, however, been made during the voyage out by the scientific staff.

GENERAL.

Geographical Reading for Teachers.—Under the title of 'Hints to Teachers and Students on the Choice of Geographical Books for Reference and Reading, with Classified Lists' (Longmans), Dr. H. R. Mill, the Society's librarian, has compiled a little volume which ought to be of the greatest service in geographical education. Unless a teacher goes beyond his class text-book, his teaching is not likely to bear much fruit. Few teachers have the necessary time or knowledge to discover for themselves the best books to consult on any particular subject. So far as geography is concerned, Dr. Mill has done all that most students and teachers are likely to require. There are two introductory chapters on the Principles of Geography and on the Teaching of Geography, accompanied by a list of books on Methods of Teaching Geography. This is followed by short chapters on the Choice of Text-books, on Atlases and Means of Illustration, and on Works of Reference on Geography, with lists. Then come chapters on Mathematical Geography, Physical Geography, Bio-Geography, and Anthropogeography, followed by sections on the various divisions of the globe, each containing a select list of books. The concluding section is on General Travel and Biography. The hints given are all the result of extensive experience on the part of the author, while the selection of books recommended has evidently been carefully considered. Those interested in the improvement of geographical education will be grateful to Dr. Mill for the service he has rendered.

Portuguese Celebration of the Discovery of the Sea-route to India.—We have received a copy of the programme, drawn up in accordance with a ministerial decree of April 2 last, for the national celebration in Portugal of Vasco da Gama's voyage to India. The main features of the celebration will be those already sketched in the preliminary programme (*Journal*, vol. viii. p. 303), but the dates now fixed for the public rejoicings are the 17th to the 20th of May, 1898. At day-break on the 17th, all the Portuguese fortresses and war-vessels will fly the national flag and usher in the festivities by a salvo of one hundred guns; the thanksgiving services in the cathedrals and churches will also be held at the same time. Among the varied items of the commemoration will be an exhibition, on the site of which a permanent "maritime and fluvial aquarium" will be built, and a grand naval review, in which both foreign governments and the principal steamship companies and commercial associations throughout the world will be asked to take part. The headquarters of the Central Executive Committee, and the place of meeting of the scientific congresses, etc., are at the new buildings of the Lisbon Geographical Society. The president of the committee is Captain F. J. Ferreira do Amaral, and the secretaries are Senhores L. Cordeiro and E. de Vasconcellos.

Death of A. von Mojsisovics.—The announcement in our last number of the death of E. von Mojsisovics is due to an error on the part of the correspondent by whom the notice was sent to us. That geologist is, we are glad to say, still living and engaged in active work as Vice-Director of the Imperial Geological College in Vienna. The deceased is his brother, the geologist *August Mojsisovics von Mojsvár*, who held the posts of Military Director of the Crown Prince Establishment, Custodian of the Styrian State Museum, and Professor of Zoology at the Technical High School at Gratz.

New Geographical Society at Southampton.—By the exertions of Mr. T. G. Rooper and others, a new geographical society has been set on foot at Southampton, the growing commercial importance of which port renders such a society particularly desirable as a means of disseminating reliable information regarding the foreign countries with which this country has or might have trade relations. The new society will work in close harmony with the Chamber of Commerce, which, its promoters hope, will be able to supply it with much useful information, which otherwise might be lost to the general public. While, however, the commercial aspects of geography will receive particular attention, it is hoped that the society will do good work also in the furtherance of geographical education, a subject in which Mr. Rooper is well qualified to guide the way. It will especially aim at assisting those secondary schools, where any of the scholars are preparing for the Commercial Certificate of the Associated Chambers of Commerce. The formation of a library, especially devoted to the supply of information respecting the British empire, and a collection of lantern slides and maps for loan, will also form items in its programme. The formal inauguration took place on November 16, on which date Sir Clements Markham went to Southampton to deliver an opening address.

OBITUARY.

Sir Rutherford Alcock, K.C.B., D.C.L.

By the death of Sir Rutherford Alcock, at the advanced age of eighty-eight years, yet another name has disappeared from the now scanty list of former Presidents of the Royal Geographical Society, which thus loses one who, during the long period of service on its Council, contributed in no small degree, by his valued advice and co-operation, to the furtherance of the objects for which the Society is constituted. It was only quite recently that Sir Rutherford had been compelled to live in retirement, and had been unable actively to participate in its affairs; but while his health permitted, there were few members whose interest in its proceedings was more constantly maintained.

Born in 1809, Rutherford Alcock was trained for the medical profession at King's College, London, and gained his first experience of service abroad as surgeon in the British forces employed in Spain and Portugal during the stormy times of the Carlist and Miguelite wars, receiving medals and other decorations from the Spanish and Portuguese Governments in recognition of his services in the field. On the disbandment of the Spanish Legion, to which he had been attached as Deputy Inspector-General of Hospitals, he became commissioner for the adjustment of the claims of the British troops on the Governments in whose support they had fought.

In 1844 Mr. Alcock was transferred to the East, which was destined to be the scene of the labours with which his name is principally associated. In that year he

received the appointment of Consul at Fu-chau, one of the ports then lately thrown open to foreign commerce by the treaty of Nan-king. After two years' service there, he was appointed to the same post at the still more important port of Shanghai. Here he remained eight years, the latter of which fell within the troublous times of the Taeping rebellion. A serious rising took place at Shanghai in 1853, and the European settlement was for some time in considerable danger. The energy displayed by Mr. Alcock, however, helped much towards the organization of an efficient defence, and, though the Chinese city fell into the hands of the rebels, no attack was made on the foreign quarter. During his service at Shanghai, he was instrumental both in founding the excellent municipal government of the foreign settlement, and also in establishing the commission for the collection of dues on foreign trade, which afterwards became known far and wide as the Imperial Maritime Customs. In 1854 he was transferred to Canton, where difficulties had already arisen between Sir John Bowring and the Chinese officials with regard to the opening of the city to Europeans, and where the events soon afterwards occurred which led to the second foreign war. In this, however, Mr. Alcock had no part, as he had returned home on leave before the outbreak of hostilities, being succeeded in the Canton Consulate by Mr., afterwards Sir Harry, Parkes.

This closed Mr. Alcock's first period of service in China, for in 1858, Lord Elgin having concluded a treaty of intercourse with the Empire of Japan, he was selected as the first British minister to that country. In this capacity perhaps his most important public services were performed, for Japan was in an unsettled state, and both tact and firmness were needed for the successful maintenance of British influence in the country. The bulk of the people were opposed to foreign intercourse, and the Government itself was anxious to draw back from the course of concession it had already entered upon. Murderous attacks on foreigners were frequent, and on at least two occasions an armed mob attacked the British Legation itself. The minister, however, was firm in his determination to maintain the treaties, and to let no outrage on British subjects go unpunished. It was in this spirit that he more than once took severe measures of retaliation against the perpetrators of such outrages, a course which laid him open to much criticism at home, though he was able ultimately to disarm it, and to secure the general approbation of his countrymen for his services. In 1862 he was made a K.C.B.

Apart from his political services, Sir Rutherford Alcock did much to extend our knowledge both of the country and people of Japan, and may be said to have led the way in the modern exploration of that empire. In the *Society's Journal* he has left valuable records of journeys in the interior of the country, made at a time when that interior was still almost a *terra incognita*. In the volume for 1861 he described one such journey, which included an ascent of the great mountain Fusi-yama and a visit to the sulphur baths of Atami; and in the following volume we have the account of a journey from Nagasaki to Yeddo, with a description of the great commercial city of Osaka. Both of these papers contain many details on the natural features of the country, the conditions of life in it, the prospects of trade, and so forth. In his book entitled 'The Capital of the Tycoon,' published in 1863, Sir Rutherford entered more fully into these subjects, and showed clearly the sort of difficulties to be faced in opening up intercourse with the Japanese people. In 1878 he published a work on 'Art and Art Industries in Japan,' a subject in which he took a great interest. It was entirely through his exertions that Japanese arts and industries were represented at the International Exhibition of 1862, in which he was unable to induce either the Japanese Government or people to take part.

In 1865 Sir Rutherford was appointed British Minister at Peking, where his career was less eventful than it had been in Japan. He was for the most part

engaged in unostentatious work in the direction of improving the position of Europeans in China. He endeavoured to place the commercial relations of Great Britain with that country on a firmer basis by the negotiation of a new convention, but though such a convention was drawn up, the opposition of British merchants to some of its provisions led to its being withdrawn.

In 1871 Sir Rutherford retired on a pension, and took up his residence in



SIR RUTHERFORD ALCOCK, K.C.B., D.C.L.

London, where, however, he continued to take a deep interest in the affairs of the East, many articles from his pen appearing in reviews and newspapers on subjects connected with it. In particular, he contributed the concluding chapter to the journals of Augustus Margary, who first joined the consular service while Sir Rutherford was minister at Peking, and whose career he had followed throughout with much interest. In 1876 he became President of the Royal Geographical

Society, of which he had been a Fellow since 1862, and during his two years' tenure of the office, as also subsequently as Vice-President, he gave the Society the benefit of his wide experience, frequently taking part in the discussions on papers read at the evening meetings. He was also Chairman of the African Exploration Fund, and thus took part in the labours which resulted in the despatch of Mr. Keith Johnston and Mr. Joseph Thomson to East Africa, and, by bringing the latter into notice, had such important results in the direction of the opening up of that part of the continent. Another important service rendered by him to the British enterprise abroad was that which he performed as first chairman of the British North Borneo Company, in the formation of which he had taken much interest. He remained on the Council of our Society until May, 1893.

Sir Rutherford Alcock was twice married. His first wife—daughter of Mr. Charles Bacon, of London—died during his consulate at Shanghai, and he subsequently, in 1862, married the widow of Mr. Lowder, formerly chaplain at Shanghai.

Dr. Don Agustin Aspiazu.

The recently formed Bolivian Geographical Society has to lament the loss of its distinguished President, Dr. Don Agustin Aspiazu, who died on March 18 last. In Bolivia a scholar, one who desires to acquire more than superficial knowledge, labours under almost insuperable difficulties, and must possess great energy and perseverance, as well as talent. With a fertile imagination and remarkable power of application, young Aspiazu very soon mastered all that could be taught in the university of his native country, and devoted himself to the study of sciences unknown in Bolivia. Except when occasionally occupying official posts, he devoted his whole time to study during fifty years. He also traversed the wildest parts of the Andes to take observations and make scientific investigations. Born in 1827, Dr. Aspiazu was one of the founders of the "Ateneo de Bolivar" when he was a young man only twenty-three years of age, and before many years he was Minister of Instruction and Chancellor of the University of San Andres, frequently representing the city of La Paz in congress. He wrote a course of physics (1852), a paper on the theory of earthquakes (1868), a work of considerable merit entitled "Conocimiento del Tiempo" (1880), almost amounting to a nautical almanac; and since 1889 various papers by Dr. Aspiazu have been communicated to the Geographical Society of La Paz. The most important of these are his memoirs on the plateaus of the Andes, on methods of determining longitude, and on the boundary-line between the Bolivian province of Caupolican and Peru. He left behind him some very useful papers on astronomical geography, with solutions of problems, which have been printed. Mr. Aspiazu was a man of whom his country may well be proud, and his loss will be much felt by the members of the La Paz Geographical Society, to whom, however, he has set an excellent example.

GEOGRAPHICAL LITERATURE OF THE MONTH.

*Additions to the Library.*By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.	Mag. = Magazine.
Ann. = Annals, Annales, Annalen.	P. = Proceedings.
B. = Bulletin, Bollettino, Boletim.	R. = Royal.
Com. = Commerce, Commercial.	Rev. = Review, Revue, Revista.
C. Rd. = Comptes Rendus.	S. = Society, Société, Selakab.
Erdk. = Erdkunde.	Sitzb. = Sitzungsbericht.
G. = Geography, Geographie, Geografia.	T. = Transactions.
Ges. = Gesellschaft.	V. = Verein.
I. = Institute, Institution.	Verh. = Verhandlungen.
J. = Journal.	W. = Wissenschaft, and compounds.
M. = Mitteilungen.	Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

- Alps.** Die höchsten Teile der Seealpen und der Ligurischen Alpen in physiographischer Beziehung. Von Dr. Fritz Mader. Leipzig: G. Fock, 1897. Size 9½ × 6½, pp. 236. *Illustrations.* Mader.
- Austria—Meteorology.** Věstník Král Čeaké Společnosti Nák. Třída mathematičko-přirodovědecká. 1897. IV. Příspěvek B. poznání nefometrických poměrů zemi hercynsko-sudetských. Podává Dr. Josef Frejlach. v Praze, 1897. Size 10 × 6½, pp. 24. *Diagrams. Presented by the Author.* Frejlach.
- On the cloudiness of the north-western mountain district of the Austrian monarchy.
- Europe—Lithuania.** *Globus* 71 (1897): 381-384. Tetzner.
Das litauische Sprachgebiet. Von Dr. F. Tetzner. *With Map.*
On the Lithuanian-speaking districts of Prussia and Russia.
- France and Germany.** *P. Literary and Philosoph. S. Liverpool* 50 (1896): 235-262. Birchall.
Medieval Towns in France and Germany: their Origin and Municipal Development. By James Birchall. *With Map.*
On the economic reasons for the growth of free towns in medieval Europe.
- France—Ardèche.** *Mém. S. Spéléologie* 1 (10) (1897): 1-40. Raymond.
Les Rivières souterraines de la Dragonnière et de Midroi (Ardèche). Par M. le Dr. Paul Raymond. *With Plans and Illustrations.*
- France—Capbreton.** *Rev. Maritime* 134 (1897): 509-541. Gabarra.
L'ancien port de Capbreton. Par M. J.-B. Gabarra.
A history of the port of Capbreton, intimately associated with the geographical problem of the former mouth of the Adour and its relation to the remarkable submarine cañon known as the Capbreton Deep. The question of creating a harbour of refuge at Capbreton is also discussed. The paper, which is written by the curé of Capbreton, is throughout of remarkable interest.
- France—Normandy.** *C. Rd.* 125 (1897): 380-382. Bigot.
Sur les dépôts pléistocènes et actuels du littoral de la basse Normandie. Note de M. A. Bigot.
On the character and movements of the northern coast of France.
- France—Provence.** *A travers le Monde (Tour du Monde)* 3 (1897): 193-196. Porcher.
La Sainte-Baume et Saint-Maximin. Par Jacques Porcher. *With Illustrations.*

- Germany.** *Aus allen Weltteilen* 28 (1897): 601-606, 639-650, 671-684. **Detmer.**
Landschaftsformen des nordwestlichen Deutschlands. Von Dr. W. Detmer.
- Germany—Eifel Lakes.** *Petermanns M.* 43 (1897): 149-153. **Halbfass.**
Tiefen- und Temperaturverhältnisse der Eifel-maare. Von Dr. Wilhelm Halbfass.
With Map.
A note on this paper was given in the *October Journal* (*ante*, p. 436).
- Germany—Kiel.** *Schriften Naturw. V. Schleswig-Holstein* 11 (1897): 187-194. **Weber.**
Die Temperaturschwankungen in Kiel. Von Professor Dr. L. Weber.
- Germany—Kiel Bay.** **Schöck.**
Schriften Naturw. V. Schleswig-Holstein 11 (1897): 149-156.
Magnetische Beobachtungen an der Kieler Förde und Eckernförder Bucht, übertragen auf 1895, 5. Von A. Shück.
- Germany—Meteorology.** **Bezold.**
Bericht über die Thätigkeit des Königlich Preussischen Meteorologischen Instituts in Jahre 1896. Von Wilhelm von Bezold, Direktor. Berlin, 1897. Size 10 × 6½, pp. 30.
- Germany—Meteorology.** **Bezold.**
Veröffentlichungen des Königlich Preussischen Meteorologischen Instituts. Herausgegeben durch dessen Direktor Wilhelm von Bezold. Ergebnisse der Beobachtungen an den Stationen II. und III. Ordnung im Jahre 1893 zugleich Deutsches Meteorologisches Jahrbuch für 1893. 1893. Heft III. Berlin: A. Aaher & Co., 1897. Size 13½ × 10½, pp. xvi. and 99-291 [192]. *Map.*
- Germany—Saxony.** **Heinrich.**
Kalender und Statistisches Jahrbuch für das Königreich Sachsen nebst Marktverzeichnissen für Sachsen und die Nachbarstaaten auf das Jahr 1896. Dresden: C. Heinrich, 1897. Size 8 × 5½, pp. 88, x., and 222.
- Greece.** **Philippson.**
Thessalien und Epirus. Reisen und Forschungen im nördlichen Griechenland. Von Dr. Alfred Philippson. Herausgegeben von der Gesellschaft für Erdkunde zu Berlin. Berlin: W. H. Kühl, 1897. Size 9½ × 6½, pp. x. and 422. *Maps and Plates. Presented by the Gesellschaft für Erdkunde, Berlin.*
This will be further noticed.
- Greece.** **Sergeant.**
Greece in the Nineteenth Century. A Record of Hellenic Emancipation and Progress: 1821-1897. By Lewis Sergeant. London: T. Fisher Unwin, 1897. Size 9½ × 6, pp. x. and 400. *Map and Illustrations. Price 10s. 6d. Presented by the Publisher.*
"This volume," says the prefatory note, "is neither a history altogether nor exclusively a plea, but it combines the features of both. It is also an accretion, for it includes as much as seemed to be worth repeating of a volume on 'New Greece,' published in 1878 and republished in 1879." The book is illustrated, and contains a clear large-scale map of Greece.
- Italy—Venetia.** *Riv. G. Italiana* 4 (1897): 449-453. **Bertolini.**
I fiumi di resorgiva in relazione alle lagune ed al territorio veneto. Nota del Prof. G. L. Bertolini.
- Norway—Botany.** *G. Tidsskrift* 14 (1897): 76-86. **Lange.**
Fra Smaarejser i Norge. Ved cand. mag. Jonathan Lange.
On the plant-life of Norway as observed in summer excursions.
- Russia—Botany.** *Globus* 72 (1897): 197-200. **Krause.**
Vegetationskizze Mittelrusslands. Botanische Notizen von der Reise zum internationalen medicinischen Kongress in Moskau. August, 1897. Von Dr. Ernst H. L. Krause.

ASIA.

- Arabia—Historical.** **Rossi.**
G. B. Rossi. L'Yemen, avanti il profeta. Estratto dalla *Rassegna Nazionale* di Firenze fasc. del 16 Luglio 1897. Firenze, 1897. Size 9 × 6, pp. 14. *Presented by the Author.*
On Yemen before the Mohammedan era, as deduced from inscriptions recently discovered.

- Arabia—Makalla.** *Globus* 72 (1897): 37-40. **Hirsch.**
 Ein Aufenthalt in Makalla (Südarabien). Von Leo Hirsch. *With Illustrations.*
- Central Asia.** *Rev. Française* 22 (1897): 598-602. **Boborovski.**
 Asie Centrale: L'exploration Boborovski. *With Map.*
- Central Asia—Pamirs.** *Verh. Ges. Erdk. Berlin* 24 (1897): 328-339. **Olufsen.**
 Herr Premier-Lieutenant O. Olufsen: Ueber die dänische Pamir-Expedition im Jahr 1896. *With Map.*
- Central Asia—Pamirs.** *G. Tidsskrift* 14 (1897): 51-76. **Olufsen.**
 Den danske Pamir-Expedition. Ved Premier-løjtnant i Hæren O. Olufsen. *With Map.*
 This expedition has been referred to in the *Journal* for November (*ante*, p. 536).
- China—Railways.** *Oester. Monats. Orient* 23 (1897): 61-72. **Feigl.**
 Die Eisenbahnfrage in China. Von Hermann Feigl.
- China—Historical.** **Groeneveldt.**
Bijd. Taal-, Land- en Volkenk. Ned.-Indië 4 (1898): 1-598.
 De Nederlanders in China. Door W. P. Groeneveldt.
 This is the first part of a series of records of the early Dutch trade to China, and deals with the traffic to China and the Pescadores between 1601 and 1624.
- China—Manchuria.** *C. Rd.* 124 (1897): 1402-1404. **Venukoff.**
 Sur les résultats d'observations météorologiques faites en Mandchourie et dans les pays limitrophes. Note de M. Michel Venukoff.
- Chinese Empire—Tibet.** *J. United Service I. India* 26 (1897): 177-198. **Wellby.**
 From Leh to Peking across Tibet. By Captain M. S. Wellby. *With Map.*
- India—Assam.** _____
 Report on the River-borne Trade of Assam for the Quarter ending the 31st of December, 1896. Size 13½ × 9, pp. 44.
- India—Assam.** **Stephen.**
 Annual Sanitary Report of the Province of Assam for the year 1896. By Surgeon-Colonel A. Stephen, M.B. Shillong, 1897. Size 13 × 8½, pp. 44, xlviii, and 6. *Map.*
- India—Assam, Tea Culture.** _____
 Report on Tea Culture in Assam for 1896. Shillong, 1897. Size 13½ × 8½, pp. 6 and iv. *Map.*
 The output of tea in the province of Assam for 1896 was 109 million lbs., an increase of ten per cent. over the previous year.
- India—Bengal.** *Miss. Catholiques* 29 (1897): 368, 380, 391, 403, 418, 429, 439. **Gryse.**
 Les premiers habitants du Bengale ou les Aborigènes du Chota-Nagpore, de l'Orissa et des Santal-Pergannas. Par le R. P. de Gryse. *With Illustrations.*
- India—Burma.** **Newland.**
 A Practical Hand-book of the Language of the Lais as spoken by the Hakas and other allied tribes of the Chin Hills (commonly the Baungshè Dialect). By Surgeon-Major A. G. E. Newland. Rang-on, 1897. Size 9½ × 6, pp. 688. *Presented by the Author.*
- India—Burmese War.** *Indian Antiquary* 26 (1897): 40-47. _____
 An Unpublished Document relating to the First Burmese War. Preface by Lieut.-Colonel K. C. Temple.
 The document in question was a manuscript bound up with a copy of Wilson's "Documents of the Burmese War, 1827," which belonged to Colonel Hopkinson, who took part in the campaign, and was presumably written by him.
- India—Hindu Customs.** **Nevins.**
P. Literary and Philosoph. S. Liverpool 50 (1896): 263-291.
 Hindu Domestic and Religious Customs. By J. Ernest Nevins, M.B.
- India—Malabar.** *Imp. and Asiatic Quarterly Rev.* (3) 4 (1897): 288-300. **Fawcett.**
 The Moplas of Malabar. By F. Fawcett. *With Illustration.*
- India—Mergui Archipelago.** *Indian Antiquary* 26 (1897): 85-91, 119-126. **Temple.**
 Extracts from Official Documents relating to the Selungs of the Mergui Archipelago. By R. C. Temple.

Indo-China. *B.S.G. y Estadística Rep. Mexicana* (4) 3 (1895): 407-413. Revilliod.
Viaje de Saigon á Bangkok, atravesando el Cambodge y el Siam. Discurso . . .
por Mr. John T. Revilliod. Traducción del socio Carlos Roumagnac.

AFRICA.

Africa. *Imp. and Asiatic Quarterly Rev.* (3) 4 (1897): 312-324. Cust.
Africa in 1897. By Robert Needham Cust, LL.D.

A presentation of the dark side of African exploration.

Africa—Natives. *Koloniales Jahrb.* 10 (1897): 120-133. Nachtigal.

Die Eingeborenen Afrikas, die Kolonial-Regierung und die Mission. Von Missions-
prediger A. Nachtigal.

Anthropology—Games. Culin.

Mancala, the National Game of Africa. By Stewart Culin.—Annual Report of the
Board of Regents of the Smithsonian Institution . . . for the year ending June 30,
1894. Report of the U.S. National Museum, pp. 595-607. Washington, 1896.
Size 9½ × 6. *Illustrations. Presented by the Smithsonian Institution.*

British South Africa. *Scottish G. Mag.* 13 (1897): 505-514. Selous.

The Economic Value of Rhodesia. By F. C. Selous. *With Map.*

This paper was read to Section E, Geography, of the British Association at the
Toronto meeting, a fact which, by inadvertence, is not mentioned when reproducing it.
The paper is illustrated by an excellent hypsometrical map of the region described.

Central Africa. Blaikie.

Central Africa since the Death of Livingstone. By the Rev. W. Garden Blaikie,
D.D., etc. From the *North American Review*, September, 1897. Pp. 318-332.
Presented by the Author.

Congo State. Chapaux.

Albert Chapaux. Le Congo, historique, diplomatique, physique, politique, écono-
mique, humanitaire, and colonial. Ouvrage contenant une grande carte en quatre
feuilles, tirée en couleurs, 6 cartes, croquis et plans, intercalés dans le texte, 163
portraits, types d'indigènes, vues, etc. Bruxelles: C. Rozez, 1894. Size 11 × 7½,
pp. x. and 888. *Price 15s.*

Congo State. *B.S.R. Belge G.* 21 (1897): 193-200. Leclercq.

Le Congo doit être notre Java. Par Jules Leclercq.

Congo States. *Globus* 72 (1897): 117-121. Thonner.

Das Gebiet des Mongalafusses in Centralafrika (Kongostaat). Nach eigenen For-
schungen von Franz Thonner. *With Illustrations.*

On the country bordering the Mongala, one of the northern tributaries of the Congo,
and its people.

East Africa—Historical. Benoit.

B. Union G. Nord de la France 17 (1896): 97-124, 193-244.

La Côte Orientale d'Afrique au-delà de la Mer Rouge, dans l'antiquité. Par M.
François Benoit. *With Maps.*

Egypt—Antinoë. *A travers le Monde, Tour du Monde (n.s.)* 3 (1897): 233-236. Gayet.

Les Fouilles d'Antinoë. Par M. A. Gayet. *With Illustrations.*

Egypt—The Sphinx. *Sitzb. K.P.A. W. Berlin* (1897): 752-760. Borchardt.

Ueber das Alter des Sphinx bei Giseh. Von Ludwig Borchardt. *With Illustration.*

Equatorial Africa. Poskin.

L'Afrique Équatoriale. Climatologie, Nosologie, Hygiène. Par le Dr. A. Poskin.
Bruxelles: Société Belge de Librairie, 1897. Size 10 × 7, pp. x. and 478. *Map.*
Price 12 franca. Presented by the Publishers.

The author has written largely on medical and climatological subjects, and having
served as medical officer to the Congo Railway Company, he has practically acquired
experience of his subject. The book will be noticed along with other recent works on
Africa.

German South-West Africa. *Globus* 72 (1897): 190-192. Gessert.

Reise längs der Flussläufer des südwestlichen Gross-Namalandes. Von Ferdinand
Gessert.

Herr Gessert is a settler in German South-West Africa, and in this paper he describes
a journey made in August, 1896, for the inspection of land in the river valleys.

Niger Coast Protectorate—Benin.**Boisragon.**

The Benin Massacre. By Captain Alan Boisragon, one of the two survivors.
London: Methuen & Co., 1897. Size 8 × 5½, pp. 190. *Portrait and Sketch-map.*
Price 3s. 6d. Presented by the Publishers.

A thrilling narrative of the massacre of British officials by the King of Benin, told with remarkable modesty and free from any suspicion of exaggeration by one of the survivors.

Niger Territories.**Vandeleur.**

Nupe and Ilorin. By Lieut. Seymour Vandeleur. From the *Geographical Journal* for October, 1897. Size 10 × 6½, pp. 26. *Maps, Plans, and Illustrations.*

Réunion.*Rev. Française* 22 (1897): 584-598.**O'Zoux.**

L'Agriculture à la Réunion. Par Léon O'Zoux.

NORTH AMERICA.**Bering Sea—Sealing.****Thompson.**

United States. No. 3 (1897). Report by Prof. D'Arcy Thompson on his Mission to Behring Sea in 1896, dated March 4, 1897. London: Eyre and Spottiswoode, 1897. Size 13½ × 8½, pp. 40. *Diagram.* Price 6d.

Canada.

British Association for the Advancement of Science, Toronto Meeting, 1897. Handbook of Canada. Published by the Publication Committee of the Local Executive, Toronto, 1897. Size 8 × 5½, pp. viii. and 416. *Maps and Diagrams.*

This handbook contains, in part i., chapters on the Physical Geography and Geology of Canada, by Dr. G. M. Dawson; on the Climate, by Prof. Stupart; the Zoology, by Prof. Ramsay Wright; and the Flora, by Prof. Macoun. Part ii. deals with the History and Administration of Canada; and part iii. with Economic Resources, Trade, and Population. There are excellent coloured geological, "surface-features," climatological, and political maps of the Dominion.

Canada—Geological Survey Report.

Geological Survey of Canada. G. M. Dawson, c.m.g., etc., Director. Annual Report (New Series), volume viii. Reports A, D, J, L, R, S. 1895. Ottawa, 1897. Size 10 × 7. *Maps and Plates.* Presented by the Survey.

Canada—New Brunswick.*B. Nat. Hist. S. New Brunswick* 15 (1897): 65-82.**Duff.**

Tidal Phenomena of the St. John River at low summer level. By A. Wilmer Duff, m.a. *With Diagram.*

An important contribution to tidal observations.

Canada—North-West Territory, Klondyke.*Nautical Mag.* 66 (1897): 762-766.**Small.**

Waterways to Klondyke. By H. B. Small.

Canada—North-West Territory, Klondyke.*Fortnightly Rev.* 62 (1897): 464-470.**Wade.**

The Klondyke Gold Fields. By Mark S. Wade, m.d. *With Map.*

Mexico.*J. Geology* 5 (1897): 466-478.**Farrington.**

The Eruptive Rocks of Mexico. By Oliver C. Farrington.

Mexico and Central America.*B. American G. S.* 29 (1897): 160-167.**Littlehales.**

Recent Foreign Surveys under the direction of the U.S. Hydrographic Office. By G. W. Littlehales.

Describes the survey of the west coast of Mexico, and of the bay of Honduras.

Mexico—Altitudes.**Felix and Lenk.**

B.S.G. y Estadística Rep. Mexicana (4) 3 (1894-95): 207-335.

Tabla de alturas tomadas de la obra Estudios complementarios para la Geología y Paleontología de la República Mexicana. Por Dr. J. Felix y Dr. H. Lenk. Obra traducida por Ingeniero Isidoro Epstein.

A table of altitudes with authorities, arranged alphabetically in provinces.

Mexico-Guatemala Boundary Question.**Romero.**

B. American G.S. 29 (1897): 123-159.

Settlement of the Mexico-Guatemala Boundary Question. By the Mexican Minister at Washington.

This paper is not only of geographical value, but full of human interest, being in large part an account of incidents in the life of the author, and affording insight into the diplomatic methods of the Latin-American republics.

- Mexico—Islands.** *B.S.G. y Estadística Rep. Mexicana* (4) 3 (1895): 336-357. **Bojas.**
El Archipiélago del Norte. Apéndice al dictamen de la Comisión respectiva, y Estudio jurídico por el socio Lic. D. Isidro Bojas.
- Mexico—Popocatepetl and Ixtacoihuatl.** **Farrington.**
Field Columbian Museum. Publication 18. Geological Series. Vol. i. No. 2. Observations on Popocatepetl and Ixtacoihuatl, with a Review of the Geographic and Geologic Features of the Mountains. By Oliver C. Farrington, PH.D. Chicago, 1897. Size 10 × 6½, pp. 67-120. *Map and Illustrations.*
- Mexico—Popocatepetl.** *Appalachia* 8 (1897): 221-224. **Douglass.**
An Ascent of Popocatepetl. By A. E. Douglass. *With Illustrations.*
- Mexico—Yucatan.** *B.S.G. y Estadística Rep. Mexicana* 3 (1894): 19-20. **Menéndez.**
La costa oriental de Yucatan. Rodolfo Menéndez.
- Mexico—Yucatan.** *Globus* 72 (1897): 200-206, 219-223. —
Neuere Forschungen in Chichen-Itza. *With Plan and Illustrations.*

CENTRAL AND SOUTH AMERICA.

- Amazon Valley.** *J. School G.* 1 (1897): 193-200. **De Kalb.**
The Valley of the Amazon and its Development. By Courtenay De Kalb.
- Argentine and Chile Rio Aisen.** **Steffen.**
Informe preliminar sobre la expedición exploradora del río Aisen (Diciembre 1896—Abril 1897) presentado al señor Ministro de Relaciones Exteriores, Culto i Colonización. Por Dr. Juan Steffen. Santiago de Chile, 1897. Size 10 × 7, pp. 28.
- Argentina Republic.** *An. Museo Nacional Buenos Aires* 5 (1896-97): 333-347. **Aguirre.**
Notas geológicas sobre la Sierra de la Tinta. Por el Ingeniero Eduardo Aguirre. *With Map.*
- Argentina Republic.** *An. Museo Nacional Buenos Aires* 5 (1896-97): 25-32. **Valentín.**
Comunicaciones geológicas y mineras de las provincias de Salta y Jujuy. Por el Doctor Juan Valentín. *With Plans.*
- Argentina Republic—Buenos Ayres.** —
Annuaire Statistique de la ville de Buenos-Ayres. VI^{me} Année—1896. Buenos-Ayres, 1897. Size 10½ × 7½, pp. xxii. and 620.
- Bolivia—Andes.** *Globus* 72 (1897): 25-31. **Mosbach.**
Streifzüge in den bolivianischen Anden. Von Ingenieur E. Mosbach. II. *With Illustrations.*
- Bolivia and Peru.** **Armentia.**
Oficina Nacional de Inmigración, Estadística y Propoganda Geográfica. Límites de Bolivia con el Perú por la parte de Caupolicán. Por el P. Fr. Nicolás Armentia. La Paz, 1897. Size 8 × 6, pp. iv., 176, and 64.
- Brazil.** **Papstein.**
Führer für den Anwanderer nach Brasilien. Von A. Papstein. Berlin: Deutscher Kolonialverlag (G. Meinecke) (1897). Size 7½ × 5, pp. 84. *Map.* Price 1 mark. *Presented by the Publisher.*
- A guide for emigrants to Brazil prepared by the Brazilian correspondent of the *Deutsche Kolonialzeitung*. It consists of a concise description of Brazil and its resources, with special hints and warnings for settlers in Southern Brazil, and a transcript of the German emigration law.
- Brazil—Amazons.** **Grossi.**
Prof. Dott. Vincenzo Grossi. Nel paese delle Amazzoni. Roma, 1897. Size 7½ × 5, pp. 130. *Map.* *Presented by the Author.*
- Brazil—People.** *Globus* 72 (1897): 133-139. **Vierkandt.**
Die Indianerstämme Brasiliens und die allgemeinen Fragen der Anthropologie. Eine Besprechung von A. Vierkandt. *With Plates.*
- Refers largely to Ehrenreich's 'Anthropologische Studien über die Urbewohner Brasiliens.'
- Brazil—Trinidad.** *Rev. Trim. I. G. Hist. Bahia* 4 (1897): 19-37. —
A Ilha da Trindade (A Posse Oficial).

British Guiana—Gold.

British Guiana. Report of the Council of the Institute of Mines and Forests, on the Gold and Forest Industries of British Guiana, for the year ending June 30, 1897. Demerara, 1897. Size 13 × 8, pp. 12.

The output of gold in British Guiana for 1896-97 was 128,333 ounces, showing a slight increase on the previous year, but still below the average for 1892-95.

British West Indies.

Tymohri 11 (1897): 64-72.

Burnley.

Tobacco and Cotton Cultivation in the British West India Colonies. By William H. Burnley.

Central America—Canals.

Whiteley.

The Diplomacy of the United States in regard to Central American Canals. By James Gustavus Whiteley. From the *North American Review*, September, 1897. Pp. 364-378.

AUSTRALASIA AND PACIFIC ISLANDS.

Austra'asia—Exploration. *Deutsche Rundschau G.* 19 (1897): 448-455. Greffrath.

Fortschritte der geographischen Forschungen und Reisen im Jahre 1896. I. Anstralien und die Südeee. Von Henry Greffrath.

Australia—Discovery.

Macdonald.

Trans. R.G.S. Australasia (Victoria) 14 (1897): 20-28.

Notes on "The Discovery of the Eastern Coast of New Holland" (Australia), by Captain Cook. By A. C. Macdonald. *With Portrait and Chart.*

Ellice Group—Zoology.

Hedley.

Australian Museum, Sydney. Memoir III. The Atoll of Funafuti, Ellice Group: its Zoology, Botany, Ethnology, and General Structure, based on collections made by Mr. Charles Hedley. Part 3. Sydney, 1897. Size 10 × 6½, pp. 163-226. *Plates. Presented by the Australian Museum.*

Fiji—Meteorology.

Vaughan.

Fiji. Meteorological Observations taken at Suva during 1896. By J. D. W. Vaughan. Suva, 1897. Size 13½ × 8½, pp. 16.

The mean temperature of the year was 79°, that of January, February, March, and April (summer) each 83°, and of July, August, September, and October (winter), within a degree of 76°. The absolute minimum was 60° on July 20, the maximum 94° on April 5. Rain fell on 259 days, with a total of 79 inches for the year, February, October, and December being the wettest months, June and August the driest. The wind was east on 145 days, and north-east or south-east on 147. There was only one record of west wind.

New Guinea.

Ann. Hydrographie 25 (1897): 321-323.

Krieg.

Hydrographische Beobachtungen während der Rundreise S.M.S. "Falke," Kommandant Korv.-Kapt. Krieg, im Schutzgebiet Neu-Guineas und des Bismarck-Archipels und der Reise von Matupi nach Sydney. Januar-Februar, 1897.

New South Wales. *J. and P.R.S. New South Wales* 30, 1896 (1897): 214-285. Curran.

On the Occurrence of Precious Stones in New South Wales, and the Deposits in which they are found. By Rev. J. Milne Curran. *With Plates.*

POLAR REGIONS.**Antarctic Islands.**

Tour du Monde 3 (1897): 367-408.

Mercié.

Aux Terres de Kerguelen, îles de St.-Paul et d'Amsterdam. Par M. E. Mercié. *With Map and Illustrations.*

A visit to the islands of the Southern ocean by a French man-of-war in 1892-93.

Arctic Geology.

Nature 56 (1897): 301-303, 351-352.

Gregory.

Some Problems of Arctic Geology. I. The Polar Basin; II. Former Arctic Climates. By Dr. J. W. Gregory. *With Sketch-maps.*

Arctic—Glaciers.

Rabot.

Commission Internationale des Glaciers. Les variations de longueur des Glaciers dans les Régions Arctiques et Boréales. Par M. Charles Rabot. Première partie. Extrait des *Archives des Sciences physiques et naturelles*, t. iii. pp. 163 et 301. Genève: H. Georg & Cie., 1897. Size 9½ × 6½, pp. 86. *Presented by the Author.*

Arctic—Ice-Limits. *Ann. Hydrographie* 25 (1897): 313-316.

Die Eisgrenze zwischen Grönland—Island—Spitzbergen. *With Diagrams.*

Three maps are given, showing the approximate boundaries of sea-ice in the North Atlantic for the respective months of May, June, and July.

Arctic—Nansen's Expedition. *Petermanns M.* 43 (1897): 128-132, 153-163. **Supan.**

Die norwegische Polarexpedition, 1893-96. Von A. Supan.

A detailed review of Dr. Nansen's book, including a critical comparison of some points of difference between the English and German editions.

MATHEMATICAL GEOGRAPHY.

Geodesy—Measures. *C. Bd.* 125 (1897): 199-203. **Wolf.**

Le Gnomon de l'Observatoire et les anciennes Toises; restitution de la Toise de Picard. Note de M. C. Wolf. [Also in *Rev. Scientifique* 8 (1897): 193-195.]

The discovery of a manuscript of J. Cassini, written in 1682, has enabled the hitherto unknown error of the toise of Picard to be determined. It proves to be about one-thousandth part shorter than the toise of Cassini; and thus the meridional arc-measurements of Picard may at last be accurately compared with modern results.

Photographic Surveying. **Rosenmund.**

Untersuchungen über die Anwendung des Photogrammetrischen Verfahrens für Topographische Aufnahmen. Bericht an das eidgenössische topographische Bureau von M. Rosenmund. Bern: Fritz Haller & Co., 1896. Size $9\frac{1}{2} \times 7$, pp. 42. *Illustrations.* Price 2s. 6d.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Botanical Maps. *Scottish G. Mag.* 13 (1897): 537-541. **Herbertson.**

The Mapping of Plant Associations. By Andrew J. Herbertson. Also separate copy. Size $10 \times 6\frac{1}{2}$, pp. [6]. *Presented by the Author.*

A study of the conditions on which botanical mapping depends, and on the methods of overcoming the difficulties in this kind of representation.

Earth-Pillars. **Kittler.**

Münchener geographische Studien. Herausgegeben von Siegmund Günther. Drittes Stück: Ueber die geographische Verbreitung und Natur der Erdpfpyramiden. Von Dr. Christian Kittler. München: T. Ackermann, 1897. Size $9\frac{1}{2} \times 6$, pp. 56. *Illustrations.*

This will be referred to in a note.

Glacial Land-forms. *J. Geology* 5 (1897): 421-465. **Taylor.**

Moraines of Recession and their Significance in Glacial Theory. By Frank Bursley Taylor. *With Maps.*

Islands. *B.S.B. Belge G.* 21 (1897): 5-22, 113-132, 201-217. **De Windt.**

Recherches sur la constitution des îles. Par Dr. Jean de Windt.

Meteorology. **Duclaux.**

Smithsonian Contributions to Knowledge. 1034. Hodgkins Fund. Atmospheric Actinometry and the Actinic Constitution of the Atmosphere. By E. Duclaux. Washington: The Smithsonian Institution, 1896. Size 14×10 , pp. 48.

Meteorology—Föhn. *Sitzb. K.A. W. Wien.* 105 (Abth. II. a.) (1896): 117-137. **Perner.**

Die allgemeine Luftdruckvertheilung und die Gradienten bei Föhn. Von J. M. Perner. *With Diagrams.*

On the general conditions of atmospheric pressure during Föhn winds, illustrated by the isobars of Europe for several typical instances.

Meteorology—Temperature. **Arrhenius.**

Bihang K. Svenska Vetens.-A. Handlingar 22 (1896): 1-102.

Ueber den Einfluss des atmosphärischen Kohlensäuregehalts auf die Temperatur der Erdoberfläche. Von Svante Arrhenius.

Oceanography—Currents. *Scottish G. Mag.* 13 (1897): 515-523. **Davis.**

Winds and Ocean Currents. By Prof. W. M. Davis.

This will be specially noticed.

Oceanography—Loch Fyne.**Mill**

Report on Physical Observations bearing on the Circulation of the Water in Loch Fyne in April and September, 1896. By Hugh Robert Mill, D.Sc. [Part iii. Fifteenth Annual Report of the Fishery Board for Scotland. Pp. 262-279.] Size 10 x 6½. Presented by the Author.

The results of this research are summarized in a note.

Oceanography—North Atlantic. B.S.G. Com. Bordeaux 20 (1897): 2732-86.**Hautreux.**

Atlantique nord; vents, courants et glaces en 1895-1896. Par A. Hautreux. With Chart.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.**Ancient Symbols.****Wilson.**

The Swastika, the earliest known Symbol, and its Migrations; with Observations on the Migration of Certain Industries in Prehistoric Times. By Thomas Wilson. —Annual Report of the Board of Regents of the Smithsonian Institution . . . for the year ending June 30, 1894. Report of the U.S. National Museum. Pp. 757-1011. Washington, 1896. Size 9½ x 6. Map and Illustrations.

A study of the sign of the cross in all lands and at all periods from the prehistoric to the early Christian.

Anthropogeography. Scottish G. Mag. 13 (1897): 475-487.**Chisholm.**

On the Relativity of Geographical Advantages. By G. G. Chisholm, M.A., etc.

Colonization. P. Literary and Philosoph. S. Liverpool 50 (1896): 1-44.**Nevins.**

Systems of Colonization from Prehistoric Periods and their Results. By J. Kirkbeck Nevins, M.D.

This paper passes in brief review the successive colonizations of prehistoric peoples, Phœnicians, Greeks, and Romans, the Teutonic colonization of England, and modern colonization by European nations.

Commercial Geography. Deutsche Rundschau G. 20 (1897): 33-34.

Begleitworte zur Colonial- und Weltverkehrskarte. With Map.

The map, on Mercator's projection with equatorial scale of 1 : 85,000,000, shows the colonial possessions of all European powers by different colours, the most important ocean-routes and telegraph cables, the great trans-continental railways, and the limits of navigation on great rivers.

Historical—Cabot. B.S.G. Italiana (3) 10 (1897): 224-235, 270-287.

Giovanni Caboto. Quarto centenario della scoperta del continente Nord-Americano. With Portrait, Map, and Illustration.

History of Geography.**Phillip.**

P. Literary and Philosoph. S. Liverpool 50 (1896): 313-339.

The Enlargement of the Geographical Horizon, as illustrated in the History of Cartography, down to the end of the age of Discovery. By George Phillip, Junr.

A concise summary of the history of geographical exploration.

Primitive Travel.**Mason.**

Primitive Travel and Transportation. By Otis Tufton Mason.—Annual Report of the Board of Regents of the Smithsonian Institution . . . for the year ending June 30, 1894. Report of the U.S. National Museum. Pp. 237-593. Washington, 1896. Size 9½ x 6. Illustrations. Presented by the Smithsonian Institution.

A remarkable account of the appliances for facilitating travel and transport employed by primitive races, illustrated from specimens in the Smithsonian Museum. The snow-goggles used by Eskimos are amongst the most curious.

Town-sites.

J. School G. 1 (1897): 225-231.

Semple.

Some Geographic Causes determining the Location of Cities. By Ellen C. Semple.

BIOGRAPHY.**Benincasa.**

Riv. G. Italiana 4 (1897): 443-448.

Bruzzo.

Di Grazioso Benincasa e del suo Portolano (una lettera inedita). G. Bruzzo.

An account of Benincasa and his nautical work (1435-45), contained in a hitherto unpublished letter (dated 1770) from Bernadino Noja, vicar-general at Ancona, to the Cardinal Stefano Borgia.

Cabot. *Deutsche Rundschau G.* 20 (1897): 36-40. **Wolkenhauer.**
Giovanni Caboto. Zur Erinnerung an die Entdeckung Nord-Amerikas durch denselben im Sommer 1497. Von Dr. W. Wolkenhauer. *With Portrait.*

Celtis. **Gaiger.**
Münchener geographische Studien. Herausgegeben von Siegmund Günther. Zweites Stück: Conrad Celtis in seinen Beziehungen zur Geographie. Von Dr. Theodor Geiger. München: T. Aokermann, 1896. Size 9½ × 6, pp. 40.

Conrad Celtis was born near Würzburg in 1459, and died in 1508. He wrote on the topography of Germany amongst other subjects.

d'Anville. *Deutsche Rundschau G.* 19 (1897): 468-471. **Wolkenhauer.**
J. B. Bourgnignon d'Anville. Von Dr. W. Wolkenhauer. *With Portrait.*

Knox. **Ferguson.**
Captain Robert Knox: The 'Twenty Years' Captive in Ceylon, and Author of 'An Historical Relation of the Island Ceylon, in the East Indies' (London, 1681). Contributions towards a Biography. By Donald W. Ferguson. Colombo (Ceylon) and Croydon, 1896-97. Size 10 × 7½, pp. 72. *Presented by the Author.*

An interesting biography of a merchant-adventurer of the seventeenth century, whose memory the author believes is not done justice to in the Dictionary of National Biography.

Raleigh. **Hume.**
Sir Walter Raleigh. The British Dominion of the West. By Martin A. S. Hume. (Builders of Greater Britain. Edited by H. F. Wilson, M.A.) London: T. Fisher Unwin, 1897. Size 8 × 5½, pp. xviii. and 432. *Portrait and Maps. Price 5s. Presented by the Publisher.*

This is a notable biography from the geographical point of view, dealing as it does with a great personality engaged in the first colonizing ventures of England. The maps are mere sketches, and there is no attempt to enrich the text with facsimiles of contemporary documents, but the book is well printed and attractive; it should be valuable for reading in schools, combining as it does geography and history with biography.

Thomson. *Nautical Mag.* 66 (1897): 855-857. _____

The Editor's Album: Captain A. S. Thomson, O.B., R.N.R. *With Portrait.*

GENERAL.

Bibliography of Geography.

Bibliographie de 1896. 6^e Bibliographie annuelle.—Annales de Géographie. No. 29—6^e Année. 15 Septembre 1897. Paris: A. Colin et Cie. Size 10 × 6½, pp. 288.

This selected and annotated bibliography fully maintains the high character of the earlier volumes. In many cases the abstracts of the memoirs noted are so full as to make it unnecessary for any except the specialist student to refer to the originals.

British Empire. *Scottish G. Mag.* 13 (1897): 400-419. _____

Notes on Exploration within British Territory during the last Sixty Years.

A sketch of explorations carried out during the Queen's reign in British territory. The summary is classified according to continents.

Church Missionary Society.

Proceedings of the Church Missionary Society for Africa and the East. Ninety-eighth Year, 1896-97. London: Church Missionary House, 1897. Size 8½ × 6, pp. lxxx., 454, and (360). *Maps. Presented by the Church Missionary Society.*

Educational—Methods. *Scottish G. Mag.* 13 (1897): 523-530. **Dodge.**

School Geography in the United States. By Prof. Richard E. Dodge.

An excellent statement of the position of geography as a school-subject in the United States, with copious references to the literature of the subject.

Educational—Methods.

Education Department. Special Reports on Educational Subjects, 1896-97. London: Eyre & Spottiswoode, 1897. Size 10 × 6½, pp. iv. and 732. *Maps and Illustrations. Price 3s. 4d. Presented by the Education Department.*

The geographical features of this volume will be referred to in a special note.

Educational—Textbook.**Redway.**

The Natural Geographies. Natural Elementary Geography. By Jacques W. Redway. New York, etc., American Book Co. [1897]. Size 10½ × 8½, pp. 144. *Maps and Illustrations. Presented by the Publishers.*

In a circular accompanying this volume, high claims are made for originality and utility. It is really a creditable example of an American text-book on the usual plan; the quarto size, excellent small-scale illustrations in the text, clear but somewhat crude coloured maps, also printed in the text, and effective diagrammatic relief maps are none of them new features. The neglect of countries outside the United States is also an established feature in American geographical books. Canada is called a "minor country of North America," and receives utterly inadequate notice even for the most elementary school. The style is often childish, and the points selected for notice are occasionally trivial.

Geographical Progress. *Scottish G. Mag.* 13 (1897): 449-466.**Keltie.**

Address to the Geographical Section of the British Association. [Toronto, 1897.]
By J. Scott-Keltie, LL.D.

Geographical Year-book.**Wagner.**

Geographisches Jahrbuch. XX. Band, 1897 . . . herausgegeben von Hermann Wagner. Erste Hälfte. Gotha: Justus Perthes, 1897. Size 9 × 6, pp. 248. *Price 7s. 6d.*

This issue contains Reports on recent progress in Terrestrial Magnetism, by Prof. Karl Schering, of Darmstadt; on the geognostic structure of the Earth's surface, by Prof. Franz Toula, of Vienna; on explorations of Africa, Australia, and America, by various writers; on the progress of Oceanography, by Prof. Krummel, of Kiel; and on the literature of the History of Geography since the Middle Ages, by Prof. Buge, of Dresden. The second division completing the annual volume is announced for early publication.

German Colonial Literature.**Brose.**

Die Deutsche Kolonialliteratur von 1884-1895. Mit einem Anhang: Verzeichnis von Werken, die sich auf fremdländische Kolonien beziehen und in der Bibliothek der Deutschen Kolonialgesellschaft vorhanden sind. Herausgegeben von der Deutschen Kolonialgesellschaft bearbeitet von Maximilian Brose. Berlin, 1897. Size 9½ × 6½, pp. vi. and 158. *Presented by the Deutsche Kolonialgesellschaft.*

A classified catalogue which bears marks of careful compilation, and appears to be very complete.

Missionary Exploration. *B.S.G. Lyon* 14 (1897): 417-453.**Groffier.**

Explorations et travaux géographiques des Missionnaires Catholiques en 1896.
Par M. Valérien Groffier.

The exploring journeys of Roman Catholic missionaries are here recounted for Oceania, America, Europe (Iceland), Africa, and Asia.

Mountains—Definition. *Deutsche Rundschau G.* 19 (1897): 347-356, 406-415. **Neuber.**

Was ist ein Gebirge? Von August Neuber.

Nautical Almanac Office. *Nautical Mag.* 66 (1897): 435-446.**Lord.**

The "Nautical Almanac" Office. By W. B. Lord.

A popular description of the Nautical Almanac Office and the routine of its work.

Navigation.**Cooper.**

A New Theory of the Stability of Ships (with Diagrams). By Alfred J. Cooper. London: J. D. Potter, 1897. Size 10 × 6½, pp. 30. *Price 2s.*

North Africa and Arabia.**Rossi.**

G. B. Rossi. Nei paesi d'Islam in Barberia—in Egitto—il Pellegrino d'Islam—el Yemen. Impressioni e Ricordi. Rocca S. Casiano, L. Cappelli, 1897. Size 9½ × 6½, pp. viii. and 240. *Illustrations and Map. Presented by the Author.*

Account of a journey from Tunis into Tripoli, thence to Egypt, followed by an account of the pilgrimage to Mecca, and a visit to Yemen.

Oriental Literature.**Müller.**

The Sacred Books of the East, translated by various Oriental Scholars, and edited by F. Max Müller. Vol. xxxviii. (pp. 508); vol. xlii. (pp. lxxiv. and 716); vol. xiv. (pp. xlii. and 456); vol. xlv. (pp. x. and 500). Oxford: the Clarendon Press, 1895-97. Size 9 × 6. *Presented by the Secretary of State for India.*

Oriental Studies.**Schlagintweit.**

Die Berechnung der Lehre. Eine Streitschrift zur Berichtigung der buddhistischen Chronologie verfasst im Jahre 1501 von Sureçamatibhadra. Aus dem Tibetischen übersetzt von Emil Schlagintweit. Aus den Abhandlungen der k. bayer. Akademie der Wiss I. Cl. xx. Bd. iii. Abth. München, 1896. Size 11½ x 9, pp. 82. Presented by D. W. Freshfield, Esq.

Pacific Ocean.

Deutsche Seewarte. Segelhandbuch für den Stillen Ocean. Mit einem Atlas von 31 Karten herausgegeben von der Direktion. Hamburg: Friederichsen & Co., 1897. Size 11 x 8, pp. xii. and 916. Diagrams. Presented by Dr. Neumayer.

This large volume is the outcome of the researches of the German Naval Observator: at Hamburg, and embodies the experience of the masters of German merchant vessels cruising in the Pacific. Nearly half is a scientific treatise on the physical geography of the Pacific ocean, taking account of the oceanographical and meteorological researches of all countries; the other half consists of sailing directions for the principal routes frequented by merchant vessels.

NEW MAPS.By J. COLES, *Map Curator*, R.G.S.**EUROPE.****England and Wales.****Ordnance Survey.**

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(E. Stanford, Agent.)

England and Wales.**Bartholomew.**

New Reduced Ordnance Survey of North Northumberland. Scale 1:125,000 or 2 stated miles to an inch. J. Bartholomew & Co., Edinburgh, 1897. Price 2s. each, mounted on cloth. Presented by the Publishers.

Greece.**Philip.**

Philip's Special Map of Greece, illustrating the Greco-Turkish War, and the Cretan Question, with inset maps of the seat of war (on an enlarged scale), the Balkan peninsula, and the Mediterranean sea. Scale 1 : 1,330,560 or 21 stat. miles to an inch. By G. Philip & Son, London, 1897. *Price 1s. each. Presented by the Publisher.*

Historical Geography.**Poole.**

Historical Atlas of Modern Europe from the Decline of the Roman Empire; comprising also maps of parts of Asia and of the New World, connected with European History. Edited by Reginald Lane Poole, M.A., PH.D. Lecturer in Diplomatic History in the University of Oxford. Part xiii. Oxford: The Clarendon Press; London, Edinburgh and Glasgow: Henry Frowde, M.A.; Edinburgh: W. & A. K. Johnston. 1897. *Price 3s. 6d. Presented by the Clarendon Press.*

Part xiii. contains: No. 5, Europe at the time of Otto the Great, 962, by the editor; No. 35, Germany under the House of Hohenstaufen, 1138-1254, by the editor; No. 70, The House of Savoy in Italy, by Miss K. Dorothea Ewart. Each of the maps is accompanied by explanatory letterpress by the authors.

Switzerland.**Ravenstein.**

Karte der Schweizer Alpen. Gezeichnet von Hans Ravenstein. Scale 1 : 253,440 or 4 stat. miles to an inch. 2 sheets. L. Ravenstein, Frankfurt, 1897. *Price 6 marks.*

This may be regarded as a companion map to Ravenstein's "Karte der Ostalpen," the scale and style of work being precisely similar. It is orographically coloured in fourteen shades, at intervals of 250 metres. In addition to the above, it shows all means of communication, and is an excellent general map for the use of tourists and others.

ASIA.**Indian Government Surveys.****Surveyor-General's Office, Calcutta.**

Indian Atlas, 4 miles to an inch. Sheets: No. 68, districts Etah, Farukhabad, Mainpuri, Etawah, Cawnpore, etc.; No. 80, parts of districts Madura, Tanjore, and Ramnad (Madras Presidency), and Tondiman (Native State); No. 112, parts of districts Darbhanga, Musaffarpur, Patna, Gaya, Hazaribagh, Monghyr, Bhagalpur, Sonthal Parganas, Dinajpur, Malda, Murshidabad, and Purnea (Bengal); No. 113, parts of districts Birbhum, Burdwan, Bhagalpur, etc. (Bengal). Quarter-Sheets: 3 s.e., part of district Karachi (Sind) and of Cutch State (Bombay Presidency); 3 n.w., part of district Karachi (Sind); 13 n.w., parts of districts Okhamandal, Halar, and Barda (Kathiawar, Bombay Presidency); 22 s.w., parts of Kathiawar, Jhalavad, and district Ahmedabad (Bombay Presidency); 2 n.e., parts of districts Karachi and Hyderabad (Sind, Bombay Presidency); 1a s.e., parts of districts Shikarpur and Upper Sind frontier (Sind, Bombay Presidency); 22 a.e., parts of districts Ahmedabad, Broach, Kaira, and Panch Mahals of Jhalawad (Kathiawar), and the Native States of Baroda, Cambay, Mahi Kanta, and Rewa Kanta (Bombay Presidency); 27a s.e., part of Baltishan or Little Tibet; 36 s.w., parts of districts Panch Mahals and Kaira, and Native States of Baroda, etc. (Bombay Presidency), Indore, Jhabua, Rajpur Ali, and Jobat (Central India Agency); 51 n.e., parts of Native States of Gwalior (Central India Agency), Kerowlee, and Dholpur (Rajputana Agency); 51 s.w., parts of Native States of Gwalior (Central India Agency), Boondee, Tonk, Jeypore, Kotah, and Jhallowar (Rajputana Agency); 53 n.e., parts of Gwalior (Sindhia) and Bhopal Native States; 69 n.e., parts of districts Hamirpur, Fatehpur, Unao, Jalaun, Banda, Etawah, Cawnpore, and Rae Bareilly; 78 s.w., parts of districts Salem, North Arcot, and South Arcot (Madras Presidency), and of Kolar (Mysore); 126 n.w., parts of districts Dacca, Mymensingh, Tippera, Sylhet, and Hill Tippera; 127 n.e., parts of districts Noakhali, Chittagong, and South Lushai Hills (Bengal); 130 n.e., parts of districts Sibsagar and Naga Hills, and of Naga tribes (Assam); 131 s.w., portions of districts Cachar and North Lushai Hills, and of Manipur Native State (Assam).—Railway Map of India, railways brought up to March 31, 1897, 1 inch to 48 miles, 4 sheets.—India, showing railways, corrected up to March 31, 1897. Sheet No. 29 of Gujarat (2nd ed.t.), parts of the Kaira and Panch Mahals districts, of the Gaikwar's territory, and of the Rewa Kantha States, 1 inch to a mile, Season 1876-77.—Bombay Survey, 1 inch to a mile. No. 209, parts of district Ratnagiri and Savantvadi States, Season 1893-94; No. 246, district North Kanara, Season 1893-94; No. 337, parts of districts Dharwar (Bombay), Shimoga, and Chitaldroog (Mysore), Seasons 18c2-88 und 1893-94; No. 391, district Mymensingh, portions of Tippera

and Sylhet (Assam), Seasons 1855-56 and 1860-62.—Madras Survey, 1 inch to a mile. No. 24 (2nd edit.), parts of districts Shimoga and Chitaldroog (Mysore) and Dharwar (Bombay), Seasons 1882-88 and 1893-94.—Lower Burma Survey, 1 inch to a mile. No. 184, districts Hensada and Bassein, Seasons 1882-85.—Upper Burma Survey, 1 inch to a mile. No. 126, district Minbu, Season 1891-92.—Indus Riverain Survey, 1 inch to a mile. Nos. 33, 18 and 35, 34, 35, 36 (skeletons), district Karachi, Season 1894-95; No. 51 (skeleton), districts Karachi and Hyderabad, Season 1894-95.—District Murshidabad, Lower Provinces, Bengal, 4 miles to an inch, with corrections to February, 1897.—District Garhwal, Seasons 1864-69 and 1872-75, 1 inch to 2 miles.—Punjab, 80 miles to an inch, additions to 1896.—Chota Nagpur Division, 1 inch to 8 miles, 1897.—The North-Western Provinces and Oudh, 16 miles to an inch, 1897.—District Gurdaespur, Punjab, 1 inch to 8 miles, 1897.—District Chanda, 1 inch to 16 miles, Central Provinces, 1897.—District Rawalpindi, Punjab, 1 inch to 8 miles, 1897.—District Gujranwala, Punjab, 1 inch to 8 miles, 1897.—District Darbhanga, Bengal, 1 inch to 8 miles.—District Jalpaiguri, Bengal, 1 inch to 8 miles, 1890.—District Rangpur, Bengal, 1 inch to 8 miles, 1891.—District Saugor, Central Provinces, 1897.—District Jhang, Punjab, 1 inch to 8 miles, 1897.—District Lohardaga, Bengal, 16 miles to an inch, 1894.—District Wardha, Central Provinces, 8 miles to an inch, 1897.—District Saran, Bengal, 8 miles to an inch, 1891.—District of Mandla, 1 inch to 8 miles, 1897.—District Sonthal Parganas, Bengal, 10 miles to an inch, 1891.—North-East Frontier, 4 miles to an inch, country round Myilkyiana (Upper Burma), parts of sheets No. 23 n.w. and n.e.—Map of Waziristan, 4 miles to an inch, 1897.—Bajaur and adjacent countries, 4 miles to an inch, 1897.—Calcutta and surrounding country (2nd edit.), 1 mile to an inch, 1897.—Index to the Standard Sheets of the Central Provinces, with additions and corrections to 1897.—Index to the Standard Sheets of Bombay Presidency, with additions and corrections up to 1897.—Index to the Standard Sheets of Central India and Rajputana, sheets 1 and 2, with additions and corrections up to 1897.—Conventional signs to be used on topographical maps with additions and corrections to 1897. *Presented by H. M. Secretary of State for India, through the India Office.*

Manchuria.**Russian Ministry of Finance.**

Russian Map of Manchuria. Scale 1 : 3,360,000 or 53·1 stat. miles to an inch. Russian Ministry of Finance, St. Petersburg, 1897.

This map shows the various proposed routes for the extension of the Trans-Siberian railway towards the southern portion of Manchuria. The lettering is in Russian character.

North-West Frontier of India.**Philip.**

Philip's Large-Scale Map of the North-Western Frontier, with a map showing the Overland Routes to India, and a Military Map of the Indian Empire. Scale 1 : 4,000,000 or 63 stat. miles to an inch. G. Philip & Son, London, 1897. *Price 1s. each. Presented by the Publisher.*

Persia.**Stahl.**

Geologische-Karte des nördlichen Persien. Nach Originalaufnahmen von A. F. Stahl. Scale 1 : 840,000 or 14·7 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Ergänzungsheft, No. 122, Blatt 1, 2, 3, 4. Gotha : Justus Perthes, 1897. *Presented by the Publisher.*

AFRICA.**Africa.****Stanford.**

Large-scale map of the Nile from Dongola to Khartum, and of the Desert Route from Suakin to Berber. Scale 1 : 1,140,480 or 18 stat. miles to an inch. By E. Stanford. Stanford's Geographical Establishment, London, 1897. *Presented by the Publisher.*

Algeria.**Service Géographique de l'Armée, Paris.**

Carte d'Algérie. Scale 1 : 50,000 or 0·78 stat. mile to an inch. Sheets: 109, Sidi Madjour; 111, Souagui. Dressé, héliogravé et publié par le Service géographique de l'Armée, Paris. *Price 1·50 fr. each sheet.*

Egypt.**Philip.**

Philip's New Map of the Nile Valley and the Approaches to Khartum. Scale 1 : 5,677,056 or 89·6 stat. miles to an inch. G. Philip & Son, London, 1897. *Price 1s. each. Presented by the Publisher.*

Egypt.**Bartholomew.**

Bartholomew's Tourist's Map of Egypt and the Lower Nile. Scale 1:1,000,000 or 15.6 stat. miles to an inch. J. Bartholomew & Co., Edinburgh, 1897. *Price 3s. each, mounted on cloth. Presented by the Publishers.*

Transvaal.**Hatch.**

A Geological Map of the Southern Transvaal. By F. H. Hatch, PH.D., F.G.S. Scale 1:240,000 or 3.75 stat. miles to an inch. 1897. Edward Stanford, London. *Presented by the Publisher.*

This map is geologically coloured, and is furnished with copious explanatory notes of reference.

Transvaal.**Hatch.**

Map of the Transvaal, showing the physical features and political divisions. By F. H. Hatch, PH.D., F.G.S. Scale 1:1,570,000 or 24.7 stat. miles to an inch. 1897. Edward Stanford, London. *Presented by the Publisher.*

West Africa.**Spicq.**

Carte de la Boucle du Niger dressée par le Lieutenant Spicq, de l'infanterie de marine ayant pour base la Carte de M. le Gouverneur Binger et les travaux récents du Capitaine Marchand complétée et mise à jour. Scale 1:1,500,000 or 23.5 stat. miles to an inch. Service Géographique des Colonies. Paris, 1897. Maison Ardriveau-Goujon. Henry Barrère, Editeur-Géographe.

This map includes all the country between the Niger and the West Coast, and is based on the most recent surveys. The routes followed by numerous explorers, as well as those reported by the natives, are shown. The boundaries up to the date of publication are clearly defined, but in some cases they already require revision. At the present time, owing to disputes as to what nation certain portions of the territory belong, this cannot fail to be an interesting map.

AMERICA.**British North America.****Stanford.**

Stanford's Map showing the position of the Yukon goldfields. Scale 1:5,094,144 or 80.4 stat. miles to an inch. E. Stanford, London, 1897. *Presented by the Publisher.*

Peru.**Viellerobe.**

Mapa del Peru. A. F. J. M. Viellerobe. Scale 1:2,908,224 or 45.9 stat. miles to an inch. Lima, 1896.

This map, which has been published under the authority of the Government, will be useful for purposes of general reference. All railways and lines of submarine telegraph cables are laid down, and the relative importance of towns is shown by symbols.

PHOTOGRAPHS.**Baluchistan.****Bremner.**

Six photographs of Quetta and surrounding country. Taken from the fort, by F. Bremner, Esq. *Presented by G. P. Tate, Esq.*

These photographs, which have been taken by Mr. F. Bremner, show views of Quetta and the scenery in its vicinity. Four of them form a connected series of views looking towards the east, the remaining two are consecutive pictures looking towards the west. The spot from which they were taken is a commanding position in the fort, and the time of year was the early part of the winter.

The photographs are remarkably good specimens, and convey a very clear idea of the station and its environment.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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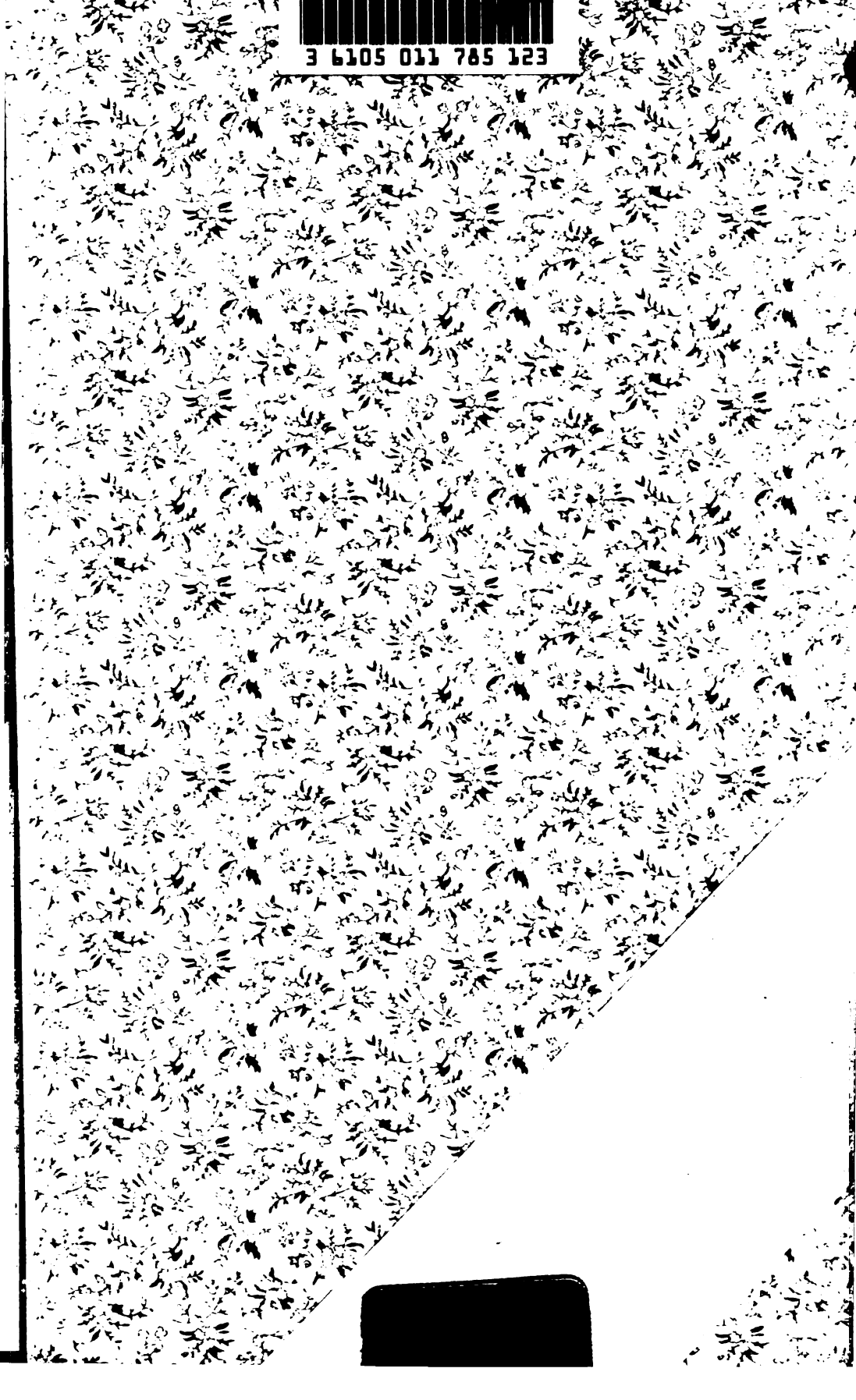








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