Edw. A. Fitz Gerald.

Vol. XIII. No. III.

PROCEEDINGS

OF THE

ROYAL GEOGRAPHICAL SOCIETY.

PUBLISHED UNDER THE AUTHORITY OF THE COUNCIL,

AND

EDITED BY THE ASSISTANT SECRETARY.

Issued July 20th, 1869.

CONTENTS.

ADDITIONAL NOTICES.

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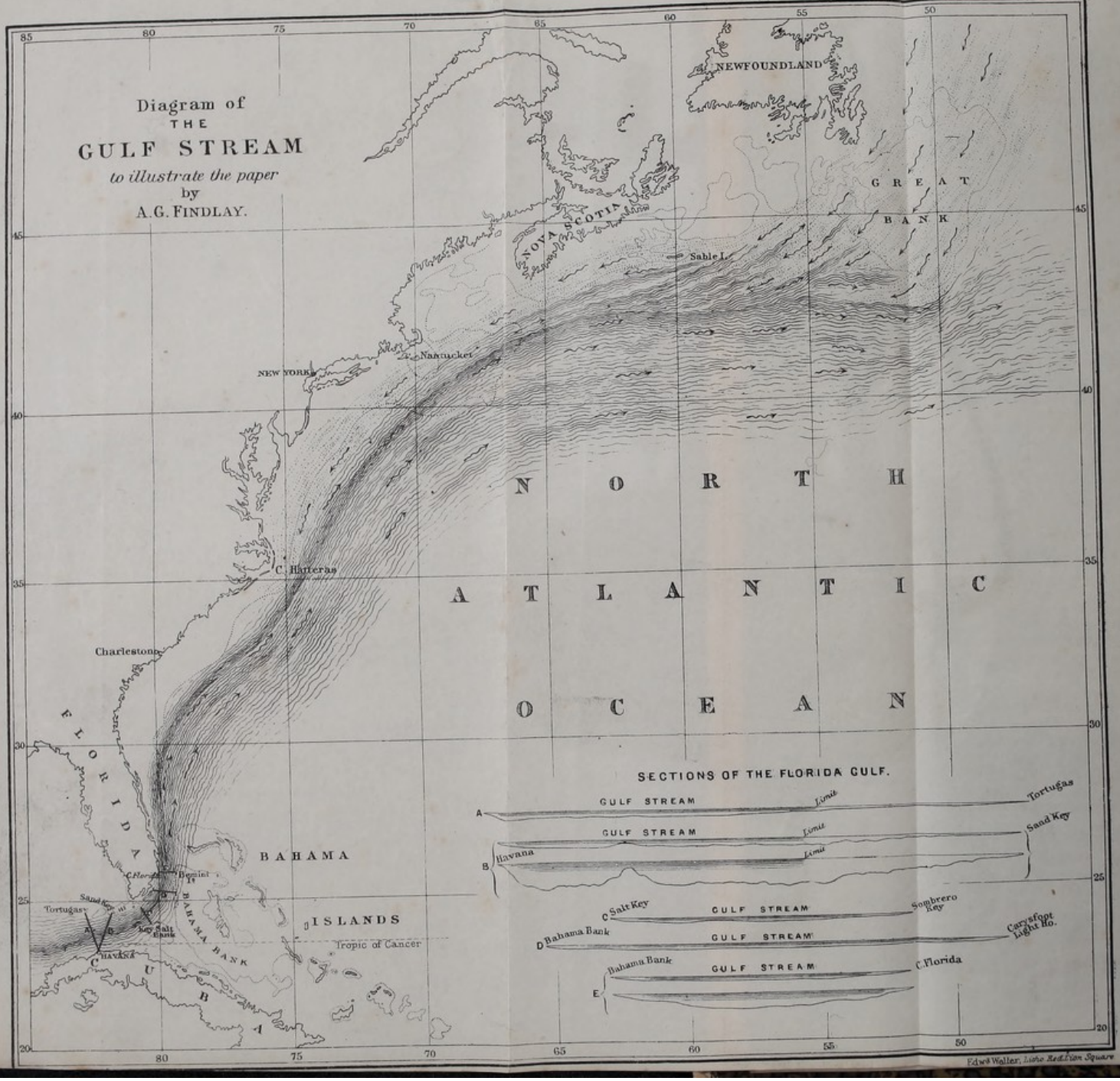

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PROCEEDINGS

OF

THE ROYAL GEOGRAPHICAL SOCIETY.

[Issued July 20th, 1869.]

SESSION 1868-69.

Eighth Meeting, March 8, 1869.

Major-General SIR ANDREW SCOTT WAUGH, R.E., F.R.S., Vice-President, in the Chair.

Presentation.—*Dr. Alfred Barry*, M.A.

Elections. — *Ebenezer Forster, Esq.; Sir Henry Green*, K.C.S.I.; *William Griffiths, Esq.* (Magistrate for Middlesex); *Lieut.-Colonel Nassau Lees*, D.C.L.; *F. T. Mott, Esq.; Lieut.-Colonel Edward Neville.*

Accessions to the Library from February 22nd to March 8th, 1869.—'Turkestan in 1866.' By P. N. Pascheno. (*In Russian.*) St. Petersburg, 1868. 'Il Giappone e il Viaggio della Corvetta *Magenta* nel 1868.' Per V. F. Arminjon. Genova, 1869. Donor, Il Commr. Negri Cristoforo. 'The Malay Archipelago.' By Alfred Russel Wallace. 2 vols. 1869. Donor, the author. 'The Geographical Distribution of Mammals.' By Andrew Murray. 1866. Purchased. 'A Journey to Kashgar in 1858.' By Captain Valikhanof. Translated from the Russian by R. Michell. Donor, the Viceroy of India. 'Notes on the North of China.' By the Rev. A. Williamson. 1867. Donor, Sir R. I. Murchison. 'Submarine Telegraph to India and Australia.' Donor, Major Leveson. Foreign Office List for 1869. Donor, Edward Hertslet, Esq.

Accessions to the Map-room since the last Meeting of February 22nd.—A large Polar Diagram of the Antarctic Regions, extending from the South Pole to the parallel of 50° s. Presented by Staff-Commander J. E. Davis, R.N. Two Diagrams, illustrating the transit of Venus over the Sun's disc for the year 1882. Presented by Staff-Commander Davis, R.N. A Pictorial Diagram of Cockburn

Island, in the Antarctic Regions. Presented by Staff-Commander Davis, R.N. A Bust of Richard Lander, Esq., the first Gold Medalist, discoverer of the course of the River Niger. Presented by Mrs. Elsom. Abyssinia, Eastern portion, showing the line of march of the Army under Lieut.-General Lord Napier of Magdala. On five sheets. Presented by Sir H. James, R.E., Director of Ordnance Survey. Admiralty Charts, 11 in number. Presented by the Lords Commissioners of the Admiralty, through the Hydrographer, Capt. G. H. Richards.

The CHAIRMAN, in announcing the subject of the paper, said, that it related to a region which had never been explored by scientific travellers, and therefore offered peculiar interest to geographers, whose motto was *terra incognita*. The region west and south-west of the Rocky Mountains was interesting in a geological point of view, and also in its ethnology. To the south of it were those peculiar people the Aztecs. The physical character of the country in some respects resembled Abyssinia and Thibet, where the rivers cut deeply into the earth and formed enormous ravines or cañons, which served as natural barriers against the extension of nomadic races.

The following Papers were read:—

1. *On the Physical Geography of the Colorado Basin and the Great Basin Region of North America.* By W. A. BELL, Junr., M.B., F.R.G.S.

THE country treated of in this paper lies between the Rocky Mountains on the east and the Sierra Nevada of California on the west, and was shown by the author to present many very remarkable topographical features. A description was first given of the Colorado Basin.

Dr. Bell joined the survey expedition dispatched by the Union Pacific Railway Company to determine the best route for a southern line of railway through New Mexico and Arizona to California. He traversed the western part of America between the 33rd and 31st parallels of latitude, recrossed the great interior plateaux farther north, and travelled through Sonora from north to south. The basin of the Colorado has an area of 200,000 square miles, and the Great Basin an area of 280,000 square miles. These basins are separated by the range of the Wahsatch Mountains, which have a breadth of 60 miles. The basin of the Colorado is of triangular shape, and consists of successive table-lands of from 4000 to 7000, or even 8000 feet in elevation, having abrupt edges and generally barren surfaces. The Green and Grand rivers passing over the table-lands have formed for themselves deep cañons. The great cañon of the Colorado has a length of 300 miles, and the sides of its gorge rise from 1000 feet to nearly a mile in perpendicular height. Last year James

White traversed this gorge on a raft of cotton-wood. Canoñs are formed entirely by the action of river-water. They cannot exist except where there are the following conditions: a dry climate, never-failing streams, and a slope great enough to give force to the current of water. In the case of the cañons of the Colorado Basin the surface-strata are soft, but the erosion, once begun, is carried on even through the hardest granite. Where cañons exist the table-lands above them must be barren. All the water flows away in the deep river-valleys, and tributary streams come to the chief river through tributary cañons. Central Arizona here and there has heights of volcanic origin. It is a fertile and beautiful country, abounding in pine, cotton-wood, grass, &c., rich in mineral wealth, and possessing a considerable rainfall. This last circumstance results from the fact that the Rocky Mountains proper terminate about the 35th parallel, and that the Sierra Madre of Mexico does not commence till some distance to the south-west, thus allowing the rain-laden winds from the Gulf of Mexico to penetrate to this part of the basin.

Dr. Bell traversed the cañon of the Aravaypa, a small tributary of the Colorado. The gorge has a length of 30 miles, but took six days and five nights for its passage. The travellers had to make their journey chiefly in the bed of the stream. At the entrance of the gorge was "Look-out" Mountain. The fall of the stream at first was about 50 feet in a mile; and the rocks on either side were first conglomerate, and then sandstone overlying granite. The vegetation was very dense, a perfect thicket of trees, through which progress could only be made at the rate of 2½ to 3 miles a day. Quails, kingfishers, wild turkeys, &c., were found in abundance. After 7½ miles the cañon narrows to the mere bed of the stream, and beyond this contracted part was found an open space, in which grew ash, willow, walnut, and other trees, and there was mistletoe in abundance. Farther on a change in the rocks took place, and volcanic rocks were seen. The great cactus (*Cereus giganteus*) was found in abundance, some of the plants rising to a height of 40 feet. Then came a second narrow gorge, and after that the sides of the cañon presented the appearance of rising in different stories. The ledges of rock represented slips of the sides of the cañon. The appearance of the camp at night was described as most picturesque. The sky seemed but a long narrow strip, brilliant with stars; the camp-fires blazed brightly, and the sounds of the camp-life were echoed from the sides of the cañon with great vividness. The cañons have proved very complete barriers against migrations from the south, and the Indians, particularly the Apaches, have set themselves to oppose

advancing civilisation as far as they can. The land becomes more and more dreary as the head of the Gulf of California is approached.

West and north-west of the Wahsatch Range lies the Great Basin, bounded westward by the Cascade Range and the Sierra Nevada, and having an average elevation of 5000 feet. Many small ranges traverse it from north to south, each range having an average width of 12 miles, and an elevation of 1000 to 4000 feet. Where it is irrigated, the soil of the Great Basin is rich and fertile; but it has many salt lakes, some of which are dried up, and have left behind salt incrustations. Earthquakes are frequent, hot springs very numerous, and mud-volcanoes are met with in some localities. The rainfall is very small in the Great Basin, and it has no one large stream. It is really a collection of small basins, the streams of which have not force enough to unite and form one large river. The lakes into which most of these streams flow have often no outlet, and are therefore salt. The Great Salt Lake is an example of these. Lake Utah, which has an outlet, is fresh. The whole of the Great Basin abounds in silver; in four years silver to the value of eleven millions of pounds sterling was sent out from this district alone.

The paper will be published entire in the 'Journal,' vol. xxxix.

The CHAIRMAN, in returning the thanks of the meeting to Dr. Bell, said, the paper was replete with fresh knowledge respecting a country of which we previously knew scarcely anything. With the attraction of the silver ridges he had no doubt the region would soon become better known.

Dr. BELL, in answer to the questions of members, made the following remarks on the native races who inhabited the region treated of in his paper.

The country for ages had probably been inhabited by indigenous tribes of a very low type; miserable people who lived by hunting, or upon roots, snakes, reptiles, and any decayed animal matter which they could find. When the Aztec races in Southern Mexico had become numerous and powerful, they extended their little communities as far north as they could, gradually advancing until they reached Central Arizona. The Aztecs found the country peopled by these inferior tribes of red men, who, although low in the scale of humanity, were very warlike, and resisted the advance of the semi-civilised intruders. Consequently, to protect themselves against the Apaches and others, the Aztecs built curiously fortified towns on the banks of the streams, consisting each of one large dwelling from three to five and seven stories high. Zuñi, which is situated on a southern tributary of the Colorado, was one of the few towns at present inhabited by the Aztecs or Pueblo Indians. They are a very industrious people. Until the Americans came into the country they were in the habit of growing their own cotton, making their own clothes, weaving and spinning, and also making a great deal of pottery and basket-work. They worshipped Montezuma, and burned the sacred fires, showing that they had come from the south. In their progress northward they kept to the west of the Mexican Cordilleras, and extended their migrations until, about lat. 36°, they encountered the Great Cañons of the Colorado, Colorado Chiquito, and San Juan rivers, which form by their union an impassable barrier, stretching from east to west for a distance exceeding 500 miles. These town-builders never entered the country north of the Great Cañon, and the reason

why we in England had heard so little of them is that English travellers had always passed north of their country, or else south of it in Tropical Mexico. The remains of fortified Indian towns are only found in Central Arizona, between lat. 36° and 32°, and the absence of them to the southward can only be explained by the fact that there were no Apaches there to molest the Aztec settlers. The cause of the depopulation of Central Arizona and New Mexico was this:—when the Spaniards invaded this country in the sixteenth century they found it full of people. They found the Aztecs the dominant race; and the wild Indians were so kept at bay that they were scarcely noticed by the Spaniards. They saw nothing of the wild men of the mountains; but they saw a great deal of these tame Indians, whom they enslaved, and compelled to work in their mines. After a century and a half, civil wars destroyed the power of the Spaniards; they could not keep their military establishments in proper order all over the country, and they left the enslaved people to fight for themselves. Having been so long demoralised by slavery, they were not such good warriors as they had formerly been, and the Apaches have almost cleared them off the face of the country. As the population decreased, irrigation had also ceased, and the country had become much drier. With the return of population there would probably be plenty of cultivation again in the valleys formerly occupied by the Aztecs, and the humidity of the climate would increase.

With respect to a rumour, some forty or fifty years ago, of the discovery of an Aztec city on the banks of the Colorado, he stated that Zuñi, which he had before alluded to, was, no doubt, the city in question. It was the only large Aztec town at present inhabited in that locality, and consisted of six stories or lofts. It was not what we should call an ancient city, probably about three hundred years old. But there were ruins of many towns which were larger than Zuñi. North of Fort Defiance there were seven villages, all built on the summit of cliffs, each admirably fitted for the purposes of defence. Each village consisted of one large house, three stories high; and each story contained thirty, forty, or a hundred rooms. Zuñi was built of squared stones; at some places the houses were built of sun-dried bricks, not cemented. The mode of entrance was very peculiar. There were no apertures on the ground-floor. The first story was reached by a ladder from the outside: then there were doors opening all round into different rooms from a ledge on the second story; and also there were round holes in the floor through which they passed down into the ground-floor. When the Apaches came, they drove their stock on to the top of the flat mountains or mesas with perpendicular sides; and then they got on to the top of their houses and fought hard. The early Spanish writers—particularly the great explorer Vasquez de Coronado—gave accounts of assaulting Zuñi, and others of these towns, and bore testimony to the bravery with which the defenders fought. He believed that these towns were built about 150 years before the Spaniards came into the country. When the Spaniards first came, they said Zuñi contained 11,000 inhabitants. At the present time there were scarcely 3000 inhabitants. The town was like one enormous house. The term Aztec gave rather an unfair idea of these races. They were not all one distinct tribe, although they fraternized together; as a number of semi-civilised races would do in waging war against wild and savage races. In different parts they differed very much. On the Rio Grande the Pueblo Indians were a small race; at Zuñi they were of better size. But the largest of the semi-civilised races that he had seen was in Sonora—the Papagos Indians. One day he had the opportunity of measuring five of them at a ranche, and the whole of them were over six feet three inches. With regard to distinctions of rank, the different tribes were very peculiar in that respect. Some of them were very aristocratic. There was a small colony of these Indians on the Gila called Pimas: these were too aristo-

cratic to work for hire. They used to grow cotton to an immense extent; but they did not do so now, because they could buy clothing at a much cheaper rate than they could make it for themselves. But they grew three times as much corn as they required for home consumption, and they sold it at a great profit through the medium of Government agents. The Papagos, on the contrary, were fond of hiring themselves out as labourers. At certain seasons they would leave their country—which was very barren and desolate—and hire themselves out for a dollar a day. They would till the ground, work in a mine, or do anything else. Then, when the proper season came round, they would go back to their own country, and cultivate their crops. They had a regular system of government; the head-man was appointed by universal suffrage. They were quite democrats in their notions. They married only one wife: they did not work their women to the extent the wild savages did; in fact, they treated them with a certain amount of respect. He had never known a Papago, a Pima, or a Zuñi Indian, beat his wife. Unfaithfulness on the part of their women was of very rare occurrence and was punished with death. They had flocks and herds in considerable numbers. Horses were scarce among them, because they could only get them from the Americans. Mules they valued very highly, and would give a high price for them—as much corn as would fetch 300 dollars.

2.—*On the Formation of Fjords, Cañons, and Benches.* By ROBERT BROWN, F.R.G.S.

1. FJORDS.—Intersecting the sea-coast of various portions of the world, more particularly in northern latitudes, are deep, narrow, inlets of the sea, surrounded generally by high precipitous cliffs, and varying in length from two or three miles to one hundred or more, variously known as, "inlets," "canals," "fjords," and even on the western shores of Scotland as "lochs." The nature of these inlets is everywhere identical, even though existing in widely distant parts of the world, so much so as to suggest a common origin. On the extreme north-west coast of America they intersect the sea-line of British Columbia to a depth in some cases of upwards of a hundred miles, the soundings in them showing a great depth of water, high precipitous walls on either side, and generally with a valley towards the head. On the eastern shore of the opposite island of Vancouver no such inlets are found, but on the western coast of the same island they are again found in perfection, showing that in all probability Vancouver Island was isolated from the mainland by some throe of nature prior to the formation of the present "canals" on the British Columbia shore, but that the present inlets on the western shore of Vancouver Island formed at a former period the seaboard termination of the mainland, and were dug out under conditions identical with those which subsequently formed the fjords now intersecting the coast.

Jervis Inlet may be taken as the type of nearly all of these inlets

here as well as in other portions of the world. It extends in a northerly direction for more than 40 miles, while its width rarely exceeds 1½ mile, and in some places is even less. It is hemmed in on all sides by mountains of the most rugged and stupendous character, rising from its almost perpendicular shores to a height of from 5000 to 6000 feet. The hardy pine, where no other tree can find soil to sustain life, holds but a feeble and uncertain tenure here, and it is not uncommon to see whole mountain-sides denuded by the blasts of winter or the still more certain destruction of the avalanche which accompanies the thaw of summer. Strikingly grand and magnificent, there is a solemnity in the silence and utter desolation which prevails here during the months of winter—not a native, not a living thing to disturb the solitude; and though in the summer a few miserable Indians may occasionally be met with, and the reverberating echoes of a hundred cataracts disturb the silence, yet the desolation remains and seems inseparable from a scene nature never intended as the abode of man. The depths below almost rival the heights of the mountain summit: bottom is rarely reached under 200 fathoms even close to the shore.* The deep inlets on the Norwegian coast, known as *fjords*, a familiar name now applied generally to such breaks in the coast-line, are too well known to require description. On the coast of Greenland are again found similar sounds, indenting both sides of that island (?), but more particularly the western or Davis Strait shore. Most of these inlets are thickly studded with floating icebergs, and others are so densely choked with them as to receive the names of ice-fjords. All of these fjords form the highways by which the icebergs float out from the glaciers at their heads, whenever these prolongations of the great *Mer de Glace* of Greenland (the "inlands iis") reach the sea. After a long and careful study of these fjords in most parts of the world where they are found, I have come to the conclusion that we must look upon glaciers as the material which hollowed them in such a uniform manner. Everywhere you see marks on the sides of the British Columbian fjords of ice-action, and there seems no reason to doubt but that they were at one time the beds of ancient glaciers, which grinding their outward course to the sea scooped out these inlets of this great and uniform depth. At this present day, not far from the head of most of these inlets, glaciers are found in the Coast range and Cascade Mountains, and along both ranges marks of old glacier-action can be seen 2000 to 3000 feet below their summits, and even near the sea-margin. Such

* 'Vancouver Island Pilot,' p. 139. Richards.

a depression of the coast, with the presence of the lower temperature then prevailing, would fill these fjords with glaciers. I may add that though Prof. Whitney,* on the most hearsay evidence, seems inclined to think that the northern drift is not found over Vancouver Island and British Columbia, it certainly exists in a well developed condition.

2. CAÑONS.—This convenient word, of Hispano-American origin, is used extensively all over the Pacific to express the high perpendicular clefts through which many of the rivers of the west flow often for miles. These cañons are generally found where the river breaks through some mountain range or other obstruction of a like nature on its way to the ocean. Such are the cañons of the Steken in Alaska, the cañons of the Fraser in British Columbia, the "Gorge" of the Columbia or the cañon of the Colorado in Sonora. An examination of these cañons shows them to have been caused by the force of the rivers which flow through them when these rivers contained (as there is every evidence to prove they did at one time) a greater body of water than at present. During the time when these glaciers covered the sides of the Cascade and other ranges adjoining these rivers, a greatly increased amount of precipitation would swell the volume of these streams, enabling them to score so deeply the surface of the plateau, and "force mountain barriers to reach the ocean, cutting deep channels in its shores where we now found them." These rivers seem at one time to have been merely the outlet of great lakes which emptied themselves into the ocean by one or more small rivulets, creeping through the opposing barrier of mountains by rocky gorges or volcanic clefts. Gradually they seem to have enlarged these clefts until a greater body flowed through them. Some of the lesser emptiers were cut off, and joined their volume to the main stream, giving its importance and strength until in the course of ages they graved their record in the huge rocky cañons through which they now flow—the great descendants of the humble outlets by which they once found their way to the country on the other side of the Cascade Mountains and to the Pacific. It appears that many of the rivers of the west have, at one time or another, changed their course and bed. Some of these changes seem to have occurred in very remote times prior to the present arrangement of the superficial formations. At all events the gold-miner now and again comes upon these old river-beds in the course of running his drifting-tunnels or sinking his mining-shafts. They look eagerly for them, as they are generally rich in gold. Other

* Proc. California Academy of Sciences, vol. iii. p. 272.

changes seem to have occurred in very recent times, and seem to have been mainly owing either to the causes I have attempted to portray or to some volcanic action, resulting in throwing the river out of its former course into a new channel. Such is the *grande coule* of the Columbia River well known to all voyageurs. I have spoken of the great cañon of the Colorado River, of which the first published account is contained in the work of Castenada, giving a description of the expedition of Don Francisco Vasquez de Coronado in search of the "Seven Cities of Cibola," in 1540-1, during which time they discovered this river, and named it the *Rio de Tison*. The walls of this cañon are probably 5000 feet in height, and when we consider that the river traverses a magnificent defile of this description for upwards of 200 miles, the effect of the scenery may be imagined. Many years ago, it is said that a party of trappers built a large boat, and made the attempt to descend the river through the defile of the cañon, and were never heard from afterwards; they probably dashed their boat in pieces, and were lost by being precipitated over sunken rocks or high falls. In 1857 Lieutenant Ives, of the United States Army, attempted the exploration of this great gorge with a light-draught steamer, but without success; and in 1865 another attempt was made, but resulted in equally unfruitful results.* Here then is a field where some of those young men who seek athletic laurels in the hackneyed Alps may expend some of their superfluous cash and muscular power, with the additional advantage of probably being likely to add something to our geographical knowledge! An almost equally stupendous cañon is that of the Red River of the south. This cañon shows that these remarkable defiles were not formed by any paroxysmal convulsion of nature, for when a tributary stream enters the main river it passes through a tributary cañon. The action of rivers in forming such gorges as these in geological and modern times is an important but much neglected subject in geology.

3. BENCHES.—On the banks of many rivers of the western slope of the Rocky Mountains are found curious terraced "benches," not unlike in general appearance to the famous "Parallel Roads of Glen Roy," but (without stirring up such debatable ground) altogether different in character. These "benches" are always found to the *east* of the Cascade Mountains, and are well seen at Lilloet on Fraser River in British Columbia. Lord Milton and Dr. Cheadle figure them in their "North-West Passage by Land," as seen at this point. These benches are generally flat and of a good soil, though,

* In August, 1865, I sent a detailed account of this attempt to Sir R. I. Murchison; but it met the fate of many such documents, and never reached him.

as everywhere else to the east of the Cascades, very dry. From what I have already said in reference to the formation of cañons, I need scarcely enter into any long explanation of their origin, as it is at once self-evident, if the explanation I have given of the formation of the clefts just named is correct. In a word, the benches were formed when the Fraser (or other river) was a lake only emptied by some little streams (or stream), now and then gathering strength, and as barrier after barrier was broken down, these benches mark the successive stages of the lowering of the lake's margin until it finally sinks into the channel of the river. I have supposed these breaks to have occurred at intervals as some portion of the wall of the gorge gave way or wore away. This level may have continued for years—it may be centuries—when another break happened, and so on; the height of the "bench" marking the character of the gap made each time. These breaks may have been (indeed no doubt were) assisted by the volcanic disturbances which at a comparatively late period seem to have riven all the country in that region, and volcanoes in the mountains through which these rivers flow were the active agents of disruption. The same "benches" can be seen more or less distinctly wherever the physical contour of the country is the same, or where a river is barred from reaching the sea, under similar conditions to what the Fraser bears to the Cascade Range. That these benches were not connected with glacier action is shown (among other proofs) by the rich character of the soil and the total absence of *moraines*, or other marks of glacier-action. These broadly-marked "benches" ought not to be confounded with some terraces found on various rivers, such as the Columbia, &c., to the west of the Cascades. These terraces are probably connected with glacier-action when the mouth of that river was hollowed for more than a hundred miles of a great and uniform depth. The channel of the Golden Gate (San Francisco) has a maximum depth of nearly 50 fathoms, being greatest immediately in the line of the axis of the chain through which it is cut, while the bar without and the bay within are silted up to within less than 10 fathoms of the surface. The Straits of Carquenes, near the mouth of the Sacramento, have a maximum depth of 18 fathoms, and in the line of the range which bounds them an average depth of 14. Dr. Newberry * thinks that these phenomena are due to glacier-action of a similar character to that which hollowed out the fjords, and on the whole there seems some reason to accept his theory with reservations. On passing down the Columbia from the

* 'Pacific Railroad Surveys,' vol. vi. p. 43.

Dalles to the Cascades a curious feature is seen, which, though scarcely strictly coming under either of the headings of this paper, is yet interesting as helping to explain some of the phenomena of bench and cañon. Under the water can be seen, standing upright and firmly rooted in the soil, the remains of a forest of *Abies Douglasii*, Lindl. General Fremont notices this in his voyage down the river and attributed it to a landslip. This explanation may be easily proved to be erroneous, and must, I think, though generally received without investigation, give way to a totally different one. The vicinity of the Cascade exhibits marks of recent volcanic action, and disturbance of the traps, red scoriæ, &c. The Indians even say that at one time the river used to flow under an archway, but that during an eruption of Mount Adams this bridge was thrown down, forming an island in the centre, and helping to give rise to the "Cascades." The effect of this would be to form a dam in the river, raising its waters above the scene of disturbance, and submerging the forest which grew down to its margin. The very recent date of this submergence is shown by the sound character of the wood. The "bench" is also well figured in the plate of the Cañon of Psuc-see-que Creek (Oregon), in volume vi., p. 85, of the 'Pacific Railroad Surveys.'

This paper will be printed at greater length in the 'Journal,' vol. xxxix.

Mr. E. Whymper, in compliance with an invitation from the President to state what he knew of the subjects of the paper, said that he had seen so few of the fjords in Greenland, that he should not like to generalise about them. With regard to those he had visited, it appeared to him true that, at some earlier period, they had been filled by glaciers; but he doubted whether the fjords had been excavated by them. There was nothing to show that any excavation of the sort had occurred. We found in the fjords generally lee sides, that was to say, unworn sides, to the rocks, which would not have been the case if the fjords had been excavated by glaciers.

Dr. Bell wished to impress upon the meeting that there was a great difference between gorges in mountainous regions and true cañons. The true cañon could be formed only in a dry climate, by a river passing over sedimentary rocks, and gradually and slowly eroding its way through them. The cañon was thus a very distinct formation from the chasms and gaps we saw in Switzerland, and other mountain regions. Those might be caused in a variety of ways; but the true cañon was formed by a stream grinding for ages and ages in a dry climate through sedimentary rocks, where there was no heavy rainfall or floods to wash away the sides of the chasm.

Dr. Rae said the fjords he had seen in Greenland all bore marks of ice very high up. Even on the fjord at Frederickshope he distinctly saw the marks of ice, as if a glacier formerly reached the sea there, though now no glacier was given off. The very next fjord to that continued to give off glaciers. He believed these fjords were formed, in great part, by glacial action. The glaciers gradually wore away the rocks, and the action of the streams flowing from the rocks helped to cut them away at the same time. Of the cañons he could not speak, but he could say that Mr. Brown's description of the Fraser River was perfectly accurate.

Ninth Meeting, 22nd March, 1869.

SIR RODERICK I. MURCHISON, BART., K.C.B., PRESIDENT, in the Chair.

PRESENTATION.—*Warington Smyth, Esq.*

ELECTIONS.—*Edmund W. Ashbee, Esq.; Charles Atlee, Esq.; William Carr, Esq.; Frederick Fitch, Esq.; Colonel Barnett Ford; Henry Fawcett, Esq.; Charles Livingstone, Esq.; Delmar Morgan, Esq.; Alexander B. St. Clair, Esq.*

ACCESSIONS TO THE LIBRARY FROM THE 8TH TO THE 22ND OF MARCH, 1869.—'Instructions for the Navigation of the Northern Pacific Ocean.' By A. G. Findlay. Donor, the author. 'Tree and Serpent Worship; Sanchi and Amravati Topes, India.' By James Fergusson. 1869. Donor, Alfred Davis, Esq. 'Greater Britain.' By Charles W. Dilke, Esq. 1869. Donor, the author. 'Results of a Tour in Dardistan, Kashmir, Little Tibet, Ladak, &c.' By G. P. Leitner. Donor, the author. 'Sounding Voyage of H. M. S. *Hydra*, Captain Shortland.' Donor, the author. 'A Descriptive Hand-Atlas of the World.' By J. Bartholomew. 1869. Donor, the author. 'Trans-Himalayan Explorations during 1867.' By Captain Montgomerie. 1868. Donor, the author. 'Direct Commerce with the Shan States and West of China.' Forty-eighth Memorial from the Wakefield Chamber of Commerce to the Lords of H.M. Treasury. 1868.

ACCESSIONS TO THE MAP-ROOM SINCE MEETING OF MARCH 8TH.—4 Atlases and 20 Maps. By Sir R. I. Murchison, K.C.B., President. Royal Atlas of Modern Geography. By A. K. Johnston. 1861. Complete. Royal Illustrated Atlas of Modern Geography. By H. Fullarton and Co. (Parts deficient, Nos. 2, 3, 4, 5, 6, 7, and 22.) Karten-Atlas zu Dr. A. v. Middendorff's Reise in dem äussersten Norden und Osten Sibiriens. 1856. Carte du Canal de Nicaragua. By F. Belly. 1858. Ancient Map of the World, viz. 'Apographon Descriptionis Orbis Terræ.' About 15th century. Published in 1797. Discoveries in the Arctic Sea between Baffin's Bay and Melville Island. By Captain H. T. Austin, C.B., and other officers in search of Sir John Franklin. 1850. Chart of the North-West Passage, discovered by Captain McClure, H.M.S. *Investigator*. 1850. Melville Island and Prince Patrick Land, showing the Explorations of Captains M'Clintock and Mecham.

MS. Arctic America: Discoveries of the Searching Expeditions under the command of Captain H. T. Austin, R.N., C.B., and Captain Penny. 1851. Geological Map of Europe, according to the researches of Sir Roderick I. Murchison, K.C.B., and J. Nicol, F.G.S. Constructed by A. K. Johnston. 1856. Map of Ireland, showing the heights by gradations of shade, to accompany the Report of the Land Tenure Commission. 1845. Four sheets of the Government Map of Bavaria, viz., Nos. 85, Traunstein; 92, Auerberg; 93, Reichenhall; 94, Berchtesgaden. The Eastern Alps, a MS., drawn by Mr. Gardner for Sir R. Murchison. Esquisse de l'Herzegovine et du Montenegro. By H. Br. de Beaumont. Corrected by A. Boné. 1861. Karte des nöerdlichen Ural, on 2 sheets. By the Ural Expedition. 1847-50. Map of Aderbeijan. By N. Khanikoff. 1862. Map of Turkestan, in Russian characters. 1867. Map of Khiva and the surrounding country. By J. Arrowsmith. 1841. A Russian map of Khiva, showing the theatre of war (in Russian characters). By C. Zimmermann. 1840. A map of the republic of New Granada, dedicated to Baron de Humboldt by Col. Joaquin Acosta. 1847. Victoria, western portion; showing the various trial lines surveyed for projected railways from Port Phillip to the Murray River. 4 sheets. 1855. By G. C. Darbyshire, C.E. Comparative Size of the Scales of the Government Surveys of European Countries, shown by squares. Five outline maps relating to the engraving and shading of hills, by the triotinto and medallion process. Island of Teneriffe. By L. de Buch. 1814. A map of the South-Eastern Alps (Austria). By Julius Payer. Presented by A. Petermann. A Map of Tibet, showing the Gold-fields and Sources of the Indus. By a Pundit. Presented by A. Petermann. French charts, 70 sheets, and 16 books of pilotage.

The PRESIDENT observed that the paper about to be read that evening was by Professor A. E. Nordenskiöld, a distinguished man of science who had accompanied all these memorable expeditions to Spitzbergen, and by Fr. W. von Otter, of the Swedish navy. The Swedes, though not a rich nation, were undertaking for the third time an expedition into these arctic regions. It was a great honour to the Swedish nation that they had accomplished so much in exploring the physical geography of Spitzbergen and of the neighbouring seas.

The Papers of the evening were the following:—

1. *Account of the Swedish North-Polar Expedition of* 1868, *under the command of* A. E. NORDENSKIÖLD and FR. W. VON OTTER.

(EXTRACTS.)

THE study of the natural history of the polar regions has been of late years prosecuted in Sweden with so much interest that, exclu-

sive of the present year's undertaking, no less than three * separate expeditions have been sent out from this country to the arctic seas. When Nordenskiöld last winter again brought forward a proposal for a new expedition, on a different plan, which was to set out in the autumn from the northern coast of Spitzbergen and penetrate farther northward, the means requisite to defray the expenses of the expedition were in a few days raised in the second city of Sweden, Göteborg [Gottenburg], at the instance of the resident governor, Count Ehrensvård. When, moreover, the Government, in order to assist the undertaking, fitted out and manned the steamship *Sofia*, well adapted for the purpose, strongly built of Swedish iron, and originally intended to carry the mails over the Baltic in winter, the new expedition was enabled to assume a more extensive character and embrace a wider compass than had originally been intended.

Most expeditions of this kind have had for their object to attain as high a degree of north latitude as possible ; but a glance at their history will convince us how difficult and uncertain the attainment of this object is, and how frequently an insignificant circumstance has obliged the, in other respects, best planned expeditions to return without any scientific result whatever,—a contingency which there would have been no reason to apprehend if proper care had been taken in the scientific furnishing and manning of the expedition. In order to remove all fear of the new Swedish expedition

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* These were the following :—

The Expedition of 1858, fitted out at the expense of Otto Torell. The following gentlemen took part in the undertaking : O. Torell, A. E. Nordenskiöld, A. Qvenuerstedt. The Expedition visited the western coast of Spitzbergen, and brought home considerable zoological and geological collections.

The Expedition of 1861, fitted out at the public expense. The gentlemen who took part in the expedition, besides the proposer and chief, O. Torell, were A. von Goës, A. T. Malmgren, F. A. Smitt, G. von Yhlen, zoologists and botanists ; B. Lilliehöök and W. Kuglenstjerna, commanders of the vessels ; C. W. Blomstrand, C. Chydenius, N. Dunér and A. E. Nordenskiöld for geological and physical investigations. The expedition visited, in both vessels, the western and northern coasts of Spitzbergen, made extensive journeys in boats for the purpose of constructing a topographical and geological map of the group of islands, and of examining the northern part of the triangulation for degree-measuring, which the present President of the Royal Society, General E. Sabine, as early as 1826, proposed to get executed, in these high northern regions, and lastly brought home with them a collection of materials for studying the *fauna*, *flora*, and geology of the islands, probably not surpassed in completeness by any similar collections from districts situated at so great a distance from the centres of civilisation.

The Expedition of 1864, fitted out at the public expense, chiefly for the purpose of continuing the survey for the measurement of the degree. The gentlemen who took part in the undertaking were A. E. Nordenskiöld, chief, N. Duner and A. J. Malmgren. The expedition visited the southern part of Spitzbergen and Storfjord, completed the survey for the degree-measuring, and brought home rich geological, zoological and botanical collections.

having a result of this kind, it was determined that in this, as in the preceding Swedish arctic expeditions, a continuation, as general as possible, should be made of the researches in natural history commenced by their predecessors. For this purpose the expedition was, by the Royal Academy of Science in Stockholm, provided with a carefully selected and appropriate scientific apparatus,* and was accompanied by as numerous a body of professional scientific men as room and circumstances permitted.

The plan of the journey was, during the summer and early part of the autumn, to pay a visit in the *Sofia* to Beeren Island and Spitzbergen, and carefully examine both the marine and terrestrial fauna of both lands; their flora, both phanerogamous and cryptogamous, as also their geography and geology. It was also intended to make deep soundings, and to take meteorological and magnetical observations, &c. A supply of coal was to have been deposited by a ship, hired for that especial purpose, at some fitting spot on the north-west corner of Spitzbergen, which is accessible till late in the season; which tract the *Sofia* was accordingly to visit during the course of the autumn, and whence some of the scientific men were, in the beginning or middle of September, to return in one of the colliers to Norway. The rest were to endeavour, in the *Sofia*, to make their way farther north, and, if necessary, to pass the winter (circumstances permitting) in some appropriate harbour of the Seven Isles, which form the Old World's most northern archipelago.

The gentlemen who took part in the expedition were:—*Geologist*, —A. E. Nordenskiöld;† *Captain*,—Fr. W. v. Otter, Royal Swedish Navy; *Lieutenant*,—A. L. Palander, Royal Swedish Navy; *Physician*, —C. Nyström; *Natural Philosopher*,—S. Lemström; *Zoologists*,—A. E. Holmgren, A. J. Malmgren, F. A. Smitt; *Botanists*,—Sv. Berggren, Th. M. Fries; *Geologist*,—G. Nauckhoff.

The vessel was manned by fourteen seamen, together with zoological conservator Svensson, and six dredgers, hired in Norway. The ship placed at the disposal of the expedition having been, under the inspection of Captain von Otter, duly fitted out in Carlscrona, and furnished with provisions for something more than a year—or, when account is duly made of the game that in these

* The London Royal Society and the University of Helsingfors contributed to the instrumental apparatus of the expedition.

† The geographical and hydrographical researches were to be performed by Nordenskiöld, von Otter, and Palander. These last—of whom, in consequence of their office, one was almost always on board—also took upon themselves the meteorological observations. Nyström assisted the zoologists, and also directed his attention to the remarkably interesting hygienistic features of these regions.

parts one may always reckon upon, for about a year and a half—and touched at Göteborg to take on board the scientific apparatus and the men of science who took part in the undertaking, anchor was weighed on the 7th of July. The 16th-20th Tromsö was visited for the purpose of taking in coal, &c.

On the 22nd the *Sofia* cast anchor in the southern harbour of Beeren Island, where some members of the expedition landed to study the natural phenomena of a place difficult of access on account of the want of a good harbour; while the remainder continued on board the vessel, which cruised in the neighbourhood, and occupied themselves with soundings and with an examination of the local marine fauna.

The expedition left Beeren Island on the 27th of July. Our course was directed to the eastern coast of Spitzbergen, which had not been visited by any of the previous Swedish expeditions; but already at South Cape we met with ice, which, as we approached the Thousand Isles, became more and more abundant, and we were obliged to turn back. After some hesitation as to whether we should wait at South Cape till the water became more free from ice, in order to proceed further eastward, or immediately begin the scientific operations on the west coast of Spitzbergen that entered into the plan of the voyage, we embraced the latter alternative; and it was very fortunate that we did so, for on our return home we learned that the east coast, during the whole summer of 1868, had been rendered completely inaccessible by the ice.

Our course was now directed to Ice-fjord, where the *Sofia* cast anchor on the morning of the 31st of July. We continued a fortnight in the different harbours of that extensive fjord, and penetrated, in our boat-excursions, to the innermost parts of the fjord's northern arm, which had not previously been visited by the Swedish expeditions. During this time all the members of the expedition were busily occupied in scientific researches, and in collecting objects of natural history. The change was, indeed, advantageous, as well for our zoological and botanical as especially for our geological investigations.

The previous Swedish expeditions had pretty fully explored the principal features of the geology of Ice-fjord, and had found it, in consequence of the varying strata on its shores, full of different types both of animal and vegetable remains, and unusually rich in materials illustrative of the geological history of the extreme north.

Innermost in the fjord are found immense, probably Devonian, beds of red clay-slate, and sandstone, which, however, do not here contain petrifactions. On them lie strata of limestone, gypsum,

and flint, filled with large coarse-scaled mountain-limestone brachiopoda; then come *Trias* beds, with large nautilus forms and remains of Saurians; after these, *Jura* strata with *Ammonites;* then *Tertiary* strata, in many places rich in plant-impressions, indicating a former temperate climate; and, lastly, scanty remains of *Post-tertiary* strata, with plant-fragments and sub-fossil marine shells, *some of which now first occur in living condition in the northern parts of Norway.* The preceding Swedish expeditions had brought home specimens from all these strata;* not, however, sufficiently numerous to give a geological representation of the place's former history so complete as the importance of the subject requires. To supply this defect was one of the chief objects of the expedition of 1868; and we succeeded in bringing home unusually rich collections, especially of plant-impressions and trias petrifactions, which, when duly studied, will, no doubt, throw much light on the condition of the climate and arrangement of the land of the arctic regions at that remote period.

Spitzbergen, as is generally known, is at present frequently visited by Norwegian ships engaged in walrus and seal fishing, or in fishing for the "haakjoering" (*Scymnus microcephalus*) on the banks beside the island's coast. The walrus is, however, now but very rarely met with on the western side of Spitzbergen; and its fjords are therefore only occasionally visited for the purpose of taking in water or hunting the reindeer. On how large a scale the hunting of these animals may be carried, is evidenced by the circumstance that the vessels fitted out from Tromsö alone in 1868, according to official returns, killed 996 head. From Hammerfest the returns are still greater; whence one may conclude that, in spite of the war of extermination which, under the name of hunting, has for some time been carried on against these animals, two or three thousand head are annually slaughtered. If we compare that number with the scanty extent of ice-free meadow-land in Spitzbergen, we are tempted to suppose that an immigration must take place from Novaja Zembla, which, nevertheless, is scarcely possible, unless some large island or group of islands facilitate the communication between these two countries, situated at a distance of between 400 and 500 sea miles from one another. Of late years the Norwegians have resumed the method, formerly employed by the Russians,

* The first mountain-limestone petrifactions in Spitzbergen were found by Parry in 1827 at Cape Fanshawe, and the same year by Keilhau at South Cape. Jura fossils were first discovered by Lovén in 1838; the tertiary plant-remains by Nordenskiöld in the Swedish expedition of 1858; the Trias strata by Blomstrand in 1861; the post-tertiary beds, containing Mytilus, by Torell, Malmgren and Blomstrand in 1861; the Saurian strata by Nordenskiöld in 1864.

of using large nets, formed of rope, to catch the Beluga (*Delphinopterus leucas*); and in 1868 several vessels were fitted out exclusively for that species of fishing. Some of the fishermen whom we met had, on one or two occasions, taken from twelve to twenty head at a single drag of the net: right handsome sport, when one considers that the *Delphinopterus* is often larger than the walrus itself.

Ice-fjord, like most of the other gulfs of Spitzbergen, is surrounded by vast glaciers with their mouths turned towards the sea, which offer to the geologist an opportunity of studying that important phenomenon in the history of the earth's development. But also extensive valleys or declivities free from ice and snow are met with, especially in the inner parts of the fjord, and the fertile soil here produces a vegetation more luxuriant than in other parts of this island group. One may here see whole fields yellow with poppies (*Papaver medicante*), or covered with a thick green and red carpet of the beautiful *Saxifraga oppositifolia*. The fjord, which lies beneath them, and in the summer months is often as still and clear as a looking-glass, abounds with marine animals of various kinds. Everything contributes to make this a most important spot for the study of both animal and vegetable life in the Arctic regions. The zoologists and botanists of this expedition here gathered a rich harvest; among the results of which we may mention the taking of several fine salmon, and fully-developed examples of the esculent mushroom, &c.

We left Ice-fjord on the 13th of August. At the entrance a boat-party was sent out northward, to map and examine geologically Foreland Sound. Their work was now—as during the expedition of 1861, when Blomstrand and Dunér sailed through the sound—rendered difficult by almost perpetual fog. During this time the vessel made a somewhat longer excursion westward for the purpose of making soundings; which, however, were on the occasion rendered almost impossible by the heavy swell. We had arranged to meet at King's Bay, whither both parties came on the 17th, in the afternoon. Several zoological, botanical, and geological excursions having been made from this point, and a large number of miocene fossil plants collected, the *Sofia*, on the 19th, proceeded on her course farther northward.

We had hoped here, in some degree at least, to reinforce our already considerably diminished stock of coal, but we soon found that that would necessarily cause too great a delay. In fact, whereas, more to the south, the tertiary formation occupies the greater part of the extensive peninsula between Ice-fjord and Bell Sound, and there in many places forms mountains of above a thousand feet high,

at King's Bay, on the contrary, its extent is very inconsiderable, so that at present it forms only a few small hills consisting of strongly folded strata, and separated from each other by the furrows cut by the glacier-streams. By this the supplies of coal, notwithstanding the by no means inconsiderable thickness of the beds and their accessibility (they lie only a few hundred feet from the shore of one of the best harbours in Spitzbergen), become of but little value, especially as the frost, which begins at a very short distance under the surface, renders the breaking of them extremely difficult; in fact, in consequence of the ice-drenched coal's extreme toughness, almost impossible without regular mining. It is even to be expected that the whole of what still remains of the miocene formation of this spot will, in a comparatively short period, be washed away.

Late at night, on the 20th August, the *Sofia* anchored at Amsterdam Island, and the following day we had the pleasure of hailing the first of the ships which had been hired in Norway for the expedition for the transport of coals. A coal depôt having been established on the low tongue of land that shoots out south-eastward from Amsterdam Island, and five of the scientific members of the expedition having been, together with necessary tents and boats, landed at Kobbe Bay, to prosecute there their zoological, botanical, and physiological researches, the *Sofia* sailed off with the rest on a sounding-tour towards Greenland. Our intention was to penetrate thither along the 80th degree of N. latitude, but before we had reached the longitude of Greenwich we were met by impassable masses of drift-ice. It was evident that the coast of Greenland was accessible only at a latitude much lower than was compatible with the plan of our voyage. We therefore turned our course north and north-east, and gradually, after innumerable zigzags in the ice, arrived at 81° 16′ N. latitude. The temperature had now sunk to 6° (centigr.), with thick ice, fogs, and snow-storms. The ocean was sometimes covered with a thin coating of new ice, and the old ice northward was quite impassable, so that we were obliged to seek a passage out in a south-easterly direction. After another vain attempt to reach Depôt Point, in Brandewijne Bay, the *Sofia* anchored, on the 29th, in Liebde Bay.

During the passage of the *Sofia* from Norway to Spitzbergen, its officers, Captain Baron von Otter and Lieutenant Palander, took a number of soundings in the deeper parts with a "Bulldog" apparatus of the same kind as that constructed at Tromsö, by Torell and Chydenius, for the voyage of 1861, and which was found to be particularly applicable. These soundings were zealously continued during our cruising amid the drift-ice between 80° and 82°, and

gave very interesting results not only as regards the ocean's depth in the parts visited by us, but also concerning Arctic animal life at the greatest measurable depths. It showed us that Spitzbergen may in a manner be looked upon as a continuation of the Scandinavian peninsula, inasmuch as that island-group is not separated from Norway by any very deep channel (not above 300 fathoms), whereas a little to the north and west of Spitzbergen there is a depth of 2000 fathoms and more. From these great depths specimens of clay were brought up by the Bulldog apparatus, which, on immediate and close examination, were found to contain not only several microscopic but even larger and tolerably highly organised animal forms (*e.g.*, several kind of crustacea and annellata). The greatest depth from which any specimen was procured was 2600 fathoms, and the mass there raised consisted for the greatest part of white and red Foraminifera, in general scarcely so large as a pin's head. It is, moreover, deserving of remark, that, during our cruisings amidst the ice, we met with and collected, not only a number of pieces of drifting wood, but also (as, for example, at 80° 40′ E.) glass balls of the kind used by the Norsemen at their Loffoden fisheries for floats; an additional proof of the already well-established fact * that the Gulf Stream reaches, though in a greatly weakened state, even these tracts.

Liebde Bay had never before been visited by any scientific expedition, and its topography and geology were accordingly entirely unknown. A boat-party, consisting of Malmgren, Nordenskiöld, and Nyström, with three men, were therefore left here, while the ship went to fetch their comrades who had been left at Kobbe Bay. The boat's journey was favoured by calm and mild weather and a clear sky; although a high wind, accompanied by snow-storms, prevailed out at sea—a circumstance very common at Spitzbergen, and which is said especially to characterise that beautiful and, according to the unanimous testimony of the fishermen, appropriately named fjord. We were thus enabled, during the few days that our boat-voyage lasted, to map it, and ascertain the character of its somewhat uniform geology. Its shores are occupied exclusively by the same red, green, and dark grey kinds of slate, which in Ice-fjord are covered by mountain-limestone strata with *Producti*, and in Mount Hecla form the uppermost stratum of the vast series of schists to which the name of that mountain has been applied. But, as yet, no petrifications had been discovered in these strata. Their age was

* Among the already given proofs of this may be mentioned, that Torell, in 1861, at Shoal Point, met with a bean that had come from the Gulf of Mexico, the *Entada gigantilobium*.

accordingly somewhat doubtful, and the probably Devonian fish-remains which we now found here are therefore a discovery of great value in the explanation of Spitzbergen's geology. The lower slate-beds contained some vegetable remains, though probably of too indistinct a character to admit of identification.

On the 2nd of September, the boat's company and the ship, returning with our comrades from Kobbe Bay, met at a little distance off the promontory that separates Wijde Bay and Liebde Bay. After remaining in that bay a couple of days longer, the *Sofia* weighed anchor and touched at the now ice-free Cape Depôt, in Brandewijne Bay, in order to fetch away the supply of pemmican that (in 1861) had been left there, an iron boat, &c. We thence steered northward, with the intention of passing round Nordostland to Giles' Land. The greatest part of the arm of the sea that lies between the Seven Islands, Cape Platen, and North Cape, which, in 1861, was already, in the middle of August, perfectly free from ice, we now, in the beginning of September, found covered with a firm crust of ice. It was therefore impossible to reach Giles' Land by this route, and we were therefore obliged, after having, for the purpose of botanical and zoological researches, remained a short time at Castién's Islands and Parry's Island, which last, being still encompassed by a girdle of land-ice, was approachable only by walking over the ice, to seek another passage, namely, that through Hinloopen Strait. Our course was directed to its southern part.

Already, before the end of September, some signs of the approach of autumn had been visible, and the hill-tops had frequently in the morning been for some time covered with a white mantle of new-fallen snow, which, however, had melted away again without causing any hindrance to our scientific pursuits. But now, during our passage to South Waijgats Islands, a copious fall of snow rendered all further researches in natural history on land impossible, and gave us pretty clearly to understand that the season for our purely scientific pursuits was to be considered as at an end. We accordingly turned back at Mount Lovén, in the southern part of Hinloopen Strait, having first on that spot collected, from under snow of a foot deep, an additional number of mountain-limestone petrifactions. On the 12th of September we again anchored at our coal depôt on Amsterdam Island, and there met our second coal-ship, by which some of the members of the expedition (Fries, Holmgren, Malmgren, Nauckhoff, and Smitt) returned to Norway, carrying with them the valuable collections of objects of natural history which the expedition had up to that time succeeded in acquiring. These collections have now happily arrived in Stockholm, and will, after having been

duly studied, be divided between the National Museum in that city, where already the extraordinarily rich Arctic collections formed by the preceding Swedish expeditions are preserved, and the Museum of Göteborg, the city whose liberal initiative first gave occasion to the new expedition. To give an idea of the extent of these collections, I need only refer to the notices above given of our geological operations, and remark that the zoological sciences were represented by no less than three members of the expedition, who, besides, had with them a taxidermist. Messrs. Malmgren and Smitt had also at their disposal a boat manned with four men for dredging every day, holidays excepted, when the ship lay still. They were thus enabled not only to make a searching examination of the Arctic marine fauna, which, in individual copiousness at least, is comparable with that of many more southern countries, but also to pay due attention to the terrestrial fauna of the locality, more especially the entomological branch, which is poor both with respect to individuals and species, and accordingly presented especial difficulties to its investigator, Mr. Holmgren. The dredgings also yielded rich contributions to the ocean's alga-flora. Every opportunity that offered itself for land-excursions was used by the two botanists of the expedition, both for investigating the flora and for forming a collection of specimens for normal herbaria of Spitzbergen's phanerogamia, mosses, lichens, and algæ.

On the 16th of September we took leave of our homeward-bound companions, and immediately proceeded northward. Our intention was to touch at the Seven Isles, but these were now found to be still more thickly surrounded by ice than when we had visited that tract about a fortnight before. We accordingly determined to avail ourselves of a channel tolerably free from ice, stretching northward from those islands.

After a number of zigzags amidst the drift-ice, our vessel, in longitude $17\frac{1}{2}°$ E. from Greenwich, succeeded in arriving at 81° 42′ N. latitude, probably the highest northern latitude a ship has ever yet attained. Northward lay vast ice-masses, it is true as yet broken, but still so closely packed that not even a boat could pass forward, and we were therefore obliged to turn to the south-west and seek for another opening in the ice; but we found, on the contrary, that the limit of the ice stretched itself more and more to the south the more we went to the west, so that, on the 23rd September, in the longitude of Greenwich, we were south of the parallel of 79° N. latitude. On the way we had in several places met with ice black with stones, gravel, and earth, which would seem to indicate the existence of land still further north.

The ice itself had, moreover, a very different appearance from that which we had met in these tracts at the end of August. It consisted now, not only of larger ice-fields, but also of huge ice-blocks, so that it seems as if the former ice had drifted to the south, and given place to new ice-masses coming from the north. The temperature had now sunk to 8° or 9° (centigr.) below the freezing point, and the ice, which in these parts had before been of tolerably loose texture, had now become so compact that any more violent collision with it was combined with no little danger. Furthermore, the nights were now so dark that it was necessary at that time to lay the ship to by the side of some large sheet of ice, at the hazard of finding oneself blocked up there in the morning. Already, in the beginning of September, the surface of the ocean, after a somewhat heavy fall of snow, had shown itself, between the ice-masses, covered with a coating of ice, which, however, was then thin, and scarcely hindered the vessel's progress. Now it was so thick that it was not without difficulty that a way could be forced through it. All things clearly indicated that the season of the year, during which it is possible to sail in these tracts, was nearly at an end, and as we intended to make yet another attempt to find a north passage from the Seven Isles, or seek a harbour for the winter, we determined to return to our coal-depôt.

On the 25th of September the *Sofia* once more cast anchor at the north-west corner of Spitzbergen, after having slightly struck upon a rock situated under the surface of the water in the middle of South-gat, and which has been forgotten in Buchan and Franklin's admirable chart of that harbour, although it appears, from Beechy's description, that they themselves happened to strike on the same shallow.

After a few days' rest, spent in inspecting the engine and taking in coal (the last remains of our store of coals had to be searched for under a thick covering of snow), and after having placed in the letter-box on the island in Kobbe Bay notices of our journey and our plans for the future, we steamed away again, on the 1st of October, northward, notwithstanding a strong wind and a snow-fog that prevailed in the harbour we left. Our suspicion that this was only local seemed to be confirmed when we got out a little further north, as the weather became clearer and calmer, but at the same time we met already, in lat. 80° 40′, sporadic blocks of drift-ice, which, as we proceeded farther north, increased in number and size. We continued our northward course during the following day, but it was soon evident that no open water would be arrived at that way, and in the afternoon we were again steering in a southerly

direction. During the night we lay to under cover of a large sheet of ice. The temperature had now sunk to 14° 5′ (centigr.), so that in calm weather the surface of the water between the ice-masses was covered with ice of two or three inches' thickness, which considerably impeded the progress of the ship. But the following day we stood southward till we got into something like open water, and then followed the edge of the ice in a northerly and north-westerly direction. By this means we again arrived at 81° N. lat., but here the *Sofia* met with a misfortune, which put an end to all further efforts to proceed northward. In the morning of the 4th of October, during a storm from the south-east, and with a high sea, the ship was thrown violently upon a huge ice-block, or rather a small iceberg, whereby she sprang an extensive leak. We were therefore forced to turn back immediately and seek our harbour, where we arrived late in the evening, after eleven hours of incessant labour to keep the vessel free from water. Nevertheless, though all took part in this work, the water continually rose, so that, when the anchor was cast at Amsterdam Island, it stood about 2 ft. over the cabin floor. Fortunately the provisions, being kept between water-tight bulkheads, were uninjured, and we succeeded, though with great difficulty, in keeping the engine-room so free from water that the fires were not extinguished. Had this not been the case, our ship must unquestionably, in a short time, have been the prey of the storm and the extremely heavy sea, which now, contrary to our former experience, raged among the thinly scattered fields of drift-ice. Immediately on our arrival at Amsterdam Island the ship was careened and the leak provisionally stopped, so that already the next day we were in a condition to seek a more secure harbour in King's Bay. Here the ship was hauled so close to land at flood, that we, at ebb, were enabled to come at the leak and stop it effectually.

King's Bay, which in summer time is almost free from ice, was now filled with innumerable ice-blocks fallen from the mighty glaciers of the fjord, which, when carried by the flood-tide in towards land, totally barricaded the harbour in which the *Sofia* had taken refuge; and, notwithstanding that the temperature here was considerably higher than in the neighbourhood of 81° N. lat., these blocks froze during the calm weather so fast together, that when we, on the 12th of October, were again in a condition to sail, it was only with the utmost difficulty that our vessel could get out.

Our stay in King's Bay, like all the preceding occasions on which the ship remained any length of time still, was taken advantage of by our Natural Philosopher, Dr. Lemström, for the purpose of making

observations for the determination of the magnetic constants and variations. The ground was, however, too deeply covered with snow to allow of any geological or botanical operations. Even the brooks, so copiously supplied with water in the summer time, which intersect the lowlands adjoining the coal harbour, were now so entirely dried up by the effect of the cold that we endeavoured in vain to reinforce our now considerably reduced supply of water.

Our ship, which had had two ribs broken by the blow that caused the leak, was now too weak to be exposed, with the slightest prospect of success, in any new attempt to force a way through fields of drift-ice, as would in all probability be necessary, should we endeavour to visit the Seven Islands, which place we had intended to make our winter harbour; and the wintering in any other part of Spitzbergen not having either entered into the plan of our voyage, nor promising any results commensurable with the costs, dangers, and hardships of passing the winter there, we determined to return to Norway. But yet we wished to make an attempt to reach Giles' Land round the southern point of Spitzbergen, which was probably still free from ice. Already during our passage along the west coast of Spitzbergen, which in summer is entirely free from ice, we passed large though scattered fields of ice, which farther to the east, near the Thousand Isles, completely obstructed the way. We were, therefore, constrained to relinquish that plan also, and to direct our course towards Norway. After having been once more, on the shallow banks off Beeren Island, during a severe storm and in a high sea rendered to the last degree boisterous by the shallowness of the water, in great danger of being ice-beset, the *Sofia* anchored again on the 20th of October in Tromsö Harbour, where we had the pleasure of learning that our comrades had happily arrived and reached home in safety.

From the above it appears that the expedition, as regards its second object—namely, hydrographical investigations in the Polar Basin—did not succeed in reaching any remarkably high degree of latitude; so that the compass of the portion of our globe that is known to us, has not been to any material amount increased by it. I hope, however, that it has afforded a by no means unimportant contribution to the solution of the so-called Polar question.

A lively controversy has, as is generally known, been of late years carried on between the principal geographical authorities concerning the real character of the Polar Basin, some geographers maintaining that it is covered by an unbroken surface of ice, presenting an impassable barrier to the progress of a ship; while

others look upon this as only an obsolete prejudice, arising in a great measure from exaggerated descriptions of the difficulties which the sailor encountered at the point where he turned back. That this latter view, at least as regards that portion of the Polar Basin that borders on Europe during the actual sailing-season in the Northern Seas, *i. e.* the summer, is not in conformity with the real fact, has been proved, not only by the adventurous journeys of the older Arctic travellers, but by a number of expeditions sent out during the last century for the exclusive purpose of such investigations, among which may be mentioned :—

Tschitschagaff's	1st	expedition,	1765,	which with their ship could only reach 80° 21′ N. lat.	
„	2nd	„	1766,	which reached 80 28	„
Phipps'		„	1773,	„ 80 37	„
Buchan and Franklin's		„	1818,	„ 80 34	„
Scoresby's		„	1806,	„ 81 30	„
Sabine and Clavering's		„	1823,	„ 80 20	„
Parry's		„	1827,	„ 81 6 *	„
Torell's		„	1861,	„ about 80 30 †	„

It might then have been considered as already absolutely decided that it was not possible at that season of the year to penetrate very far into the Polar Basin, and any repetition *at the above-named season of the year* of these attempts could therefore only be looked upon as continually treading in old footsteps, which demonstrably do not lead to the intended object. But one doubt remained. At the season of the year when, in consequence of the heat of the summer and the influence of the ocean-waves and ocean-streams, the ice-masses have been reduced to their minimum—that is to say, in the autumn, before the formation of the new ice, no ship had ever before visited the Polar Basin. One could with certainty foresee that it might then be possible to go farther than in summer. There was a possibility that one might at that season be able to penetrate very far, perhaps to some land lying north of Spitzbergen, which might hereafter serve as base from whence to push still farther onward. These considerations constituted the ground for the plan of operations for the latter portion of the Swedish expedition, and it may now be considered as proved.

That one may, during autumn, reach by ship a latitude considerably higher than that which has been attained by most of the summer expeditions, unless this year is to be considered as unusually

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* By ship, but on the ice the party penetrated to 82° 45′.
† By ship, but in boats and by land journeys as far as 80° 45′.

unfavourable with regard to the condition of the ice, we might in all probability have proceeded a considerable distance farther, perhaps beyond 83° N. lat. But we have at the same time convinced ourselves that, even in autumn, further progress is soon rendered impossible by impenetrable masses of broken ice. The voyage itself, moreover, at that season of the year, in consequence of the cold, the darkness, and the boisterous winds, accompanied by snow-storms that at that time of the year are prevalent in the Polar Basin, and the heavy sea amidst the masses of drift-ice caused by these latter, is rendered so dangerous that the risk to which the traveller exposes himself is far from being compensated by the meagre prospect of success. The idea itself of an open Polar Sea is evidently a mere hypothesis, destitute of all foundation in the experience which has already by very considerable sacrifices been gained; and the only way to approach the Pole, which can be attempted with any probability of succeeding, is that proposed by the most celebrated Arctic authorities of England, viz., that of—after having passed the winter at the Seven Islands, or at Smith Sound—continuing the journey towards the North on sledges in the spring.

The paper will be published entire, with a map, in the 'Journal,' vol. xxxix.

The PRESIDENT, in expressing the thanks of the Society to Mr. Nordenskiöld and M. von Otter for their valuable communication, said that it was a straightforward account of the proceedings of the party in those regions. The nautical part of the paper must be particularly interesting to the many distinguished naval officers present. He hoped some of them would express their opinions as to the value of the definite conclusions which the author of the paper had arrived at. He was sorry that Dr. Petermann, to whom the Society awarded their gold medal last year, and who had urged Germany to send out a small squadron to reach the Pole by the supposed open Polar Sea, was not present to advocate his views. The observation of great floating masses of ice, bearing stones and clay, drifting from the north, certainly indicated that it was not all open sea, but that there must be land in that quarter. He should be happy to hear the opinion of Arctic officers on that point, and he would first call upon Sir George Back, one of their Vice-Presidents, who had so much distinguished himself in such researches, to address the meeting.

Admiral Sir GEORGE BACK said the failure of these ships to make the passage, or even to get to any distance to the eastward of Spitzbergen, was a significant fact, because that passage had been advocated by very able Polar officers. Two of those used on a former expedition were sailing-vessels; but the *Sofia* was a steam-vessel, fitted out efficiently for the purpose, and aided by two transports laden with coal, which was deposited at Amsterdam Island. The *Sofia* tried to get to the north, and, failing to do so, did precisely what the *Dorothea* and *Trent* did in 1818, follow the trend of the ice westward, with the view of sighting Greenland, if possible. In this she was baffled, as the former expedition had been; then, going in a zigzag direction to the north, she attained to latitude 81° 16″, and after great efforts succeeded in

attaining to latitude 81° 42″, which the Swedes, with very pardonable pride, considered was the highest degree of latitude ever reached by a ship. Scoresby, however, whose object was not scientific investigation, but the capture of whales, attained in a most favourable season to 82°. There was another resemblance between the Swedish expedition and the expedition of 1818. The *Sofia* got thrown upon a heavy mass of ice and was seriously injured, and had it not been for the power of steam, she might have been lost; but her steam enabled her to go to Amsterdam Island, and subsequently to Smeremberg Harbour, where she was repaired. It was to that very place the *Dorothea* and the *Trent* went in 1818—the *Dorothea* to be hove down to repair damages brought about by having been crushed in "taking the pack" during a furious gale. Well, these gallant Swedes, nothing daunted by all those serious circumstances, tried again and again; but the ice became thicker and more compact, and they were less able to advance against it. Ultimately, late in October, they bore up for their own country, and arrived at Tromsö on the 20th of October—the very same thing which the *Dorothea* and *Trent* did, and at the same period of the year, just half a century ago. The parallel showed how very little the circumstances of Polar navigation were altered in the direction of Spitzbergen. He was not going to give an opinion whether the route by Smith Sound, by Nova Zembla, or Spitzbergen, or by that between Spitzbergen and Greenland, was the best to attempt. It seemed to him that it was only by a repetition of small expeditions that the approach to the Pole might be successfully made, namely, by being on the spot when Nature, in some of her favourable moods, might open out the ice and leave a passage clear for an adventurous explorer. He could not sit down without expressing his unqualified admiration of the perseverance and steadiness which characterised the Swedish expedition.

Admiral OMMANNEY said he could not extol too much the courage which animated the Swedes in carrying out this expedition. But he should like to have heard something more about the construction of the *Sofia*. He had heard that she was constructed of iron. Success in penetrating the Polar sea depended a great deal upon the way in which the vessel was constructed. If the *Sofia* had been of more substantial construction she would not have succumbed to the first blow of the ice, as she appears to have done. The masses of ice met with, covered with stones and earth, was to him a hopeful indication of our being able to reach the North Pole by way of Spitzbergen, of which he had always been an advocate. He hoped the failure of the present expedition would not discourage those who were in favour of that route. He was happy to see that the point reached by Parry still stood far to the north, and he hoped it would never be surpassed by any other country but England.

Staff-Commander DAVIS was of opinion that the most important part of the communication just read was the fact of masses of ice being seen bearing stones and earth; but Professor Nordenskiöld had omitted a singular fact, also observed by the same expedition, and which was recorded in Petermann's 'Mittheilungen,' viz., that in the spring of the year large flocks of birds take flight, going due north from the northern parts of Spitzbergen. This, taken in conjunction with the first-named circumstance, would lead to the belief that land existed to the north.

Admiral Sir EDWARD BELCHER said from what he had heard in this paper, and from what he had collected from Parry and Sir James Ross, he believed the ice which came down, always southerly, on the western side of Spitzbergen, and in such quantities, must cause a vacuum to the northward; and in that vacant space he felt perfectly satisfied vessels might winter, as, for instance, on the north-west of Spitzbergen, and in one of these open seasons find their way to the north. Parry, in his last observations in 1827, after having tried

all these points in the Arctic Sea, pointed out that there was a general pressure from the eastward to the westward. That we know to be the case. In Davis Straits the sea on the eastern side was open, and from an easily understood cause. All the slopes on the western coast of Greenland lay to the sun; the sun never had altitude sufficient to look on the eastern coast, consequently there were no thaws of any importance on that side, nothing to liberate the land-floe and enable it to leave the shore. On the western shore of Spitzbergen, the same rule held; the sun could only play upon that side and liberate the ice there. But if an expedition had to start again, he should advise that Nova Zembla should be the point of departure, and that the expedition should endeavour to pass westerly of that island and tumble down, if possible, on to the west of Spitzbergen on the homeward voyage. From what he could collect from the paper, the Swedes were about to try another expedition. He believed what Swedes could do Englishmen could do.

Captain Sir LEOPOLD M'CLINTOCK thought these scientific and gallant Swedes had summarised very completely the experience of a great number of previous Arctic expeditions which had visited the same seas. The Swedes seemed to have reached within half a degree or so of the extreme northern latitude attained by English explorers; they had met with similar reverses, and they had returned with much the same story to tell. There was one circumstance to be observed. All the ice they had met with was broken-up ice. It was clear they had not arrived at a fixed unbroken barrier of ice, such as impeded the progress of Ross in the south. With a sufficiently strong vessel and powerful steam-machinery they might succeed in penetrating another 100 miles farther to the north—to 83° or 84°—but there they would, he thought, meet with an impenetrable barrier. He was not a believer in an open Polar basin. According to all our experience of temperature in modern Arctic expeditions, we found the farther we went north the colder was the mean annual temperature. There were no indications of approaching a milder climate, as some theorists suggested; we found less animal and vegetable life, and we got far beyond where the Esquimaux could live.

Admiral Sir EDWARD BELCHER quoted from Parry's work the temperatures of the air and sea taken on the expedition in which Sir George Back took part in 1818. There was a whole series of observations given, and they went to prove that the difference in the mean temperature of the air and sea between the Orkneys and Cape Farewell was not so great as we imagined.* He saw

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* The journals of Franklin, 1818, Ross in 1818, Parry, 1827, and that of James Ross in Cove, 1837, prove that the sea does not attain a very low temperature as late as September; and that on the chord between the Orkneys and Cape Farewell, the south point of Greenland, in January, February and March, the temperatures are even higher than in summer. Thus:—

Extract from Admiralty Official Journal of Lieut. Franklin—hired ship *Trent*.

			Air. °	Sea. °	
Trent on May 30	79·46 N.	13·40 E.	31·0	30·0	
„ 1 June	80·30	8·22	24·0	29·0	
Beset in ice up to 12th ..	79·50	11·0	30·5	30·5	
Range.—Air .. 26 to 35·5					
Sea .. 29 „ 36·0					
June 22nd	80·0	10·12	32·0	30·5	
					Fathoms.
July 10	80·22	10·37	49·0	32 surface, 36 at 119	
All August.—Mean air ..	34·7	Sea ..	36·7		
Min. air ..	30·0	Max. ..	41·0		
Min. sea ..	35·0	„ ..	39·0		

nothing to give us cause to fear from cold weather, or to prevent the use of a steamer; and if the turbine were used, he was perfectly satisfied the action of the turbine would throw off the ice from the sides of the vessel, and enable her to proceed much more safely than she could do with the screw or paddle.

Admiral Sir GEORGE BACK said the temperatures quoted by Sir Edward Belcher were, he believed, perfectly correct; he could not speak to them himself from memory. But he recollected this fact, and he had good reason to recollect it. It was his duty to take the sun's altitude at midnight, when the sea was invariably frozen on the shady side of the vessel, merely forming a very thin film of ice. On the other side of the vessel it was comparatively warm, and there was a thaw. Sir Leopold M'Clintock spoke of the large blocks of ice; but in 1818 there were unbroken floes of ice four or five miles in diameter,—the floes remained almost stationary for some time, and the ships were made fast alongside. At length they got a circular motion and opened a space wide enough to pass through, and if they had possessed steamers, instead of heavy old colliers, he did not know where they might have gone to.

Admiral COLLINSON said the observations made by the gentlemen who had gone out on this expedition entirely corroborated the views which he expressed before the Society some time ago with respect to the possibility of reaching the Pole. The question was raised whether they should go by Smith Sound

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			Air. °	Sea. °	
September 18	70·0 N.	0·41 W.	40·5	45·0	
	Off Faro Island.				
,, 30	62·19	7·34	50·0	49·0	
Sir John Ross anchored, Brassa Sound, 1st Nov. 1818			49·0	51·0	
		Longitude.			
Parry, July 4 to 11, 1827	81·40	22·54	32·0	32·5	30 = 400 fath.
and 22nd ..	82·11	24·23			
	82·43	19·54	31·0	34·5	
			Sea. A.M.	Sea. P.M.	
Cove, James Ross	59·07	6·20	49·0	48·0	
12 January, 1836	60·25	11·30	47·0	46·0	
	61·02	23·20	47·0	47·0	
	59·34	30·13	47·0	45·0	
25 February	59·29	7·24	47·0	48·0	
	59·10	16·0	47·0	48·0	
	59·0	20·5	47·0	48·0	
20 March	56·25	33·1	44·0	44·0	
31 ,, ...	54·42	41·0	39·5	39·5	

Sounded,—27 fathoms, 44·5°; surface, 39·5°; air, 34°.

Franklin in conclusion remarks:—

		Degrees.			
Temperature of air between 60° and 70° N.	General state ..	47	46	45	
	One fine calm day ..	50	52		
During foggy weather		44	42	39	36
Water		47	46	45	
Decreasing gradually between 60° and 70° to ..		37			
Air between 70° and Cherry Island		33	32	31	
		°	′	″	
Dane's Island Observatory		79	40	20 N.	
		11	6	15 E.	

The approach to ice was not at all indicated by *any change;* nor do I think from the temperature, either of water or air, that we could have judged of our proximity to Cherry Island and the surrounding sea when we made it, had not the reckoning informed us.

or by Spitzbergen. He then stated that Parry's experience was, that unless you got hold of the land it was useless dealing with an ice-pack; there was no prospect of getting forward at all. Directly you thrust yourself into the pack, you had to go just where the pack chose to take you. Therefore, the only way to get forward in the Arctic regions was to hold by the shore. The observations of these Swedish officers entirely corroborated that view. The most interesting feature contained in the paper was, that masses of ice combined with stones had been found. As far as he could comprehend, these masses of ice and stone had been found to the westward and southward of the north point of Spitzbergen, and he would suggest that it was from there they came. He would expressly call attention to this particular fact, that Parry, when he proceeded to his most northerly point, saw nothing of stones. He had to drag his boats over the ice, and not a particle of stone was found there, not one iceberg was seen. Now, the indications of land to the north would be shown by icebergs: if there was land and open water, there would be icebergs. There was not an iceberg to be seen to the north of Spitzbergen, and from this he contended there was no proof of land to the northward of that point; and if there should be land, our only chance was to get hold of it and coast along. He made these observations in consequence of having traced the pack along Behring's Straits, and seen how impracticable it was to deal with ice in floating masses of that kind.

The PRESIDENT wished some of the naval officers present would tell the meeting what they thought could be accomplished by steam-power in the Arctic seas.

Captain INGLEFIELD, R.N., said he had commanded three vessels in the Arctic regions with steam. There was no doubt steam was of the greatest assistance in getting through ice. Upon several occasions they were enabled to break through ice upwards of 14 feet in thickness; by charging it on several occasions they succeeded in making a crack and in pushing the ship through. With reference to the question of reaching the Pole, he confessed he inclined very much to the route by Spitzbergen, for two reasons. In the first place, while making one voyage to Smith Sound, it was possible to make two or three attempts to reach the Pole by Spitzbergen. The other day, when Captain Sherard Osborn read a paper before the Society, advocating the route by Smith Sound, he was called upon to make some remarks; but he thought it would better serve the interests of the Arctic expedition to abstain from doing so, because he was in favour of the Spitzbergen route; and the Chairman had stated that one of the objections raised by Government to sending out another expedition was that Arctic officers were divided in their opinions as to which was the best route. Nevertheless, he advanced this as one of the reasons for the *route* by Spitzbergen, that we might make several attempts while we were making one attempt by Smith Sound. He had made one attempt by Smith Sound, and he was sure he should have had a better chance by Spitzbergen. He believed there was an open polar sea, from the fact that there was a strong current setting out of it; and that he had found the trunk of a tree upwards of 20 feet long at the top of Wellington Channel, which must have drifted across that sea.

Admiral Sir EDWARD BELCHER said the mode by which stones got into the ice was simply this, that the land-floe attached itself to the gravelly beach, and as the tide rose and fell towards the spring, the ice falling at an inclination broke at last, and the floe carried away with it the gravel that had been attached to it. It was very well known that the 25 feet and 40 feet floe-ice was composed of layers of 8-feet floes piled one above the other.

The PRESIDENT in concluding the discussion said, he much regretted that we were not likely to have the great question of the geography of the North Polar Basin determined by an expedition sent out by the British Government,

but he did not despair of seeing some spirited individual take it up and carry out those researches which the Government had declined to do, chiefly for the reason that Arctic officers differed among themselves as to the route which ought to be taken.

2.—*Notes on a Journey from Ningpo to Shanghai.* By CHR. T. GARDNER, H.B.M. Consular Service, China.

THE author stated that having been for nearly eight years in the service of her Majesty's Government in China, and had opportunities of travelling in various provinces of China, he did himself the honour of giving the Society an account of a journey he made in the province of Chêkiang, in which he was interpreter and consular assistant during the past two years. The paper contained, more particularly, a description of a journey from Ningpo to Hangchow.

On the 1st June, 1868, his party—consisting of Mons. Eug. Simon, of the Society of Agriculture, Paris, and French Consul at Ningpo; General Cooke, in the service of the Chinese Government; Mons. Novion, in Chinese Government service—started from Ningpo on their journey to Shanghai, *viâ* Hangchow, in a yacht of about 50 tons' burden, belonging to Cooke. The yacht was built *lorcha* fashion, *i. e.*, a sort of combination of the modern European sailing-vessel and Chinese junk. Like all Chinese boats it was propelled, in the absence of wind, by the rotatory movement of a scull on a pivot at the stern of the boat, acting on the screw principle. The party went up the Yu Yao branch of the Yung River, as far as a town called Yu Yao, which lies on both sides of the river, and is about 40 miles from Ningpo. This voyage had been so frequently made by our gunboats, and observations as to the River Yung are so well recorded, that it was unnecessary to dwell on this part of the journey, except to mention that halfway to Yu Yao from Ningpo, on the right bank of the river, great stone-quarries exist, probably the greatest stone-quarries in China; over 1500 feet in altitude of sheer stone-mountain have been cut entirely away, caverns excavated in some places to 30 or 40 feet below water-level, and many wells of almost unfathomable depth discovered; when it is considered that all this has been done with the rudest implements, no saw ever being used, we may obtain some idea of what human industry and patience can effect, even with the smallest means. On the left bank of the river, some 3 to 4 miles inland, is the small but pretty town of Tzu-chi, in which were formerly the country residences of the rich native gentry of the larger towns. These houses had originally pretty ornamental gardens and rockeries attached to them; all of these, however, were completely destroyed by the Taiping rebels, and the

work of restoration has gone on very slowly. About 10 miles up the river from the stone-quarries the party arrived at a village called Chiang-ting, where the water is quite fresh. From Chiang-ting, a branch of the Yung River flows back past the town of Tzu-chi, and from Tzu-chi the Chinese have dug a canal connecting the branch with the main river; but as at the point of junction (about 12 miles from Ningpo), the main river is salt, and as the branch river and canal are useful for purposes of irrigation, as well as for highways, a species of dam, called by the Chinese a *pa*, is put up to prevent the salt water of the river flowing into the canal, and rendering it useless for irrigation. Over these dams the Chinese cargo and passenger-boats (always flat-bottomed) are dragged by means of two windlasses, one on each side of the canal. These dams, built of flat flag-stones, are covered with a thick coat of mud, and are kept slippery by means of water; they are generally at an angle of about 30° to the horizon, and are about a foot thick at the top. The boat having been dragged to the top by a cable-line passing under its stern, overbalances itself, when the line slips, and it is allowed to rush with an extraordinary rapidity into the water on the other side. These dams are not only used for the purpose of preventing salt water flowing into the fresh canals, but also as locks when it is desirable to effect a communication between bodies of water of different altitudes. The monopoly of dragging boats over is farmed out to certain Chinese by the authorities, and the price to be charged for the service is fixed by the mandarins in conjunction with local municipal councils and trading guilds. Though these prices vary with various circumstances, the average would be about 1*d.* a ton burden for boats, and about 2*d.* a ton extra in cases where the cargo has to be transhipped, for the porterage of the goods. The windlasses are generally worked by men; one exception was known to the author where the dam being 30 feet high, bullocks and water-buffaloes perform the service.

The author continued as follows:—

Yu Yao is the furthest point reached by our gunboats. The great importance of Yu Yao consists in the fact of its being a vast cotton-market. Here we disembarked from the yacht, and took small boats roofed with bamboo-mats, to go to a place called Shan-yu, which is about 25 miles from Yu Yao. Shan-yu is celebrated from the fact of its having under the rebels been one of the cities which offered five years ago a most spirited resistance to the Imperial army under the command of Mons. Giquel, officer of the Legion of Honour, and Cooke. Here Mons. Giquel was severely wounded, and Cooke took the city and for some time commanded: this was about five years

ago, and Cooke had not been there since. It was extremely gratifying to me to observe the enthusiasm and affection with which Cooke was greeted by the inhabitants, who had neither forgotten his person nor the beneficence of his short rule over them. So strictly had he kept his soldiers in discipline, that no plunder had been committed, and now, after so long an interval, when the people knew he was in the town, they ran out to see him and to show their respect in the exaggerated Eastern fashion of prostrating themselves before him. From here we proceeded on foot to the Hsein-ku-shan, or Old Deity Hill temple, which is three miles from Shan-yu. This temple is dedicated to a deity worshipped by the Chinese before the existence of Buddhism. Michelet, in his 'Bible of Humanity,' makes the error of stating that China is an example of a nation which existed for over a thousand years without any religion whatever, until the introduction of Buddhism; and even Burnouf, careful as he generally is, accepts this statement as true without enquiry, though he owns it to be a fact that militates against all his theories on the philosophy of religion. I pointed this out to Dr. MacCartee, an American missionary of great learning, who tells me that, as the characters "Sacrifice," "Prayer," "Ghost," "Spirit," &c., occur in writings at least a thousand years anterior to the introduction of Buddhism,—that as Buddhism itself in China (modified as it has been by the ancient Chinese creeds and forms of worship) differs essentially from Buddhism in India,—he considers Michelet an untrustworthy guide in historical facts bearing on the subject.

The temple of Hsien-ku-shan has a picturesque position on the summit of a small cliff, halfway up a steep mountain, over which cliff and underneath the temple falls a pretty waterfall, which derives the water from a fall higher up the steep, flowing into and through a subterranean cavern.

At Shan-yu MM. Simon and Cooke left us, leaving Mons. Novion and myself to proceed on the journey. From Shan-yu we proceeded to *Liangwu*, the place at which we had to cross the Ngo Chiao River, which runs into the Hangchow Bay. This river has a strong tide, and is at times visited by a powerful tidal wave or *bore* (a wave resembling an earthquake-wave, which comes up strongest two days after the new moon in midsummer). Though five miles nearer the sea at Pa Kwau, there is a haul-over or pa from the canals on either side of the Ngo Chiao River; passengers generally find it more convenient to go by Liangwu, where one has to disembark, and where the arrangements made by the Chinese Transit Company are so admirable as to give very little trouble. Another reason for preferring this route is to avoid the noise,

bustle, crowding, and delays caused by the enormous goods-traffic by Pa Kwau. The instant we arrived at Liangwu sedan-chairs were brought to the boats, and a man stepped forward showing a paper setting forth that he was an employé of the Transit Company, and asked us to hand over to him the keys of our boxes, and that then we need take no trouble about them, as the Company were responsible that nothing was lost. We accordingly did as was desired of us, and jumped into the chairs provided. We were taken through about a mile and a half of mulberry-orchards, which form a belt to the right bank of the river of about 100 miles long, and from a quarter of a mile to three or four miles deep, up to the great mud embankment with which it has been necessary to protect the low-lying country from the ravages of the floods by the bore of the river. We were then shipped in our sedan-chairs into a ferry-boat, in which we crossed the river, which is here about 250 yards wide.

Shortly after starting from Liangwu we saw the commencement of the great Shao hsing Viaduct, of which the old Jesuit Fathers have given a long but inaccurate account; when I say inaccurate, I merely mean to say that they have given as its indubitable history accounts which native scholars regard as problematical. What we can ascertain with certainty is as follows: before the completion of the Chekiang sea-barrier, and before the banking of the Ngo chiao River and the Han Estuary, the whole of the now fertile lowlands of the Chekiang province was a salt-marsh (in fact it would be so again were the sea-barrier, of which I will treat farther on, removed). The first Chinese colonies which came to the province speedily occupied and built towns on the highland, among the most ancient of which were Hang chow (called by Marco Polo Cambo dan) and Shao hsing. To connect these settlements with the Ngo chiao River by a pathway, in the then absence of canals, became a necessity, hence the erection of a long bridge across the then marsh, which has been so solidly laid that it still exists. This bridge is about 90 miles long, 5 feet wide, and has a parapet remaining, in some parts of about 2 feet high. Each stone bears the date at which it was put up cut upon it; of course it may be imagined that at the present day these dates are so effaced by time that they are only legible on the more modern stones which have been used at various times for reparation. I fancied, however, that I could decypher on one stone the name of one of the emperors of the Tang dynasty. Each stone is about 12 feet long, 2 feet wide, and 1 foot thick. The pillars in the water are about 4 feet wide, thus making rectangular arches of about 8 feet span. After the

building of this bridge or viaduct the great sea-barrier of the Che-kiang Province and the banks of the Ngo chiao River, &c., were completed; and there, the low-lying land being drained off, a country half as large as Holland was, by digging canals, raised gradually to an altitude, so as to give land enough to nourish a population of more than 8,000,000; and the bridge is now only used as a tow-path when the wind is dead ahead, and as a road for the few foot passengers who do not like going by the cheap omnibus-boats, which start twice a day from Ningpo to Hang-chow. I may here mention that the system of omnibus-boats and transit companies, conducted on a far greater scale than is generally supposed, is almost universal in China. The Shao hsing Viaduct runs various distances in the centre of the main canal, sometimes one mile, sometimes only a few yards, once for nearly ten miles, it is now and then lost in recovered land, sometimes it forms an embankment of the canal, and sometimes crosses it, a modern high bridge being placed in the centre. The recovered land itself looks like a series of islands; about every quarter of a mile is a fresh-water canal, in which are dozens of chain-pumps, worked by treadles, buffaloes, and hand, for the purpose of irrigation; so valuable is land about here for this cause, and by reason of the facilities of transport, that it lets, merely for the purpose of agriculture, at about 7*l.* an acre. I may here perhaps mention that the chain-pump was deemed so ingenious a contrivance by an Australian farmer who was my guest at Ningpo, that he has introduced it into his farm there.

Making a short detour from our route, which lay through Shao hsing, we visited the celebrated Yu lin or Temple of Yu, where there is a copy of the well-known Yu tablet which has caused so much discussion. Yu was the third great Emperor of China, and lived about 2300 years before Christ. His great work was the draining of the marshes of Shauhsi and Shautung, and he has by some scholars been thought to be identical with Noah.

I commenced to study the question in an historical point of view, and collected as many Chinese modern transcripts as I could. In this I was aided by the Intendant of Circuit of Ningpo and other native scholars. I found that while all Chinese writers are agreed on the form of the ancient character in the inscription, there are as many as eleven modern Chinese versions. The whole inscription contains 77 characters, on the modern rendering of 38 of these characters all the works I have seen are agreed; 39 characters are variously rendered. The Rev. Mr. Hudson and Dr. McCartee were kind enough to aid me with their more mature Chinese scholarship in writing a paper on the subject. I submitted this paper to Mr.

Goodwin, the translator of many of the Egyptian hieroglyphics, and to Mr. Medhurst, H.B.M. Consul at Shanghai. Mr. Medhurst had entirely confined himself to the philological side of the question, and I had confined myself to the historical; we both, however, had arrived at the same conclusion, viz., that the present existent inscriptions are, except in the size of the characters, fac-similes of the inscription set up by Yu over 4000 years ago. Those interested in the subject I would refer to the 'Journal of the North China Branch of the Asiatic Society for 1868,' which is now under course of publication. I had hoped to show to this Society rubbings of the inscription, but I left them in China to be photographed and published in the 'North China Asiatic Journal.' I may perhaps state that the rhythm and form of language on this inscription offers a striking resemblance to Lamech's song in the Scriptures. At the Yu lin Temple, now inhabited by myriads of bats, are said to exist relics of Yu, in the shape of his clothes, &c. When this temple was first founded is now lost in antiquity; it was rebuilt A.D. 300, 900, and 1500.

From Yu lin we proceeded to Shao hsing, a large town celebrated for its wine, made from rice, and tasting something between Hock and Amontillado. It is drunk hot.

From Shao hsing we proceeded in boat through various Chinese towns to Hsi hsing, a town on the south bank of the great Hau River, about 190 miles from Ningpo. Here, as at Liangwu, we found sedan-chairs waiting us, and in which, leaving again our keys and boxes in charge of the Transit Administration, we were shipped in our chairs on board a junk or sea-going Chinese vessel; on this junk were about 80 passengers besides ourselves. When I state that 10 to 15 of these junks start every day from either shore, some idea of the greatness of the operations of the Chinese Transit Company may be imagined. As the wind was very light we took over an hour crossing the river, which is about 4 miles wide. Again, a mile and a half of shore and a mile of suburb took us to the gates of the city of Hangchow, the capital of the Chekiang Province, the Paris of the Chinese empire. Our journey was not yet over; we had still to traverse 3½ miles of one long street filled with shops, displaying every species of gaudy merchandise, gilded shop-fronts, flowered lanterns, &c.; almost the whole way being covered by an awning of variegated gay-coloured calicoes and cotton prints, so as to keep off the heat of the sun. At last we arrived at the hospitable mansion and church of Señor Ricci, a Roman Catholic missionary, belonging to the same family as Saint Ricci, one of the celebrated fathers who went to China in the sixteenth century, and who was a minister in the court of the then Chinese emperor. After about an

hour our baggage arrived. Outside the residence of Signor Ricci at Hangchow, originally a Nestorian church, founded in the third century, is the same magnificent façade which was admired by Marco Polo. Here is a tablet recording the order of the Emperor Chia Ching to persecute and expel Christians from the empire. Of this tablet I had already made a translation, which I published with notes in the 'Journal of the North China Branch of the Asiatic Society.' The story is briefly this. The Emperor Kanghsi—called by the Chinese the Sacred Ancestor—was greatly struck by the Christian religion, and invited many of the Catholic missionaries to his court, where he employed them as architects, astronomers, chemists, &c. He also liberally subscribed towards the erection and reparation of Christian churches and cathedrals; among others, to the church at Hangchow, outside which the missionaries put a tablet, stating it was built by Imperial order. Chia Ching, on the other hand, hated the Christian religion, on the score, it is said, of personal pique; as when he was heir-apparent he had visited the cathedral at Peking, and the bishop who was then conducting the service continued doing so, and did not at once leave off to come forward and pay his respects to the Prince. When Chia ching therefore became emperor he banished all the missionaries to Macao, and changed their churches into temples to Chinese deities. This happened in A.D. 1736, when the tablet I mention was erected to record this fact. The inscription contains an elaborate attack on the Christian doctrines, and an accusation against the missionaries of having forged the tablet, saying the church was built by Imperial order. After the late war the French Government demanded the rendition to the Catholic missions of the land and buildings of which they had then been deprived. Among those thus rendered was the church at Hangchow, which has now been restored from a temple to the Empress of Heaven to a Christian place of worship. The authorities offered at the time to remove the insulting inscription, but Monseigneur de la Place, then Bishop of Che kiang, preferred to have it left outside the church.

Père Ricci was kind enough to show us over the church and mission buildings, and our attention was attracted by seeing through the window an inclosure covering four or five acres covered by little tent-like cottages; we asked whether it was a camp, and he told us no, but that it was a collection of charitable buildings, erected after the retaking of the city from the rebels by a Chinese charitable society for the refuge of the blind, sick, and infirm; that it contained 200 blind men with their families, amounting to 800 souls; and that work, such as plaiting straw-mats, basket-making,

&c., was provided them; that besides these 800 there are 1200 other inmates, who are too old or infirm to work; and that a staff of 40 native doctors gave gratuitous advice and medicine to the 2000 inmates. None are allowed to be absolutely idle, but help towards their own sustenance by rearing fowls, pigs, cotton-spinning, and other light work. Sanitary regulations with regard to cleanliness, &c., are not, I regret to say, as rigorously enforced as they might be, but still this pleased me as being not only the largest in scale of all the charitable associations I have heard of in China, but also the best conducted; other charitable associations, such as that for the prevention of infanticide, the burial of the uncoffined dead, foundling institutions, and free schools, being generally more or less marred by abuses. I regret that time does not allow me to dilate further on these charitable institutions in China, as I believe their existence and working is not generally known in England.

We visited the monuments which have lately been erected to the memory of the Chinese who fell fighting against the rebels, and I trust I am not betraying diplomatic secrets in saying that the enlightened Viceroy Ma has recommended the Emperor to order a similar monument to be erected at Hangchow to the English and French who died in the Taiping war. Hangchow being nearly 200 miles distant from the nearest port, I think this fact alone proves that, though local disturbances may cause local irritation, the mass of the Chinese people and the Chinese Government are grateful for the assistance Europeans gave them in suppressing the dreadful scourge of the rebellion. At Ningpo itself one such monument already exists.

The next day I had to call on the Governor-General Li, brother of the well-known Li Fu-t'ai, under the following circumstances:— An order had lately been issued for the reparation of the great sea-barrier of the Chekiang province, to which I have before made allusion, and decreeing that all the stones that could be supplied by the stone-quarries in the province should be devoted to this purpose, and only the lesser stones sold to the general public. As a matter of form permission had to be asked for an exception in our favour. This great sea-barrier is built of large, flat flag-stones, is about 100 feet wide, and on an angle of about 15° with the horizon. The lower stones overlap the higher ones, and they are all fastened together by means of huge stone bolts with here and there iron clams. This sea-barrier stretches right from the southern bank of the Hau estuary's river to Chinhai, the seaport of Ningpo (Chinhai is 13 miles distant from Ningpo). The first origin of this

sea-wall is lost in antiquity, and even the accounts of the various new modes adapted as engineering science advanced are evidently of so legendary a nature, all bordering on the miraculous intervention of the deities in answer to prayer, that I content myself with giving an account of these successive alterations, as a note to this paper, in a literal translation of the commencement of a chapter in the Chinese 'Government Gazetteer' of the Chekiang province. I may mention that Mr. Thomas Kingsmill, Corresponding Secretary of the North China Branch of the Asiatic Society (himself a civil engineer), has written many papers on this subject, which have appeared in various journals and scientific publications.

The next day Père Ricci kindly accompanied us to the West Lake, outside the city, where we enjoyed ourselves thoroughly. This spot was a favourite resort of the enlightened Emperors Kang hzi and Chien Lung, to whom there are numerous arches of triumph in the neighbourhood; on the shores of the lake is the palace of the latter—alas! now in ruins, showing that the Taipings have passed the spot; from a sixteen-sided pillar, among what were once beautiful rockeries, are taken the sixteen rubbings which I have now the honour of showing this learned Society. The writing on the one I now indicate was written for the engravers by Chien Lung himself. These rubbings represent sixteen Buddhist Lo haus, or happy saints. The West Lake itself, surrounded by hills of every form and hue, is probably one of the most romantic places in the world, studded as it is with islands, whose white marble balustrades sparkle in the sun; its clear blue waters are covered with lilies, and bristle with little minaret towers, so perforated as to reflect a double globe of light on the water. On it, too, are birds of rare plumage, water-pheasants—a bird I had never seen before, divers, dippers, teals of various kinds, with their broods of ducklings. From the sky above, hardly more blue than the water below, larks warble, from the glossy-leaved bushes on the banks the thrush joins in with his music of song, and the turtle-dove, hidden in a grove of gently waving bamboos, utters pleasant cooings. Here you may see a party of gentlemen of the black-haired race, as the Chinese love to call themselves, on pleasure bent, drinking wine and laughing over the forfeits or wrong guesses in the game of Mora, sitting in some bright-coloured two-storied gondola, and through the open windows showing off their clean light silk raiment of picturesque fashion, enjoying the breeze, and now and then gazing at the scenery, with its back-ground of hills, rocks, gaudy ranges of wondrously shaped refreshment pavilions, red-walled temple, spacious palace, or lofty pagoda, which ever change their aspect as the boat

passes by some tiny promontory, or glides round an island-point. Even to us foreigners, unacquainted as we are with the legends that attach to the West Lake, the spot is one of peculiar attraction, but to the Chinese it is as a paradise, or as a garden of Eden. "He is truly happy," says the Chinese proverb, "who is born in Soochow, lives in Hangchow, and dies in Canton." 'Tis here alone almost in China that the poor mandarin, imprisoned by his dignity, and shackled by the exigencies of the deportment his countrymen consider it necessary he should adopt, is able to unbend and enjoy himself like an ordinary mortal. In every nook and corner of the lake too, in the belief of the well-read native, fairies have held their revels, and bogies and gnomes have played their pranks. In its neighbourhood among the mountains are numberless temples of the various creeds current in China, each temple having its fairy tales, which, if not very interesting to us, are at all events endless in number. While some of these temples modestly showed their bright blue and imperial yellow tiles amidst the foliage of a retired valley or hidden gorge, others proudly stand eminent on the summit of lofty peaks and overhanging precipices; others, again, halfway up the craggy steep, invite the pilgrim, wearied with the ascent up the circuitous path, and footsore with the rough hewn stones winding through the bushes, to rest in halls permeated by cooling breezes, which waft a perfume to mingle with the sweet-smelling incense of the altar, through the china-aster flowers. There, too, the traveller can slake his thirst in the icy waters of the stream which softly warbles over the pebbles by the temple; or, going a little further on, can bathe in the basin of a fall, and be inspired by the loud music of the waters dashing against the rocks. At the entrance of the West Lake is the temple of the guardian spirit of the Hangchow city, who before his soul put off the struggling coil of his human body, to be indued with the glorious spiritual body, had been a servant so faithful to his king, that when condemned on a false charge to be executed, he entreated his Majesty to slay his only son also; "for," said he, "my son's love for me will cause him to commit the crime of rebellion against the Emperor to revenge my death:" then the King slew both father and son, and after several years the truth came to light, and it was found a faithful minister had been maligned; then the King took the false accusers, man and wife, and beheaded them; and he built a temple to the faithful minister, and created him tutelar deity of Hangchow. As for his accuser, and the wife of his accuser, of them did the King make stone effigies, stript naked to the waist—as are criminals at their execution—in chains and kneeling, and he placed them in

the yard of the temple, and every man who passed this way vented ordure upon them; so that, for fear the stones should be worn away, and the advantage of the example lost to future generations, a stone palisade was put round them; yet still up to this day, after the lapse of so many centuries, through the palisade do visitors to the spot show their hatred and contempt for the effigies of the calumniators, in a manner expressive, curious, and unrefined; and so respected is the memory of the faithful minister, that even those universal destroyers, the rebels, left his temple unharmed. Another curiosity on the West Lake is the Thunder Peak Pagoda, the origin of which is connected with the following legend. A barber-boy, while walking about the shores of the West Lake, is invited by a demon, in the form of a beautiful damsel, into a palace; he naturally becomes enamoured of her and marries her. She persuades him to turn doctor, and by her skill he works most wondrous cures; he is accused of witchcraft—a crime punishable by death in China; to bribe the mandarin judges, the demon bride supplies him with large sums of money. These sums of money she has robbed, in her real demon form, of a flying dragon of the Hangchow treasury while her husband slept. This gets the hero into still further trouble, and his friends inform him that he has espoused a fiend, and persuade him, at all events, to test the fact. This he does by making her drink, without her knowledge, a consecrated wine on a high festival day, the result of which experiment is terrible. She suffers the most excruciating agonies, and resumes her hideous shape, vomiting torrents of blood over the floor. Her husband returning to the room, and finding the hideous demon where he had expected to see his lovely bride, faints away with fright. As she has no difficulty in persuading him afterwards that he has been the victim of a horrible nightmare, he restores to her his love. Till at last the Queen of Heaven interferes, and the demon bride, purified by her affection for a human being, consents to sacrifice all—even his love—for his sake, and dies, having first given birth to a son, who turns out the greatest scholar of his age. She is buried on the spot where her fairy palace stood, and, to keep her quiet in her grave, the Thunder Peak Pagoda was built over her. This, in the absence of reliable history, is the legend given by the Chinese of the Thunder Peak Pagoda which proudly lifts itself in the form of a red brick fluted pillar to the skies. Another curiosity of the West Lake consists of a perforated mountain, which seemed to my inexpert eyes to be composed of pumice-stone. This hill, by the Chinese, is supposed to have flown to the spot where it is, in a single night and of its own volition. Time fails me to speak further of the West Lake

of Hangchow. I may mention that the Government 'Guide-Book of the Antiquities and Curiosities of the West Lake' is twice as long as Gibbon's 'Decline and Fall of Rome.' I have the honour to offer to the Society an abridged popular edition of this work.* The next day we spent in visiting the Hill of the Faithful Minister, whose history I have already recorded. This hill stands in the west corner of the city, and from it a magnificent view of the city (east to west), 30 miles in circumference, is obtained. On the north is the West Lake, on the south is the magnificent Hau River. The city has now a population of nearly a million and a half; it was said to have been nearly two millions and a half before it fell into the hands of the rebels.

The journey from Hangchow to Shanghai is only interesting as showing a vast system of tidal canals, since, as the water of the river is fresh at Shanghai, it has not been necessary to institute the system of haul-overs in the Kiangsoo province that exists in the Che-kiang province; besides this, the Kiangsoo province is almost entirely plain land. The province also shows a gradual and slow recovery to cultivation of the fertile lands of the province from the fearful desolation wrought by the rebels. In the prefecture of Chia-hsing, for instance, there were formerly more than a million souls; now there are hardly eighty thousand. On the whole way from Hang-chow to Shanghai, 40 miles off, we pass through a jungle, putting up pheasants at almost every step; villages and towns, of which hardly one stone has been left on the top of the other, broken bridges, choked-up watercourses. Yet since I had been on the route two years ago, I saw a wonderful improvement, villages rebuilt on the ruins of towns, cultivation carried 15 miles further from Shanghai than before, spots of the jungle cleared, and steam-dredges deepening the blocked-up watercourses. Though restoration is being carried on as quick as is compatible with the genius of the Chinese people by the present Government, which is enlightened enough to avail itself of European science as far as the Chinese peculiar institutions and social system will permit, it will still take nearly a century to reinstate the happiness and prosperity of the period before the mad coolie Hung-hsiao-chuan persuaded a rabble of criminals that he was the Son of God and brother of Jesus Christ, and that his mission was one of plunder and destruction. On the journey, too, one meets hundreds of peasants shamefully branded on the face by the rebels with the words "runaway Taiping slave."

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* Deposited in the Library of the Society.

These were the peaceful inhabitants of the country who were unable to escape from the rebels.

It is a pleasure to record the politeness, kindness, and hospitality shown to us by natives of all classes during our journey, from the Governor-General, who sent us a present of hams, fowls, ducks, &c., large enough to stock a provision-shop, to the poorest peasant, who offered us a portion of his frugal meal of rice and sauer kraut. I cannot avoid thinking that, as all wars and national hatreds are caused by peoples' misunderstanding or not knowing each other, the policy of the late Sir Frederic Bruce was a most enlightened one, in making us known to the people of Chekiang and Kiangsoo by aiding with our arms to put down the most horrible rebellion that probably ever existed. No wonder that when the Chinese armies were led to victory by such a chivalrous and disinterested Christian gentleman as Colonel Gordon, who used the victories he gained to inculcate, as far as he could, mercy and humanity to the misguided vanquished in the minds of the angry authorities,—no wonder that there Englishmen should be well received. These two provinces, inhabited by 60,000,000 of human beings, have brought us a rich national reward in the shape of a gradually increasing trade, a growing market for our manufactures, and consequent employment for thousands of our countrymen.

The PRESIDENT observed that any experienced traveller, who also possessed the qualifications of a good scholar, might be proud of the paper which had been communicated to them by so young a gentleman as Mr. Gardner. He was informed that Mr. Gardner was a skilled Chinese scholar, and the research he had made was evident from the contents of the paper. He must express his great admiration for a young man of so much talent and research, and he would beg of him to come forward and say a few words on the country which he had described.

Mr. CHRISTOPHER GARDNER said he would only call attention to the series of portraits on the wall, which were taken from the sixteen-sided pillar in the Emperor's palace at Hangchow. The inscription on one of them was written for the engraver on the stone by the Emperor himself. Some of the characters are very like Sanscrit, but he believed they were Thibetian. It was interesting, because in the Buddhist temples one often came across Sanscrit works, not only the translations but the originals as well. There was a little island to the east of Chusan, which was a sort of Chinese Athos; it was full of Buddhist priests. The portraits were the portraits of devotees who had attained to the highest rank in the Buddhist religion.

Tenth Meeting, 12th April, 1869.

Sir RODERICK I. MURCHISON, Bart., K.C.B., President, in the Chair.

Presentations.—*Frederick Fitch, Esq.; Col. Barnett Ford; William Clark, Esq.*

Elections.—*Frederick George Chinnock, Esq.; Frederick H. Leaf, Esq.; Roger Leigh, Esq.; E. B. March, Esq.; E. M. Underdown, Esq.; Charles M. T. Western, Esq.; Rev. T. G. Wilson*, B.A.

Accessions to the Library since the last Meeting of March 22nd:—'Narrative of the British Mission to King Theodore.' By Hormuzd Rassam. Presented by the Author. 'Historia del Peru Independiente.' Por Mariano Felipe Paz Soldan. Presented by the Author. Four volumes of Chinese works relating to Antiquities and Natural Curiosities of the West Lake, Hangchow. Presented by C. T. Gardner, Esq. 'The Highlands of Brazil.' By Capt. R. F. Burton. Purchased.

Accessions to the Map-room since the last Meeting:—A Map of Abyssinia, showing the Route of the British Mission under Mr. H. Rassam, &c., from Massowah to Mágdala. Compiled and presented by G. P. Badger, Esq., F.R.G.S. Turkistan, with the adjoining Portions of the British and Russian Territories. On four sheets. Compiled by Lieut.-Col. J. T. Walker, R.E., Superintendent of G.T.S. of India. Presented by the India Office, through C. R. Markham, Esq. Map, showing the Route-survey from Nepal to Lhasa, and thence through the Upper Valley of the Brahmaputra. By a Pundit. Compiled by Capt. T. G. Montgomerie, R.E. Ordnance Survey. (191 sheets.) Presented by Sir H. James, R.E., Director of the Ordnance Survey.

The following Papers were read:—

1.—*Report of the Trans-Himalayan Explorations during* 1867. By Captain T. G. Montgomerie, R.E., of the G. T. Survey, from the original Journals, &c., of the Trans-Himalayan Exploring Parties.

[Abridgment.]

The Trans-Himalayan explorations made during 1865-6, from the Mansarowar Lake to Lhasa, supplied various pieces of information as to routes and places in Tibet, of which the names were unknown in India. Tibetans had been heard to talk of their gold-mines and

salt-mines, and the position of some of the latter was indicated roughly on European maps, but our knowledge of all such places was vague in the extreme, though the Tibetans certainly do bring both gold and salt. The first Pundit heard of these places whilst in Lhasa, and the second Pundit, when at the Gartok fair, heard various particulars from which he gathered that the route to those gold-fields east of Gartok was feasible.

It will be remembered that the second Pundit made his way to Gartok, in 1865, by one route and returned by another, thus connecting that place with points in British territory on the south that had been fixed by regular survey. There, however, still remained a large gap between Gartok and the Ladak territory, which latter had also been surveyed. It appeared to me very desirable that this gap should be filled up, the more especially as it embraced a portion of what was said to be the course of the great River Indus; a portion, moreover, that had never been traversed by any European.

The natives pointed out the position where the eastern branch came in, and a gap seen in the mountains in that direction made its existence highly probable. Having this information, it seemed to me very desirable that the question as to the existence or non-existence of this branch should be settled. I consequently determined that the second expedition of the Pundits should be in that direction, the object being to settle various doubtful points as to the position of the upper basin of the Sutlej; the second object, the question of the eastern branch of the Indus; the third, the connection of Gartok with the regular survey in Ladak; and the fourth, to explore up to the gold and salt mines east of Gartok, and as far beyond as the Pundits could get in an easterly direction. The latter being with a view to gain some knowledge of the vast *terra incognita* lying between the desert of Gobi and Lhasa. Preparations for the expedition were made during the spring of 1867; a third Pundit was entertained and trained to supplement the place of the second Pundit, who had proved to be somewhat wanting in nerve. Starting from Mussoorie, on the 2nd of May, the party under the first Pundit reached Badrinath on the 24th of May, and Mana on the 3rd June. The Mana Pass, to the north, had not been declared open, and the party had consequently to wait at Mana. Whilst there, several heavy falls of snow occurred on the neighbouring mountains.

The Pundit found that before his party could cross into Tibet it was necessary that the opening of the pass should be formally notified by the Tibetan officials, and before this is done the Jongpon (or Zungpung) of Chuprang makes enquiry every year as to the political and sanitary condition of Hindustan. The enquiry seems

to be carried out with all that assumption of lofty superiority for which Chinese officials are famous. Looking down from their elevated plateaux, they decide as to whether Hindustan is a fit country to have intercourse with. The decision come to appears not to be at all a dead letter, for, as will be seen hereafter, it ultimately affected the Pundit's movements not a little. The especial enquiries made are, as to whether there is war, epidemic, famine, &c., such as are in any way likely to affect Tibet.

At length, on the 9th of July, three men, sent by the Jongpon of Chuprang, arrived, and having made all their enquiries, declared the Mana Pass open to traders from Gurhwal; the party accordingly was able to commence its march on the 26th July. It consisted of eleven men, twelve asses, and one pony; the men being all armed with weapons they had borrowed at Badrinath, as they were told that arms would be required to keep off robbers. On the 28th they crossed the Himalayas by the Mana Pass (18,570 feet), and on the 29th July reached Lumarti Camp. Here they were told to halt until more traders joined them, so that the Tibetan officials might be saved trouble by examining and taxing a number at the same time. The second Pundit, however, was sent on ahead to intercede with the Chuprang Jongpon, and he succeeded in getting authority for the party to advance alone. Churkong is the place where traders are generally taxed, but in this instance the examination was made at Barku. The Abtuk of Chuprang searched the baggage, fortunately without discovering the instruments, and, being satisfied that the party was a trading one, he levied the taxes at the usual rates.

On the 6th August the party reached Totling, passing the small town of Chuprang on their left (north). From Totling the party advanced direct towards Gartok, crossing the Sutlej by a remarkable iron suspension-bridge 76 feet span, 7 feet wide and about 40 feet above the water. The chains are formed by links of iron of the shape of the figure 8, each about one foot in length, the iron being over one inch square. The bridge is said to have been built by Gyalpo Kesar, or Sekundar Badshah (Alexander the Great)! The iron is in capital preservation, owing to the very small rainfall, and to the care with which it is annually lubricated with butter (ghee).

On the 9th August they crossed the watershed between the Sutlej and the Indus, by the Bogola Pass, 19,220 feet above the sea, and reached Gugti Camp, close to Gartok, on the 11th instant, avoiding the latter place, lest its officials should in any way interfere with their onward progress. Continuing their journey, they ascended

the mountains east of Gartok, and, after crossing the Gugtila Pass, 19,500 feet above the sea, they found themselves, on the 14th August, in a vast desolate plateau, the lowest points of which they ascertained to be 15,280 feet above the sea.

On the 10th they crossed the Pabha-la, 17,650 feet above the sea, and descended to the Giachuruff Camp, on the banks of the Singh-gi-chu, or Indus River, 15,730 feet. After the desolate and arid table-land they had crossed, the sight of the river and its fresh water, and of the large camp beyond, was at first very pleasant to the Pundit's party; their pleasure was, however, soon damped, as they found the inhabitants of the camp very suspicious as to the object of their journey: their progress being for the first time impeded by the officials. Gopa Tajam, the head man, questioned them as to the objects of their journey, and as to who and what they were, &c. When told that they were Bisáhiris, who had come there solely to sell coral and purchase shawl-wool (pushm) in exchange, he told them flatly that he did not believe their story. With great correctness he then proceeded to point out the proper country of each individual, and said that if they had been really all Bisáhiris, and had been lately in Bisáhir, they would never have dared to enter Nari Khorsum that year, as an order had been promulgated, at the time of opening the passes, forbidding Bisáhiris to enter the country on any account, as they had in the previous year introduced small-pox, which proved fatal to many of the inhabitants. The head man, moreover, hinted that the party had introduced Europeans into the country.

The Pundit thought these suspicions were due to the jealousy of an acquaintance of his who lived near Badrinath. However, by repeated protestations, he managed to bring the head man round to a partial belief in their story, so that he at last consented to allow a portion of the party to proceed onwards, provided the remaining portion was left as a hostage for their good faith.

As the second Pundit's nerves were again considerably shaken by the dreary mountains they had crossed, and by the check they had received, the first Pundit decided to leave him at Giachuruff whilst he and the third Pundit pushed on ahead on the pretence of selling their coral. Whilst preparations for this purpose were being made the head man's suspicions began to gather again, and it was only after further entreaties, accompanied by presents, that they were allowed to advance. The Pundit left the Giachuruff Camp, on the 22nd August, with the third Pundit; but the latter was, very soon after starting, detached with one servant to carry a route-survey up the river Indus as far as he could get. The Pundit himself made a

very long march, so as to get well clear of the Giachuruff people, and by night was far away to the east, resting near the bed of a small dry stream. On the 23rd August he hoped to have been able to cross the Chomorang Range, but, owing to a very heavy fall of snow, he was obliged to halt at a camping-place below it. Snow continued to fall on the 24th and 25th, and he was not able to continue his march till the 26th August, when he crossed the Chomorang-la Pass, 18,760 feet above the sea, and after a very long march, crossing a good deal of snow, he reached the large camp of Thok-Jalung,* the chief gold-field of that part of the country.

As the Pundit descended the Chomorang-la Pass, the Thok-Jalung Camp came in sight; he found it pitched in a large desolate plain, of which the prevailing colour was reddish brown. As far as he could see, it at first appeared to be like other Tibetan standing camps, except that it was very much larger. As he got closer he made out the noise of a great number of voices singing together, and, on his arrival, found that this came from the gold-diggers and their families whilst the men were at work.

The Pundit had armed himself with a letter from the Giachuruff Chief, and this he presented the next day to the Thok-Jalung Chief with a small present of the best Indian tobacco, which he had somehow discovered to be a particular weakness of that individual. The Chief received the Pundit in his large tent; he was much gratified by the present, but, in spite of that and the letter, it was evident, from his manner, that he did not think that matters were quite right. He cross-questioned the Pundit, and then advised him to do what he had to do in Thok-Jalung quickly and to return to Giachuruff by the same road as he came. The Chief said that it was out of his power to allow the Pundit to stay long, and that properly he ought to have sent him back at once, as there was an order in force forbidding all Bisáhiris to enter the country that year.

The Chief was an inhabitant of Lhasa, called Yoodak Mingmár, about 45 years of age. He had been master of the Thok-Jalung gold-field for some time. The Pundit saw him several times afterwards, and always found him very civil. His usual dress was a red robe of Lhasa or Shigatze manufacture; his head was covered with a brown felt hat of Chinese fashion, with a broad rim turned up all round. He told the Pundit that he and every one else wore furs in the winter, and that they could not live at that season without them; which is no doubt correct, as the Pundit's observations make the gold-field to be at the great altitude of 16,330 feet above

* Latitude, N. 32° 24′ 26·5″, longitude 81° 37′ 38″.

the sea. His tent was a large circular one, about 25 feet in diameter, with two poles; it was pitched in a wide pit, some 7 or 8 feet below the surface of the ground, and the descent to it was by means of steps. Outside, the Pundit noticed one of the gigantic black dogs of Lhasa; this beast was tied unpleasantly near the door, and was so savage that there was great difficulty in preventing him from flying on strangers. The Pundit had seen many of these dogs in Lhasa, and he at once recognised it by its great size, deep jowls, and the white mark on its chest. The Lhasa people call them Gya-ki or "royal dogs."

The tent was made of black yak's hair; it contained bales of shawl-wool (pushm), leather, packages of tea, strings of dried beef from the yak, and a few other Tibetan luxuries, such as dried apricots, currants, &c.; the poles were garnished with several matchlocks and a sword. The Chief's seat was beside a small box, in which there was a drawer containing paper, pen, ink, and a couple of cups or bowls, one for drinking tea and the other for chung or whisky. The Chief's tent seems to have also been the shrine of the camp, as behind his seat there were piled up the usual images, small brass bells, tiny vases, books, pictures, lights, &c., that are carried about by wandering Buddhist Lamas. Whether the Chief was also a Lama was not ascertained, but his red dress and the ritualistic instruments point to that conclusion.

The Chief was constantly smoking a silver-mounted Nepalese hookah. Tea was forthcoming at all hours. He had about ten personal servants, who lived in small tents round about his own. The Chief was a very intelligent man, and, all things considered, the Pundit thought him well informed. His shrewdness there was no mistaking, as instanced in the matter of the coral. He noticed the Pundit's box, examined it carefully, and then asked him how he came to have such a good box. The Pundit was fortunately ready with his answer, and said he bought it at one of the "Saheb logues" auctions, to carry his coral in. The fame of these auctions had reached even this Tibetan Chief, and he expressed himself as quite satisfied, allowing the box to be removed without discovering the large sextant which was stowed away in a secret compartment. The Chief took a great liking to the Pundit, and used to send for him every now and then, in order to discuss, over tea and tobacco, the great country down below.

The Pundit found the part of the gold-field that was being worked to be a great excavation from 10 to 200 paces in width, and some 25 feet in depth, access to the bottom being by means of steps and slopes, the earth as dug out being thrown upon either side.

The excavation at the time of the Pundit's visit was about a mile in length. The digging is carried on with a long-handled kind of spade, and occasionally with an iron hoe; the iron for these implements is brought from Bisáhir, Ladak, &c. The camp had a blacksmith who could repair these tools.

A very small stream runs through the gold-field, and the bottom of the excavation is consequently rather a quagmire during the daytime; but the stream is put to good use for washing the gold out of the soil. The diggers dam up the water, and leave a sloping channel for it to escape by. A cloth is spread at the bottom of the channel, and kept down by a number of stones so as to make the bottom uneven. One man brings earth from the excavation and sprinkles it over the channel, whilst another man drives water down the channel by means of a leather bag. The water carries the lighter soil right away, but the pieces of gold fall into the uneven places, and are easily collected in the cloth by lifting up the stones. The yield of gold seems to be large, and the "finds" are occasionally very heavy—the Pundit saw one nugget of about 2 lbs. weight (75 tolahs). The diggers say they can recognise the soil that contains gold at once, but, judging from the large number of gold-fields that have been used at one time around Thok-Jalung, and are now more or less abandoned, the Tibetan gold-diggers seem to be quite as capricious as those of Australia or California; and the probability is that, whenever they are a long time without getting good finds, they strike their camp and move off to what they think a more tempting field.

From what the Pundit heard during this last expedition and the previous one to Lhasa, there is a whole string of gold-fields extending all the way from Lhasa to Rudok, along the route which must run close to the northern watershed of the Brahmaputra, probably in the depression to the north of it. The gold-fields are carefully watched by the Lhasa authorities, a gold commissioner, called Sarpon, superintends the whole of them, and each field has a separate master. Any individual is allowed to dig, provided he pays the annual tax of one sarshoo weight of gold, which is about half a tolah, or two-fifths of an ounce. The greater part of the diggers come from the Chung province around Shigatze. The gold commissioner makes an annual tour through the gold district, visiting each field and collecting the taxes.

The Pundit says that in all his travels he never experienced such intense cold as he did at Thok-Jalung, owing, as he thought, to the high cold wind that was always blowing, more than to the great elevation, viz., 16,330 feet above the sea. The tents of the diggers

are always pitched in pits, some 7 or 8 feet below the surface of the ground, so as to keep out the wind. Spite of the cold, the diggers prefer working in the winter, and the number of their tents, which in summer amounts to 300, rises to nearly 600 in winter. They prefer the winter, as the frozen soil then stands well, and is not likely to trouble them much by falling in.

The water near Thok-Jalung is so brackish that the diggers cannot drink it till it has been frozen and then re-melted. Considering these difficulties about water, the great elevation, the total absence of wood, and the general severity of the climate, gold-digging at Thok-Jalung is carried on under very much greater difficulties than in any other part of the world. Nevertheless the diggers appeared to be cheerful and were constantly singing, their families joining in a sort of chorus, which could be heard at a great distance.

Argols of dried dung from the yaks, ponies, and sheep, &c., form the only fuel. The Tibetans cook and eat three times a day, their food consisting chiefly of boiled meat, barley-cakes, butter-milk, and tea stewed with butter. The Pundit said the Tibetans all preferred China tea, and did not approve of Himalayan tea, spite of its price; they vowed the latter was too heating for them, and that only very poor folks take it.

The Pundit mixed freely with the gold-diggers, and observed all their ways and habits, but his time was limited; the Chief, spite of his friendly conduct, insisting that he could not let him stay beyond the 31st of August. He ascertained that the price of the gold at Thok-Jalung was only 5½ to 6 rupees in silver per saishoo (which weighs about a half-tolah and 8 ruttees), or rather less than 30 rupees per ounce. There were two tents belonging to goldsmiths in the camp, they came from the Chung or Shigatze province. Seeing no chance of extending his journey to the east of Thok-Jalung, the Pundit retraced his route to Giachuruff; there he found the third Pundit, who had made his way for a considerable distance up the River Indus to a place called Jiachan.

Though the third Pundit had heard that a large band of mounted robbers were wandering about the Upper Indus, he was in no way hindered by them till he reached Jiachan. There, however, whilst he was down at the river, a couple of armed robbers fell upon his servant, an oldish man, and knocked him over, seizing a thermometer and the cocoa-nut containing the supply of quicksilver. Fortunately the Pundit was not far away, and, hearing the cries, he rushed to the rescue. Seizing one of the robbers by his pig-tail, he swung him round and took back the stolen things. This third Pundit, being a tall, powerful man, completely turned the tables,

and the robbers pretended that they had only been joking with the old man, and did not really mean to take anything. The robbers made off as soon as they could, and the third Pundit, thinking they might bring down more of their brethren on him, decided to retrace his steps. He was very reluctant to do this, as, from all he could hear, three or four marches more, at the outside, would have taken him to the source of the Indus, which at the farthest point he visited was still a good-sized stream. He was, however, certain, from the peculiar head-dress of the robbers, that they belonged to the armed band he had been warned against—the head-dress being one peculiar to the nomadic inhabitants of the Shellifuk and Majin districts, who are noted as professional robbers.

The whole of the Pundit's party having been recollected at Giachuruff, he decided to trace the Indus down to its junction with the river upon which Gartok stands. Starting on the 4th September, they marched steadily down stream, passing numerous camps with their flocks and herds, but seeing no cultivation or villages till the 7th, when they came to a small village with the first patch of cultivation. All along the banks there was a low bushy jungle. The grass appears to have been abundant, and near one camp there was a herd of five or six hundred horses or large ponies running almost wild, mostly of a white or a greyish colour. On the 12th September they reached the junction of the Indus and Gartok rivers, and, crossing the latter, encamped near the Lujan-Chumik spring.

From Lujan-Chumik the Pundit sent the third Pundit to trace the river down into the Ladak territory, whilst he traced it up to Gartok. On the 14th September he reached Gargunsa, the winter residence of the Gartok authorities. He found only three large and eight small houses in it, and was informed that the rest of the inhabitants lived in tents. All along the banks of the river he found the grass tall and luxuriant. The valley all the way up was flat and wide.

On the 16th September the Pundit reached Gartok, where he found a camp of about 200 tents, mostly belonging to traders. On his arrival, he was alarmed to find that some one had been spreading reports as to his being in British employment, and he found it advisable to hasten his return. Choosing a new route, he got separated from his baggage and the greater part of his party; and had he not fallen in with traders from Shipki, he would have been put to very great hardships. He crossed by the Laochia Pass, and, marching by Shiang and Dunkhar, reached Totling on the 26th of September. Here they waited for the third Pundit, who joined

them on the 29th of September, after having traced the Indus down to Demchok in Ladak. From Demchok he crossed from the basin of the Indus to that of the Sutlej by a very high pass, and carried a route-survey down to Totling. From Totling the second and third Pundits were sent down the Sutlej to Shipki, tracing the river as closely as they could. From Shipki they carried a route-survey in a southerly direction, crossing the Himalayas by a high pass, and descending to Nilung on the upper course of the Ganges.

The Pundit himself returned from Totling to Badrinath by nearly the same route as he advanced by, only making one small variation. Ultimately the second and third Pundits rejoined the first, and they all made their way down into British territory by the beginning of November.

The geographical results of the exploration can be seen at a glance from the accompanying map. They account for the geography of about 18,000 square miles, founded on 850 miles of route-survey, with 80 heights. The routes are checked by 190 latitude observations taken at 75 different points.

The course of the Sutlej River has been roughly traced from Totling down to Shipki, on the border of British territory. Hitherto there has been no survey of any kind of this portion; and the route, though only actually touching the river for a short distance, was carried near enough to it to enable the Pundits to lay down its probable course very closely. The position of Gartok, as determined by the two routes of the last expedition, has been confirmed by a third route carried up from Badrinath. The mean of three gives a very good longitude of Gartok,* as has been proved by the further route-survey carried from Gartok to Demchok, which latter had been previously fixed by the regular survey operations in Ladak. The longitude by the route-survey only differing from that of the regular survey by 2½ minutes—a very satisfactory result from a route-survey† traversing 160 miles direct over such a very rough tract of mountains.

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* Longitude, E. 80° 23′ 33″; latitude, N. 31° 44′ 4″, and height 14,250 feet above sea.—T. G. M.

† The values of the pace, as tested by the differences of latitude, were very accordant, thus :—

	Difference latitude.	Deduced length of pace in feet.	Remarks.
	° ′ ″		
From Badrinath to Gartok ..	0 59 36	2·495	By 1st Pundit.
,, Gartok to Thok-Jalung	0 40 23	2·512	,, 1st Pundit.
,, Gartok to Demchok ..	0 57 17	2·634	,, 1st and 3rd Pundits.
,, Demchok to Totling ..	1 13 24	2·495	,, 3rd Pundit.

T. G. M.

The routes have also defined the courses of both the upper branches of the River Indus from near their sources to their junction and the conjoint stream from that point into Ladak. Neither of these branches had been previously surveyed in any way, except a small portion of the Gartok branch above Gartok, which had been roughly laid down by Moorcroft.

The existence of the eastern branch was doubted by many geographers,* as no Europeans had ever seen it. The Pundit's route has now proved that this eastern branch is the main stream known to the natives as Singh-gi-Chu or Singh-gi-Khamba (Lion's Mouth), the River Indus itself; whilst the other branch, hitherto generally supposed to have been the main stream, is much smaller than the eastern one, and invariably called the Garjung-Chu.

The routes extended beyond the eastern watershed of the Indus as far as the great Thok-Jalung or Thok-Samba gold-field. Thok-Jalung was, moreover, roughly connected with various other gold-fields and salt-mines, by means of information derived from travellers; and the general correctness of this information was roughly established by a route to Rudok, derived from similar information, which made out the position of that place tolerably close to that determined by the regular survey.

A number of lofty snowy peaks were determined from various stations of the route-survey, the most remarkable being the Aling-Gangri group north of the Indus, which, judging from the great mass of snow seen on the southern face during August and September, must be upwards of 23,000 feet above the sea—possibly as much as 24,000 feet. The line of perpetual snow on the southern slopes of the Ladak Mountains approximates to 20,000 feet in the same latitude; and it would require several thousand feet of snow above that line in order to be very imposing at 80 miles, at which distance the Pundit first saw it. The Aling-Gangri group had never, as far as I am aware, been heard of before. They appear to be a continuation of the range between the Indus and Pangkong Lake. The Pundit could see no farther continuation of the range to the east of Thok-Jalung. Another high group was seen to the east of the Medok-la, on the watershed between the Sutlej and Indus.

Altogether the Pundit and his brethren have, as I predicted, improved very much in the art of fixing distant peaks. Satisfactory proof of this has been forthcoming from their back bearings to well-

* It was indicated from native information by H. Strachey, on his Map of Ladak and Gnair-Khorsum.

known peaks,—such as Leo-Porgyal, Kamet, &c., which gave very accurate positions to those peaks—forming at the same time a valuable check on the route-surveys, and proving that there has been no large accumulation of error.

The numerous heights determined by the boiling-point give a good idea of the great elevation of the country traversed, and the consequently enormous difficulties under which the route-surveys were made. From them it will be seen that the Pundits were for more than three months at an elevation of over 13,000 feet. They crossed the great range between the Sutlej and the Indus three times—that between Gartok and Chajothol once, between Chajothol and Giachuruff once, the Chomorang range twice, and the Himalaya range three times, each of the crossings involving a pass of over 17,000 feet, two of them being over 19,000 feet.

The height of Gartok by the above is only 14,250 feet, instead of 15,000, as had previously been assigned to it. At the several points —Totling, &c., where Henry Strachey's heights were taken—the Pundit's heights are generally lower. A difference in the same direction was noted in the results of the previous expedition, at a point near the Mansarowar Lake; and, judging from the following comparisons, it appears to arise from a constant difference, probably due to the thermometer employed :—

	By the G. T. Survey. Feet.	By H. Strachey. Feet.
Hanle	14,276	14,500
Pangkong	13,936	14,300
Tangse	12,791	13,000
Diskit	9,950	10,400

The above shows that Captain H. Strachey's were generally higher than the Great Trigonometrical Survey values, by about 300 feet on the average; and the Pundit's values differing from Captain Strachey's by about the same amount, it may be concluded that they are tolerably near the mark, and at any rate not in excess.

The actual source of the eastern branch or main stream of the Indus was not reached; but the people between Giachuruff and Jiachan said it rose at a place called Gangri-Goorgiap, which may perhaps refer to the Gangri or Kailas Peak; but the direction of the course of the Indus, as seen from near Jiachan, pointed rather to the east of that mountain. The whole district along the upper course of the Indus is called Bongthol, which is divided into the small districts (puttees) of the Singhtod and the Singhmet—"Tod" signifying upper, and "Met" lower.

At the highest point visited, the Indus was still a considerable stream. At Giachuruff the ford was always a difficult one; and for

eight days after the fall of snow the Pundit experienced, the river was not fordable in any way. While it was snowing on the Chomorang range, heavy rain fell at Giachuruff, and the river consequently rose very much. The stream was generally very clear, and full of fish* of all sizes, up to about 18 inches in length.

From Jiachan to Giachuruff the Indus flows through a rather broad, flat valley; and from Giachuruff to its junction with the Gartung-Chu it flows through a similar valley, the banks being lined in many places with long patches of low jungle. The Indus above the junction was from 100 to 200 paces in breadth, with a depth of 6 to 4 feet; while the Gartung-Chu was in places as much as 250 paces in width, but with a depth of only 1 to 2 feet. The Gartung-Chu, between Gartok and the junction, flows through a particularly broad and flat valley. The Indus below the junction flows through a wide valley to a considerable distance below Demchok.

When at Thok-Jalung, the Pundit made diligent enquiry as to the adjacent countries; he was informed that a large district, called Majin, extended for nine days' journey to the east, and that a smaller district, called Shellifuk, lay to the south-east. The Majin country was said to be a difficult one to travel in, as no rivers ran through it. The Shellifuk district boasted of some streams, but they all run into a large inland lake.

Immediately to the north of the gold-fields there is no regularly inhabited country, as far as the Thok-Jalung people are aware. They say there are some wandering thieves—Champas, or Khampas—who live entirely on meat, and have had so little acquaintance with grain in any shape, that they get sick when they take it from their more southerly brethren. The Pundit, however, seemed to have very little faith in this part of the story. We heard that at a considerable distance to the north-east there was a tract called the Whor country, inhabited by Shakpo people—the same style of people as those who come from Jilung.† Tartary is said to be to the north-east of Whor. To the north-west of Thok-Jalung lies Rudok, the route to which has been roughly indicated on the accompanying map. Ting-Chu and Rawung are the intermediate districts; the first is a very cold place, and has very little sweet water, though plenty of brackish water. Rawung has much the same climate as Rudok, only slightly colder; it has, however, plenty of fresh water.

* The Dokpa people eat these fish, but those Tibetans who have read Buddhist books do not do so.

† About one month north of Lhasa.

There is said to be a direct route from Thok-Jalung, south-east to Tadum Monastery, on the great Gartok and Lhasa road. This route crosses some comparatively low ranges, but is said generally to run over great plains. Such inhabitants as there may be on the north, east, and south are all nomadic, living in standing camps, shifting every now and then according to the state of the pasture, time of the year, &c. They are almost all addicted to highway robbery.

I have already pointed out how well the Pundits have succeeded in the difficult art of intersecting and fixing distant peaks. The way in which the chief Pundit quartered his ground and divided it, so as to account for the geography of the whole, with a few routes, is another great improvement; their work covering a much greater breadth, and leaving very little doubt as to the position of the intermediate ranges. As before, the chief Pundit showed great tact in making his way among strangers; and his conduct of the whole expedition is highly creditable; and the way in which he has carried out my instructions is deserving of all praise.

The memoir will be printed entire in the 'Journal,' vol. xxxix.

The PRESIDENT remarked that the communication just read was a production of which Captain Montgomerie had every reason to be proud. These Pundits had been trained to penetrate these difficult countries, acquiring the languages, and being instructed how to make observations, which rendered their journeys of high scientific value. Many persons were not fully aware of the great dangers these people had to encounter. They travelled at the risk of their lives every moment; for if one of the scientific instruments which they possessed had been detected in their boxes, they would have been put to death. Animated by an *esprit de corps*, and a love for science, these Pundits had been able to traverse the country where no European would be safe, and to make a series of observations for latitude and longitude, and to determine the height of a great many mountains, approximatively, 3000 feet higher than Mont Blanc. He had much pleasure in making these observations, because he saw in front of him two distinguished Indian authorities—Sir Robert Montgomery, without whose countenance, in the first instance, Captain Montgomerie could not have carried out his novel project, and the ex-Governor-General of India, Lord Lawrence, who had assented to the arrangements made by Captain Montgomerie. The results were most gratifying to every geographer.

Sir HENRY RAWLINSON believed he was only expressing the feeling of all geographers in saying how deeply they were indebted to Captain Montgomerie for having devised and executed this system of exploration by native agents; because it was owing to that system alone that we had succeeded, and should in future succeed, in gaining a knowledge of the territories beyond the northern frontier of India, because they were utterly inaccessible to European travellers. Sir Roderick had drawn attention to the value of these discoveries. It was certainly of the greatest importance to remember that at last we had penetrated beyond the great elevated plateau which bounded India to the north. The Pundits had ascended the Himalayas, and had gone straight across to the outer crest, and descended to the lower plateaux of Tartary—the gold-

fields being really beyond the western frontier of Thibet. It was curious to find that there was not only a single gold-field, but a succession of gold-fields, extending the whole way from Rudok to Lhasa, along the range; and there was reason to believe that gold-fields continued in the same direction as far to the north-west as Ilchi. This was the central mart of the gold of Central Asia. The officer formerly employed by the Chinese Government to superintend the collection of this metal used to reside at Ilchi, and to send the people down into this district. We did not know how far they went; but we knew that the gold-diggers resorted to a place about 100 miles to the south-east of Ilchi, and obtained the gold along this range, so we had fair ground for believing that the gold-fields extended from Lhasa, along the foot of that range, for a distance probably of nearly 1000 miles in a direction north-west and south-east. It had been noticed by a writer in the public press, that we really had an account of these gold-fields in the most ancient times, because there seemed hardly any doubt that the gold-diggings described by the Pundits were the very same which attracted the notice of Herodotus. He described them in words which were singularly applicable. He told us that there was a wild country to the north of Cashmere—Cashmere in a broad sense including all Thibet; and that the gold was found there by "ants," whom he described as burrowing underground, just in the same way as these people were described by the Pundits, as making subterranean dwellings by throwing up the earth into heaps, and in the earth the gold was found. Then, he said, the Indians from Cashmere came very often to try and get gold, upon which the ants sallied out, and if they caught any person they ate him up, there being no hope of escape from the ants. Now, in the early history of Asia, it was usual to call races and tribes after certain animals: thus we heard of the "snakes," the "horses," the "wolves," "dogs," "lions," and "foxes." He believed that the race who then inhabited the gold district of Thibet were called "ants." It seemed to him that that was the real explanation of the statement of Herodotus. Again, their peculiarly crouching attitude, which Captain Montgomerie described, might have had something to do with suggesting the cognomen of "ants." There was only one other point which he would notice. In giving every possible credit to the Pundits, we must remember that this was not entirely a new country. The portion from Gartok to the north-east was entirely new; but Moorcroft and Henry Strachey had both been up the Indus as far as Gartok. Strachey there heard of the other branch of the Indus now discovered by the Pundits, but he was unable to penetrate into Independent Thibet. He believed, in fact, it was quite impossible for any European traveller to penetrate into that country. He trusted the future explorations of the Pundits would be equally successful; and that they would be able to clear up the question as to the existence of an ancient royal road from Hindostan to Central Asia. Moorcroft told us, that having crossed a native path between the Sutlej and Gartok, he discovered the traces of a large, wide, paved royal road; that in the plains it was paved, and in the hills excavated through the mountains; he understood it went along the Indus to Rudok, and from that point passed round the Kuen-luen hills into the plains of Tartary. A mission to discover this royal road would be a grand expedition for the Pundits; and he hoped Captain Montgomerie would be induced to send them in that direction next season. It would be very desirable, for the purposes of trade, to know the exact line which that road followed, because we might be quite certain that if such a line did exist under the Moguls, it could be opened out again with infinitely better results than were accomplished at that time.

Sir Robert Montgomery said, with reference to the royal road mentioned by Sir Henry Rawlinson, he knew it was generally supposed that there was a royal road extending from Lhasa to Ilchi. Some of the members of the

Society might remember that, in 1854, Lord Dalhousie tried to make a road from Simla towards Gartok, with the object of opening an overland route to China from India. But the road was not carried on, partly on account of the want of funds, and for other reasons. When he was in the Punjaub he endeavoured to continue the road, the object being to strike the royal road between Lhasa and Ilchi, so as to enable traffic to come direct from China to India, avoiding the roundabout course through Ladak and Cashmere, and thus turn the flank of Cashmere, and so escape the heavy duties which were levied on goods coming through that country. The road was not completed, and still remains unfinished, for want of funds; but three-fourths of it have been made between Simla and Gartok. As time passed, they hoped to get funds sufficient to complete the road; and he thought the recent discovery of the Pundits would induce the authorities to go on with that road. The President had kindly credited him with having been instrumental in the employment of the Pundits. All that he had to do with the system was this. When Captain Montgomerie first commenced sending natives into the interior, he (Sir R. Montgomery) procured for him a man in 1863, who went up to Yarkand and made observations. He believed he was the first native who accomplished such a journey. Subsequently, Captain Montgomerie adopted the plan of employing Pundits, and he had no doubt that, hereafter, we should receive very important information from these men.

Sir ANDREW WAUGH said that he had the honour of having trained Captain Montgomerie originally as an Indian surveyor, and he was naturally proud of his present achievements. He must accord to him the entire credit of having originated this system of employing native agents. Captain Montgomerie was one of his favourite officers, and belonged to his staff, and he had proved himself so worthy that the Society had awarded him their gold medal. He might remark that surveys of routes in these stupenduous mountain regions were exceedingly difficult, requiring great skill, caution, and scrupulous care to prevent the intrusion of large errors. For the Pundits to close their survey with an ascertained error of only two miles and a half in so long a mountainous circuit, showed not only that dependence was to be placed in their accuracy, but also that they had been trained on right principles. He was sure Captain Montgomerie would carry this enterprise still further, and that we should yet receive even more interesting accounts of still more *terras reclusas*.

The PRESIDENT believed that the award of a gold watch to the first Pundit, in 1868, had been productive of much advantage. He hoped, before another year was over, the Council would have to vote an additional honorary distinction.

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2. *On the Transit of Tea from North-West India to Eastern Turkestan.*

By T. DOUGLAS FORSYTH, Esq., F.R.G.S.

THIS communication consisted of a letter addressed to the President of the Society by Mr. Forsyth, with an enclosure from Mr. Shaw, who is now engaged in a commercial undertaking to the capital of Eastern Turkestan:—

"MY DEAR SIR, "Jullundur, 26th February, 1869.

"As you will be anxious to hear of the progress of Lieutenant Hayward, whom you have sent out on an expedition to Yarkand, I send herewith the copy of a letter just received from Mr. R. Shaw

to his sister, who has placed it at my disposal. Mr. Shaw is the first Englishman who has ever sent a letter from that country to us, and, with the exception of Mr. Johnson, the first Englishman who has ever been in Eastern Turkestan, and lived to let us know about the land. I trust his life may be spared, and then I have no doubt that we shall soon see trade communication freely established between the two countries.

"The path for Mr. Shaw's entry was carefully prepared. When I was at Leh last September, I sent a horse-load of tea with a letter to the Kooshbegi, telling him that this was only a sample of what could be supplied in larger quantities from the Indian tea-plantations. At the same time the Kooshbegi was asked to receive favourably a caravan of traders, who went with the Vakeel who had my letter. In this caravan was one of Mr. Shaw's servants, who took presents from his master to the Kooshbegi. Mr. Shaw himself followed about three weeks afterwards, and waited at the confines of Turkestan for news from his servant. He received encouragement to proceed, and his letter tells the rest. Further information, as soon as it is received by me, shall be sent to you.

"Mr. Hayward's approach, it appears, was *not* made smooth beforehand, and, as the people of that country are naturally suspicious, they have hindered his advance. No personal injury, however, will, I trust and believe, be done to him, for the Kooshbegi is evidently desirous of entering into friendly relations with us.

"I have to thank you exceedingly for the very kind letter you have sent me, and for the flattering notice which you are good enough to bestow on my humble efforts to open out trade with Turkestan. I can truly say that, in setting this task before me, I have been actuated by no idea of Russophobia, and, in justice to myself, I hope you will allow me to explain that recent allusions by me to possible complications with Russia have been greatly misunderstood by the English press.

"I will not enlarge on this subject, which is foreign to the commercial and scientific question with which alone the Royal Geographical Society concerns itself, but I owe it to you, as our distinguished President, no less than to myself, to say that, because the impression had got firmly fixed in people's minds that my efforts to open out this trade were utterly futile on account of the impassable character of the Himalayas, I ventured to show how very easy the passage by the Changchenmo route really is. You, doubtless, know that the province of Ladak has been invaded ere now by a Kalmuck army passing over this route.

"Having but one object in view—the furtherance of trade and

the advance of science—I desire to pursue the subject with single earnestness of purpose; and it is, indeed, a high honour and reward to receive words of encouragement from the President of our Society.

"The great interest which Lord Mayo takes in the subject is a guarantee that this interesting country will not much longer remain a sealed book to us.

"I may add, that Mr. Shaw is one of our most enterprising settlers in the Kangra Valley. After receiving an University education, he came out to India to set up as a tea-planter. From the time when we commenced to make efforts for taking advantage of the expulsion of the Chinese to open communications with Yarkand, Mr. Shaw has evinced the utmost practical interest in the subject, and I am personally indebted to him for valuable information and important help. This year, when he announced to Dr. Cayley and me his determination to visit Yarkand, I honestly confess that I did my utmost to dissuade him from running what was considered by so many a fearful risk. To him, therefore, rather than to any one else, will be due all the credit of success, should we hereafter find our mercantile relations with Yarkand established on a sound basis.

"Even if Mr. Hayward should fail to penetrate into those regions, I feel sure that your Society will, ere long, receive most valuable and reliable information regarding them from one whom I am glad to be able to call my friend.

"I am, my dear Sir,

"Yours, very faithfully,

"T. DOUGLAS FORSYTH.

"Sir R. Murchison, Bart., &c., &c."

Copy of Letter from Mr. R. Shaw to his Sister at Lahore.

"Camp near Sanju, Turkestan, Nov. 28th, 1868.

"I AM within a few days of Yarkand, having crossed the last pass on my road yesterday (the 11th since leaving Dhurmsala). I am being received in the most handsome manner. A swell Moghul came as far as Shahdulla Khoja (beyond the pass) to meet me. I was detained there eighteen days for orders from the King. The delay was chiefly caused by the arrival (most inopportunely) of a second Englishman. However, on the 20th, we left Shahdulla, and to-day have been met by the Governor of Yarkand's brother, who has been sent to meet me as Mihmandar, with a large camp. Guns

were fired, and I was escorted in state to a Kirghiz tent (*see* Atkinson's 'Siberia' for description). I was ushered in, made to sit alone in the place of honour, on the carpet at the far end, while my Mihmandar sat on a side carpet. He gave me the most complimentary welcome from his King, saying that he was sent simply in order to facilitate my journey and consult my wishes. I paid him a return visit at his tent, and in departing was clothed with a silk robe. I must tell you that I now dress entirely as a Turkee, turban, robe, and everything. He excused himself for the want of proper presents out in the jungle, saying otherwise I should have received a horse, &c.

"None of my servants are allowed to go on foot; even the Tibetan coolies are mounted on yaks. I have picked up some knowledge of Turkee, and hope to improve in it during the winter.

"In fine, you may consider that I am about as well off as I could be, were my utmost wishes realised in the present matter. All my goods, too, have been taken over by the King's people, who are to give the price. The tea will fetch about 8 rupees per pound, as far as I can make out. It is much liked. Unfortunately, half my caravan, which was following me, has either wandered off towards China or gone to Khoten by mistake.*

"The apples and pears are delicious here, after a long desert journey. A lot of fruit and a sheep are given me every day, and I have now a large flock, though all my servants are sated with meat. They, too, are gorgeously clothed. This letter will go inside a bag of flour with the return Tibetan yak-drivers; for my hosts, although most polite, are very suspicious of letters in unknown tongues. I am afraid the other Englishman, Hayward, who is sent by the Royal Geographical Society, but has not prepared his way as I have, will not be allowed to come on. He is kept under guard at Shahdulla, and we were not allowed to communicate."

The President, in calling for observations on the adventurous and successful undertaking of Mr. Shaw, said he would take this opportunity of correcting a misapprehension into which many persons had been led respecting some prior observations on this route by Sir Henry Rawlinson. All that Sir Henry meant was, that there was a road across the Himalaya and Kuen-lun available for camels and yaks, without very great difficulty; and this had been taken as an admission that this route was practicable for an army.

Sir Henry Rawlinson said he had the honour on a previous occasion to notice the opening out of this particular road, which was now generally

* The man in charge lost his way and returned to Ladak. He has since written to tell me of his making a fresh start to join his master.—T. D. F.

known as the Changchenmo route, and to be the most direct and easiest route between Ladak and Turkestan. Judging from the information then available, he certainly said the physical difficulties of the route were very much less than those of any other, and that it promised to be a valuable line for commerce. At the same time he said he considered such a route was impracticable to an army. To move a caravan consisting of a few mules and camels was a very different thing from moving an army with a commissariat. He had been met on that point by the statement that in former times armies had marched without great difficulty from Kashgar to Cashmere, in fact that one of the kings of Kashgar had died at Cashmere. He must reply to that by saying that the passage of the flying hordes which, in former days, swept over Asia, led by Mogul emperors, had no analogy to the movements of armies in the present day. Those flying hordes never carried a commissariat, and never required one. There was one point in Mr. Shaw's journey which he wished to refer to, and this was that a portion of the route he travelled over was absolutely new to us. When on the former occasion he described Mr. Forsyth's route, he was not aware that Dr. Cayley had himself travelled over the whole distance from Leh to the Karakash River. But he was now in possession of Dr. Cayley's Report, with an excellent map of his journey; and had received from him, since he had returned to England, a description of his journey in detail. Dr. Cayley, who was our agent at Ladak, in September last year, travelled along this route by the Changchenmo route to the Karakash. Here began the difficulties. When Mr. Johnson went to Ilchi he crossed the great range by two very difficult passes; but he heard that there was a route down the banks of the river. Dr. Cayley travelled to the same point, but was unable to go down the river. Mr. Shaw had now accomplished this. He travelled by the Changchenmo route as far as the upper waters of the Karakash, and then he followed the banks of the river to Shadula. He found this road an easy one. Hitherto, he believed, no one had followed the Karakash River down into the plain of Tartary. Dr. Cayley had informed him that where the route left the river it was quite impossible for any traveller to keep to the bed of the stream. The only means of entering the plain was by crossing a saddle on the west of the Karakash River, called the Sanju Pass. With respect to Mr. Hayward, he still hoped that that gentleman might succeed in getting forward, and that he would send us some very valuable information. Regarding trade, it was interesting to hear that Mr. Shaw sold his tea at 16*s.* per lb. Considering that the same tea could be purchased in England at 2*s.* 6*d.* per lb., 16*s.* per lb. was a tempting bait to traders. Unfortunately, as we learned from the Pundit's paper, the Thibetans did not like Himalayan tea, they preferred China tea. It should also be borne in mind that our merchants in taking tea to Yarkand would meet with very great competition on the part of Russia, who was doing all she could to extend her trade. He thought it was all the better for our merchants that they should have to meet competition rather than that they should go into a market with unlimited control.

Captain SHERARD OSBORN congratulated the Society upon the steady way in which, by pundits, travellers, or by tea-merchants, we were getting rid of another of those bugbears, the so-called impenetrable geographical barriers of the world— the Himalayas. Some years ago a Russian officer asked him if the English had not put a good many thousand feet on to the Himalayas, and created a good many difficulties there, for political purposes. He began to think that there was some grounds for the question, and that we should find, as we went on exploring, that where there were routes available for yaks, ponies, and horses, there would soon be found others fit for all commercial purposes. It struck him that the line of the Russian territory, which he held was the line of civilisation, would come down southward and obliterate that

Mahomedan barbarism which had been the real impenetrable barrier in Central Asia. The Russians would come down as a natural law, and the sooner we recognised that fact, and the sooner we got rid of all our fears respecting the extension of Russia, the better for the world and for us.

Eleventh Meeting, April 26th, 1869.

Sir RODERICK I. MURCHISON, Bart., K.C.B., President, in the Chair.

Presentation.—*Frederick H. Leaf, Esq.*

Elections.—*E. C. Bowra, Esq.; Frederick T. Galsworthy, Esq.; C. T. Gardner, Esq.; Edward J. Leveson, Esq.*

Accessions to the Library from April 12th to 26th, 1869. *By Purchase.*—Chardin, 'Voyage en Perse.' 10 vols. Paris, 1811. Cordiner's 'Ceylon.' 2 vols. 1807. Cuningham's 'Cosmographical Glass,' 1559. D'Anville, 'Carte de l'Inde,' 1753. D'Anville, 'États en Europe.' 1771. Davison's 'Africa.' 1839. 60 Tracts relating to Dutch Possessions in the Indian Archipelago. 1799 to 1847. Engelmann's 'Bibliotheca Geographica.' Hoffmeister's 'Ceylon, 1848.' 'Missione alla Cocincina.' Roma, 1631. 'La Bissachere Tunkin.' 2 vols. 1812. Mann's 'Mer Noir,' &c. 1778-79. Marryat's 'Borneo, 1848.' Osbeck's 'China, 1771.' Prevost's 'Collection des Voyages.' 19 vols. 1746-70. Seemann's 'Viti, 1862.' Shelvocke, 'Voyage Round the World, 1726.' Temminck, 'L'Inde Archipel.' 3 vols. 1846-49. 'Viaggi di tre Francesi.' 1669. Pertusier, 'La Bosnie.' 1822. Fortis' 'Dalmatia, 1778.' Gamba's 'La Russie, 1826.' 'Histoire de la Moldavie.' 1781. Ardouin's 'Haiti.' 2 vols. 1853. J. E. Tennent's 'Natural History of Ceylon.' 1861. Von der Decken's 'Reisen in Ost-Afrika.' 1869.

By Donation.—Carl Zimmermann's 'Chiwa.' Berlin, 1840. By W. Spottiswoode, Esq. 'Dualla Language of the Camaroons River.' The same.

Accessions to Map-room since the last Meeting of April 12th.—Carte lithologique des Mers de France, &c. Par M. Delesse, Professeur à l'École des Mines. Presented by Sir R. I. Murchison, Bart., President. Map of the Eastern Part of Abyssinia, showing the Route of the British Army in 1867-8 from Annesley Bay to Mágdala. By Dr. A. Petermann. Presented by the author. A large Map of China in 32 Sections (in Chinese characters). Presented by J. S. Coysh, Esq., F.R.G.S. Two Diagrams, showing the Surface

Temperature, &c., of the North Atlantic Ocean, for the month of January, during the years 1849-52. By N. Whitley, Esq.

The following Papers were read:—

1. *Recent Explorations in the Peninsula of Sinai.*
By the Rev. F. W. HOLLAND.

THE project of a systematic survey of the Peninsula of Sinai owes its origin to the Rev. Mr. Pierce Butler, late Rector of Ulcombe, Kent; and although he himself was not spared to aid in carrying out that project, to which he had devoted so much energy and thought, to him we are mainly indebted that a well organised expedition, under the superintendence of the Director-General of the Ordnance Survey, is now engaged in making explorations in that most interesting country.

I much regret that the present session of the Royal Geographical Society will have come nearly to an end before the return of the officers in command of that expedition, and that they themselves will therefore not have an opportunity of laying before you the result of their work.

But such being the case, having had the advantage of working with them during the first three months that they spent in the Peninsula, and having had access to their reports and letters home since that time, I have ventured to record in the following Paper the progress that has been made.

There are many people, I believe, who have concluded that the Peninsula of Sinai must *already* have been a well explored country, since so many travellers have visited it, and so many books have been written about it; but, owing to various local causes, there is probably no other country in which travellers have been led to carry out more fully their ovine propensity to follow exactly in each other's steps; and, consequently, it is only the *main* wadys, or valleys, which form the high-roads, and one or two of the principal mountains, that have been explored, and even those very hastily and incompletely. There can be no doubt, too, that the religious enthusiasm which has led many travellers to the country, however much it may claim our sympathy, has nevertheless tended in a very great degree to lower the value of the information obtained. A man who goes out with foregone conclusions as to what the country *ought* to be, and where the Children of Israel *ought* to have marched, is almost sure to favour his own prejudices to the exclusion of truth.

Thus it happens that although the *coast line* of the Peninsula of

Sinai has for many years been well laid down by a nautical survey, the *interior* has remained, with the exception of a few parts, but little known to us; and we have had as yet no sufficiently accurate data for instituting a just comparison between its *present* and its *past* condition, or asserting how far it illustrates the truth of that history, which alone renders it a land of such intense interest to us. Hence the importance of a *careful* and *systematic* survey of the country, conducted by professional men, free from all bias, and of whose accuracy there cannot be any suspicion.

The organisation of the expedition is all that could be wished. It is under the command of Captains Wilson and Palmer, of the Royal Engineers, the former of whom is well known for his admirable survey of Jerusalem. The other members of the expedition are Mr. Palmer, Fellow of St. John's College, Cambridge, a very able Oriental scholar, and quite worthy of the name of "Pundit," which he soon received to distinguish him from Captain Palmer; Mr. Wyatt, who volunteered to go out entirely at his own expense, to study the natural history of the country and collect specimens; Sergeant MacDonald, who is an experienced photographer, and three other non-commissioned officers of the Royal Engineers, all of whom have been specially selected for the work from the staff of the Ordnance Survey.

My own previous knowledge of the country and Arabs, gained chiefly during four months' solitary wandering amongst them in the preceding year, led to my being requested to accompany the expedition in the capacity of guide, a request to which I readily acceded, and I remained with them up to the beginning of February (when I was obliged to return home), rendering such assistance as I could.

We sailed from Southampton on the 24th of October last, and landed at Alexandria on the 7th of November. The Viceroy, at the request of Colonel Stanton, had given orders that our baggage should be passed through the custom-house unopened, and that every assistance should be given us by the officials; and thus we were enabled to proceed that same evening to Suez, where we arrived early on the following morning.

I had sent a message several weeks before to some of the Arab sheikhs of Sinai to tell them that we were coming out; and on alighting from the train I was welcomed by several of my old acquaintances, who for many days had haunted the platform in expectation of our arrival.

The Peninsular and Oriental Company kindly gave us permission to draw provisions from their stores; and three days were busily

spent at Suez in selecting and packing the things we required, buying water-skins, barrels, and the numerous requisites for a desert life, and drawing up a contract with the Arab sheikhs for camels, which is always a somewhat lengthy process.

Mr. Palmer, who had arrived in Egypt a few weeks before us, now joined us. He had meanwhile been profitably engaged in Cairo, in examining the colleges and libraries attached to some of the principal mosques.

On Wednesday, November 11th, we sent on our camels round the head of the Gulf of Suez, to await our arrival on the opposite shore, and in the afternoon conveyed our baggage across by boat, and pitched our tents for the first night in the desert. Our caravan consisted of 32 camels laden with our baggage and stores, and 12 dromedaries for riding, including those of our two sheikhs.

The Arabs in the southern portion of the Peninsula of Sinai are so poor, that no single sheikh was able to provide so large a number of camels as we required, and we therefore found ourselves compelled to engage two sheikhs, an arrangement which was a continual source of contention as long as they were with us, since there was a daily fight for the lightest loads, and much jealousy between the two parties, neither of whom paid very much deference to their respective sheikhs. The management of the Arabs, therefore, and superintendence of the daily loading of the camels, which fell to my charge, was at this time no sinecure.

Three days' journey brought us to Wady Ghurundel, where we halted for Sunday. We took the upper road after passing "the wells of Moses," and the barren plain along which our course lay offered few points of interest. Mr. Palmer found, however, that several of the names which have been given to different wadys in this portion of the desert are wrong, and none of them appeared to have any reference to the passage of the Israelites, as some authors have supposed. We saw abundant evidences, as we proceeded, of different sea-levels of former times, and many of the stones are curiously furrowed and wrinkled by the action of the drifting sand. I remarked that some of these stones presented the exact appearance of miniature sand-drifts.

We stopped on our way to examine the spring of "Ain Howara," which many have sought to identify with *Marah*, on account of the bitterness of its water. The water was slightly brackish and dirty, but it was cool and drinkable, and better, I thought, than the water that we had with us. I cannot satisfactorily explain the extreme *bitterness* of this water at one time and its comparative *sweetness* at another. A few miles south of this point a natural basin is found,

into which the water drains from the surrounding desert, and its fertility proves how productive the desert is wherever water can be obtained.

While encamped in Wady Ghurundel we enjoyed the luxury of a bathe in the clear running stream, which bursts forth a few miles from its mouth but again disappears in the sand before it reaches the sea; not, however, before it has given birth to a considerable amount of vegetation, and formed extensive marshes, which are the favourite resort of wild ducks and other birds.

We also examined the country between Ain Howara and the sea, near the mouth of Wady Ghurundel, and found it to consist of broken ground with deep intersecting wadys and ridges, which must always have rendered it utterly unsuitable for a camping-ground.

From Wady Ghurundel we made our way across the plain, at the heads of Wadys Useit and Eth Thal, and up Wady Humr, to Jebel Sarbût el Gemal. Shortly after leaving Wady Ghurundel we passed the well-known heap of stones called Abu Zenneh. The Arabs, in passing, always curse the spot, shoot off their guns at it, and throw stones upon the heap, saying, "Eat, eat, horse of Abu Zenneh." The reason of their doing so has never yet been explained, but Mr. Palmer obtained from our Arabs the following interesting legend concerning it:—"An Arab named Zenneh, who possessed a beautiful mare, as he rode by this spot one day, touched it with his spur, and it took an enormous leap, the length of which so astonished him that he marked it with two stones, and pointed it out to his friends, who never afterwards passed this spot without celebrating the praises of the mare. After a time the Arabs began to worship her, and brought offerings of corn, which they threw down, saying, 'Eat, eat, horse of Abu Zenneh.' But at length a prophet came who taught them to worship the true God, and to give up the worship of all other things; and that which they had before worshipped now became an abomination to them; so that they no longer brought offerings of corn, but threw dust and stones upon the heap, saying, 'Eat this, horse of Abu Zenneh.'"

This legend seems to bear some marks of truth, and I would remark, in passing, that the mention of a horse is interesting, as a slight additional evidence of a change having taken place in the country, since horses are now unknown there, and could not exist in so barren a desert as it is at the present time.

In Wady Humr we saw the first Sinaitic inscriptions. From this point they occur frequently along the different wadys which form the roads to Jebel Serbal, Jebel Mûsa, and the south.

From Jebel Sarbût el Gemal we struck southwards, across the

sandy slopes of Debbet-en-Nusb, to Wady Nusb, well known for its excellent wells of water, which caused it to be formerly the centre of the mining operations in that district, as is shown by the large heaps of slag which are found at the mouth of the valley, and more especially in the immediate neighbourhood of the wells. We did not, however, then stop to examine the mines, but pushed on as quickly as possible towards Jebel Mûsa. We paid a hasty visit to the ruins of Serâbit-el-Khadim in passing, and I was able to point out to Captain Wilson the position of the turquoise mines, Egyptian tablets, and other ruins, which have since been revisited and more fully explored.

We followed the northern route to Jebel Mûsa by Wadys Kamyle, Burku, and Beráh, because it afforded the shortest road, and the most favourable, for a line of observations between Suez and Jebel Mûsa. Materials for a route-sketch of our journey were collected as we proceeded, observations for latitude were taken at every camp, and aneroids read at all watersheds and watercourses.

At the head of Wady Beráh we ascended a remarkable conical hill, called Zibb-el-Bahayr, from which a magnificent view is obtained of the whole surrounding country. The uniform height of many of the granitic mountains is a striking feature, and suggests the idea of there having originally been a vast plateau of granite, on which the sandstone was deposited; the wadys, which now intersect it in every direction, having been subsequently formed by the action of water. Lower down, in Wady Beráh, we passed a large detached rock, covered with Sinaitic inscriptions, which was said by the Arabs to have been cleft by Moses with his sword, to enable the Israelites to pass it. At the foot, at that wady, we crossed over by Wady el Akhdar (the Green Valley) and Wady el Ush (the Valley of the Nest) to Wady es Sheikh, which we followed up till it brought us, on Nov. 21st (just ten days from the time of our leaving Suez), to Jebel Mûsa. Wady el Akhdar is the name of the wady to which in my former paper I gave the name of Wady el Huther. I was wrong, therefore, in supposing that I might have found here traces of the name Hazeroth.

After selecting a spot for our camp at the foot of the so-called Aaron's Hill, near the mouth of Wady ed Deir, we paid a visit to the convent, where we were most hospitably received by the monks, and they very kindly placed a room at our disposal as a store-room. They pressed us to take up our quarters in the convent, but we preferred the independence of a tent life.

Having dismissed all our Arabs, and unpacked our stores, we set to work at once upon the special survey of Jebel Mûsa, which was

to be made on the scale of six inches to a mile. A base was selected on the plain of er Rahah, and the limits of the survey having been settled, viz., the watershed of the plain of er Rahah on the north, Jebel Abu Aldi on the south, Wady Sebaiyeh on the east, and Wady Leja on the west, we all set to work to get the poling done, while the men were engaged in measuring the base and lower ground. The base was 69 chains 34 links in length, and the dimensions of the survey 4 miles by 4¼. The poling was a work of great labour. The monks supplied us with some good poles for the ends of the base, but at all other stations we had to build cairns of stone, and whitewash them.

There were twenty-nine stations, and, with the exception of four, their heights above our camp ranged from 800 feet, the lowest, to 2500 feet, the highest. But the height in feet does not give any idea of the difficulty of the climbing which had to be done. The necessity of carrying a pot of whitewash in one's hand, the upsetting of which would often have lost one a whole day's work, added much to the difficulty; and it had sometimes to be carried in the mouth as we crawled along narrow ledges overhanging precipices many hundred feet in height, or used each other by turns as ladders. Once Captain Palmer and I found ourselves on a ledge of rock on Jebel Mûsa from which it was impossible to proceed either up or down, but fortunately I had taken the precaution that day of taking with me a rope, and with it I lowered down Captain Palmer, and then, lying on my back, slid down as gently as I could, and he succeeded in breaking my fall at the bottom.

When the poling was completed we had again to visit most of the stations to take observations from them—a work which we could hardly have accomplished without the aid of some Arab ibex-hunters, whose bare feet, and experience in mountain work, enabled them to carry up the instruments without injury—and the calculation of the observations gave most satisfactory results. In the lower ground there were 31¼ miles of traverse, not including offsets. The levelling, which amounted to 19¼ miles, was also a work of great difficulty, on account of the roughness of the watercourses and the great rises and falls crossing the watersheds.

I regret that I am unable to give accurate measurements with regard to the details of this survey, but a brief account of its main features may prove of interest. The peaks of Ras Sufsafeh, which form the northern portion of Jebel Mûsa, mark pretty nearly its central point. These rise up precipitously (about 2000 feet high) from the base of the plain of er Rahah, which is about two miles long and half a mile broad.

The plain of er Rahah is bounded on the west by a low ridge of mountains, which separates it from Wady Ilah and Jebel Tinia, and on the east by the block of mountains generally known as Jebel Fureya, but that name is properly applied only to the fertile basin which occupies the northern portion of the summit of that block. There appears to be no single name for the whole block, but the peaks which enclose it all have their individual names, such as Ajeraméa, Allojah, Soná, &c.

The southern peak of Jebel Mûsa is its highest point, and to this the name of Jebel Mûsa is especially applied. A central elevated basin, encircled by a ring of higher peaks, is a common feature in the mountains throughout the granitic district, and such is the character of the block of Jebel Mûsa, which is about 2 miles long and 1 mile broad. On the east of it runs Wady Ed Deir, so called from the convent which is situated here, and west of it runs Wady Shuraich, which again is separated from Wady Leja (a valley lying farther westwards) by the narrow ridge of Jebel Fara. Thus on the north, east, and west, Jebel Mûsa is separated from the surrounding mountains; on the south two wadys—one flowing eastwards into Wady Sebaiyeh, and the other westwards into Wady Leja—separate it from Jebel Abu Aldi, and the high range of mountains which bounds Wady Sebaiyeh on the west.

At the head of the convent valley stands a low rounded mountain, called Jebel Munedjah, and on the east of it the fine block of Jebel Ed Deir, which is divided by two ravines running north and south into three parts, the central and highest one of which is called Jebel Oribeh. An extensive recess, about $1\frac{1}{2}$ mile long by $\frac{3}{4}$ broad, near the mouth of Wady Leja, adds largely to the available camping-ground before the Ras Sufsafeh, which is generally supposed to have been the point from which the Law was given. There are five paths to the top of Jebel Mûsa.

(1.) A carriage-road made by Abbas Pasha from the head of the convent valley.

(2.) The well-known path leading up from the convent.

(3.) Another path up a ravine at the north-east corner of the mountain, by which we generally ascended it from our camp.

(4.) A fourth, leading up from the head of Wady Shuraich.

(5.) And the fifth from the ruined monastery of "El Erbain," at the head of Wady Leja.

The four last all appear to show traces of rude steps, which probably date from the earlier monastic times. The number of ruins of hermits' cells, which are found scattered over the surrounding mountains, is perfectly extraordinary; and the frequent occurrence

of walls, reservoirs, and traces of terraces for gardens, proves that almost every available spot was at one time under cultivation. There is no doubt that corn was grown in many spots; and when all the valleys and mountain-basins around Jebel Mûsa were more or less a succession of gardens, containing vines, palm, apricot, apple, pear, orange, pomegranate, walnut, mulberry, and carrûb trees,—when the supply of water from every spring was carefully husbanded in reservoirs, and skilfully conveyed from garden to garden,—it must have presented to the eye a perfect paradise.

While encamped at Jebel Mûsa we made an excursion to Jebel Abu Mas'ûd, in order to take bearings from the summit of that mountain, which was to form the south-east limit of the reconnoissance survey, and also to examine a remarkable group of ruins called by the Arabs "*namûs*," or in the plural "*nuámis*," mosquitoes, which I described in a former paper.

"These buildings," writes Captain Wilson, "are almost circular, with a domed roof rising immediately from the lintel of a door about 21 inches high; the dome is formed by stones overhanging each other, the top being closed by a large slab of stone, and the haunches weighted to prevent their springing out. I cannot describe them better than by saying that they are identical in construction with the chambers in the large cairns at Clava, near Inverness, one of the oldest known forms of habitation. Several of the 'nuámis' have been used as burial-places by a people probably of a later date than the builders of the houses, but still at a very remote period. Three of these were opened, but no opinion could be formed on the mode of burial. The bones were found mixed with earth and a little charcoal, but crumbled to pieces directly they were touched: a shell bracelet, broken and mended again, and a shell bead, were the only articles found. On our return to Jebel Mûsa we found a group of five stone circles, with small cairns in the centre exactly similar to what are called Druids' circles in Scotland, the stones being set on end and touching each other."

I may add that the "nuámis" and stone circles are found in great numbers throughout the whole of the south of the Peninsula; the largest groups that I have found being situated in a small wady between the head of Wady Hibran and Wady Solaf, in the neighbourhood of Dahab, and on the plateau of Zeranîk.

Towards the end of December it grew so cold that hill-sketching was impossible on the higher mountains, and occasional snow-storms interfered much with the progress of the survey. Most of the highest peaks in the neighbourhood of Jebel Mûsa were, however, ascended, and true bearings were taken from Jebels Katharine, Ed Deir, Tinia

(on the summit of which stands Abbas Pasha's half-built palace), and several other well-known mountains; and thus the position of most of the prominent peaks in this part of the Peninsula was fixed, and their altitudes determined by angles of elevation and depression. The altitudes of all peaks ascended were also determined by boiling-point thermometers and aneroid barometers; but the latter we found could not be depended upon to 300 or 400 feet, at so great an altitude above the sea (5000 feet).

I should mention that the latitude of our camp was obtained by the mean of twenty-two observations, and from this the latitudes of Jebels Mûsa and Katharine were computed. Observations for longitude and variation were also taken.

On the 1st of January we started for Jebel Serbal, connecting it on our way with Jebel Mûsa by a traverse survey, which was carried "through the pass" of Nukb Hawa, at the head of the plain of er Rahah, and down Wadys Solaf and Feiran.

The special survey of Jebel Serbal (also on the scale of 6 inches to the mile) presented difficulties almost as great as that of Jebel Mûsa.

A base was selected in Wady Feiran, between el Hessue and Wady Ajeleh. The same process of cairning had to be gone through, and each morning, for upwards of a week, we started off, with our pots of whitewash in our hands, to climb peaks, the ascent of two or three of which, notwithstanding their close proximity, often proved a hard day's work, so deeply were they cut by intersecting ravines.

Our camp was pleasantly situated at the junction of Wadys Aleyat and Feiran, close to the oasis of Feiran, which terminates just at this point.

The following description of the mountain is taken from a letter written by Captain Palmer, after nearly a month's stay there:—

"Jebel Serbal is about 4 miles from the camp. In massive ruggedness, and in boldness of feature and outline, this mountain unquestionably presents an aspect unequalled by any other in the Peninsula, and, though not absolutely the highest, it has a greater command over the surrounding country than any we have yet seen. Unfortunately there is not a single point in the valleys near its base, which affords a comprehensive view of the mountain. It is only by ascending some of the neighbouring hills that the whole range of its magnificent peaks can be seen at once, and there is no plain anywhere in the vicinity suitable to the assembling of a large concourse of people in the sight of any one portion. Two valleys, Wadys Aleyat and Ajelah, each from 3 to 4 miles in length, rise from Wady Feiran to the actual base of Serbal, and furnish the

roughest examples we have yet experienced of the very rough walking in the Peninsula.

"Each (and especially Wady Ajelah, the western and narrower valley) is a wilderness of boulders, and torrent beds, and high banks of alluvial deposit, bearing the marks of many a flood. From points in these two valleys, and from a few spots also in Wady Feiran, imperfect views of Serbal are to be had; but from Wady Ajelah the highest peak is never seen. The space between the two, which, I think, has been described as a *plain*, is a chaos of rugged mountains, rising to as many as 2500 feet above Feiran, and concerning which our boots and knees could tell a very different tale."

The special survey comprised these two valleys and a portion of Wady Feiran, rather more than 2 miles in length.

While encamped in Wady Feiran we made many excursions to the surrounding mountains, and, amongst others, made the ascent of Jebel Benât, which, I believe, had never before been attempted.

During our whole stay in the Peninsula, Mr. Palmer and I had been constantly employed in examining and copying the Sinaitic inscriptions; and we had already collected upwards of 1800 from the granitic districts, when, on the 26th of January, we left the rest of our party for Wady Mokatteb, to work at the inscriptions there in their head-quarters.

We first copied every legible inscription in Wadys Mokatteb and Sidri, and then took impressions in paper and photographs of some of the most important ones.

We discovered altogether no less than twelve inscriptions in which the Greek and Sinaitic occur together, undoubtedly by the same hand, and by their means Mr. Palmer has been enabled to demonstrate the value of every letter of the Sinaitic alphabet.

Mr. Palmer has very rightly determined not to publish the full results of his study of the inscriptions until he shall have been able to consult the works that have already been written on the subject, and to devote more time and care to the examination of the copies which we have obtained than he is able to do in the intervals of his present work. But a letter from him, which was published in the 'Athenæum' of the 10th of April, states some of the conclusions at which he has arrived. He describes the inscriptions as consisting of detached sentences, for the most part proper names, with such introductory formulæ as Oriental peoples have been from time immemorial accustomed to prefix to their compositions (*e. g.* "Peace be to him," or "May he be remembered").

He speaks of the alphabet as agreeing in part with that constructed by the late Professor Beer, which is only partially correct,

since the copies of inscriptions with which he was furnished were not accurately made. With regard to the authorship, there can be no doubt that they are the work, not of pilgrims, but of a commercial community who inhabited, or at least colonised, the Peninsula for the first few centuries of the Christian era. That many of the writers were Christians is proved by the numerous Christian signs they used; but it is equally clear from internal evidence that a large portion of them were Pagans.

The numbers of the inscriptions have been much exaggerated. They were executed, no doubt, almost entirely with pointed stones, and the presence of water seems to have acted more than anything else in determining their position. It is not true that they occur at extraordinary heights from the ground, nor that they were confined to the road or roads to Serbal. I discovered them last year in wadys both east and south of Jebel Mûsa; and I believe that Captain Palmer has now also found them as far west as Jebel Taset-el-Sadur. They are by no means confined to the main roads, or valleys, but are to be found in all sorts of out-of-the-way places, along mountain footpaths, and on the tops of prominent peaks. They do not appear to be connected with mines, and there is evidently no connection between the Sinaitic and two hieroglyphic inscriptions at Wady Mughârah, the close proximity of which has led them to be described as a triple inscription. Lastly, they do undoubtedly occur *painted in whitewash* under an overhanging rock at the summit of Jebel Serbal; and the ruins of a building close by, in which similar whitewash occurs, seems to point to the fact that the inscriptions and the building were made by the same hands. Mr. Palmer speaks with confidence of his being able to bring as great a weight of testimony to bear on the authorship of the inscriptions as he has already collected in support of their interpretation. Few men are so well read in Arab literature, and I sincerely hope that his confidence will not prove to be misplaced.

It was with great regret that I turned my steps homewards from Wady Mokatteb just at the time when the special survey of Serbal had been so far completed as to set Captains Wilson and Palmer free to commence the general survey of the country. The limits of this general survey, on the scale of 2 inches to the mile, were to comprise the country between Suez, the ranges of Jebels er Rahar and Tîh, the plain of Senned, Jebel Abu Mas'ûd, Jebel Umm Shaumer, Tor, and the Red Sea, *i.e.* the district through which the children of Israel must have marched, if either Jebels Serbal, or Mûsa, or any mountain south of the Tîh range, be the real Mount Sinai. The special surveys have taken up so much time, that it has been found

impossible to survey the whole of this district, but all the principal valleys which alone could form the roads have been traversed. On leaving Serbal, Captains Wilson and Palmer followed down Wady Feiran, and joined "the Pundit" at W. Mokatteb. A few days were spent here in examining the mines, and then they continued their course down Wady Sidri, which has never before been traced, to the mouth of Wady Feiran, and so on to the plain of El Káa, and to Wadys Thugadeh and Sigillyeh, at the western base of Jebel Serbal.

In Wady Thugadeh they found a small stream and a good-sized palm-grove, but nothing more of interest. A day was devoted to the ascent of Wady Sigillyeh. At its mouth giant cliffs frown down upon a narrow chasm, in many places scarcely 20 feet in width, through which the drainage of nearly the whole southern slope of Jebels Serbal and Sigillyeh breaks by a succession of leaps into the plain below. Higher up, the valley expands into a wild and romantic mountain glen, through which flows a perennial stream. At the head of the valley stand the ruins of two monasteries, which were afterwards visited from the other side of Serbal.

From Wady Sigillyeh, a dreary walk of 20 miles over the burning waste of El Káa brought them to a spot called Abu Suweirah, on the shore of the Red Sea, not far from the celebrated Bell Mountain, Jebel Nakûs. I have myself twice visited this mountain, but I prefer to describe it in Captain Palmer's own words:—"At a point about three-quarters of a mile, in a direct line from the sea, a slope of drift-sand 400 feet in height, and facing about w.s.w., fills a wide gully in the range of sandstone hills which flanks the mouth of Wady Arabeh on its southern side. This sand is so extremely fine and dry, and lies at so high an angle (about 30°) to the horizon as to be easily set in motion from any point in the slope, or even by scraping away a portion of the sand at its base. When any considerable quantity is thus set in movement, rolling gradually down the slope like some viscous fluid, then the sound begins—at first a deep, swelling, vibratory moan, gradually rising to a dull roar, loud enough at its height to be almost startling, and then gradually dying away till the sand ceases to roll. It is difficult to describe the sound. Perhaps the very hoarsest note of an Æolian harp is the best comparison I can draw, or even the sound produced by drawing the finger round the wet rim of a deep-toned finger-glass, save that there is far less music in the note produced by this rolling sand. Hot surface sand always appears to be more sonorous than the cooler layers underneath. The loudest result was obtained in the full heat of the afternoon sun, when the surface sand had a temperature of 103° Fahr.

"Sand which had long lain undisturbed seemed more sensitive than that which had been recently in motion. Thus the first trial on any one part of the slope was always more satisfactory than subsequent ones, and the experiments of the first day were better than those of the second. That this sound is purely local and superficial, and due in the first place to friction, there is, I think, no doubt whatever. I could even produce the sound in a faint degree by moving portions of the sand rapidly forward with a sweep of my arm.

"The Arabs state that the sounds can only be heard on Fridays and Sundays, and that they arise from the ringing of the Nakûs (a wooden board used in place of a bell) of a monastery that was mysteriously engulfed to save the monks from the treachery of an Arab guest."

From Jebel Nakûs the exploring party travelled by Tor and Wady Hebrán to their old camp in Wady Feiran.

On the 3rd of March they started on another expedition to Wady Ghurundel, following apparently the coast-road by the Nukb Badera, the Plain of Morkha, and Wady Taiyibeh.

From Wady Ghurundel Captain Palmer pushed on northwards to Jebel Bishăr, marked on the Admiralty Charts as Barn Hill, and generally miscalled Taset es Sadur, by the Tówarah Arabs, who mistake it for another mountain far away in the Tîh. The main object of his visit to this mountain was to take observations from its summit, so as to connect by latitudes and true bearing Suez and Jebel Mûsa.

Jebel Bishar is plainly seen from the roof of the Peninsular and Oriental Hotel at Suez, and the mountains of Sarbut el Gemal and Benât being easily seen from a great distance form a natural chain of connecting links.

I have obtained no detailed account of subsequent explorations, but in a report which I received from Sir Henry James this morning, and which was despatched from Jebel Mûsa on the 31st of March, Captain Wilson writes:—"The triangulation has been extended, and about 350 miles of route-survey made, including the roads to the interior by Wadys Sidri and Baba, the coast-road from Mokatteb to Ghurundel, portions of Wadys Eth Thal, Useit, Ghurundel, Es Sheikh, and El Akhdar; two roads from Wady Ghurundel, which enter the Jebel Mûsa district from the north; and the route from Ghurundel to Jebel Bishar. Detailed descriptions of the several valleys (he adds) will be given hereafter, but at present it may be mentioned that all practicable routes from Suez to the interior of the peninsula have been visited and surveyed with the exception of one south of Umm

Shaumer, which will be sketched next month. Notes have also been made on the water supply and vegetation in the districts examined. Altitudes have been determined by angles of elevation and depression, aneroid barometers and boiling-point thermometers.

"The hill-sketching of the survey of Jebel Serbal has been finished, and a model made by Corporal Goodwin of its most important features."

The hill-sketching of Jebel Mûsa is now in progress, and about three-eighths of it has been completed; a model of this district has also been commenced.

A large number of photographs and sketches have been taken, including views from the summits of Jebels Mûsa and Serbal. All the Egyptian tablets at Wady Mugharah, and most of those at Serâbit el Khadim, have been copied, and paper impressions taken of the most important ones. Several of the tablets are believed not to have been copied before, and one at Wady Mugharah appears to throw some light upon the character and nationality of the miners employed there.

A few excavations have been made at Serâbit el Khadim, principally with the object of uncovering fallen slabs. A few old tombs have also been opened, and drawings made, to show their construction.

A large collection of geological specimens has been made; and meteorological observations have been made at the camps in Wadys Feiran and ed Deir, and also at Suez, with instruments left there under the charge of Mr. Andrews, who kindly offered his assistance for this work.

A collection of birds has been made by Mr. Wyatt, and also a small collection of insects and plants by Mr. Palmer, but he has had little time to devote to such objects.

Mr. Palmer's special work has been the copying of the inscriptions, the collection of Arab tradition and stories, the ascertaining of the correct names of places, and, lastly, an examination of the manuscripts in the library at the convent.

In each department he has done good service. Night after night he has sat round the Arabs' camp-fires writing down their stories in Arabic; and, as he has travelled along, he has lost no opportunity of discovering local traditions. They are too wild to be of much value as records, but, being all written down in Arabic exactly as related to him, they will prove an exceedingly interesting collection to the Arabic scholar, since the Arabs of the desert speak the purest Arabic. The correct nomenclature of the country is also a most important point. I doubt if much has been found to throw

light upon the route of the Israelites, but a great deal of no less useful work has certainly been done by the upsetting of many impossible theories based on errors in names. I can speak from experience of Mr. Palmer's power of distinguishing the niceties of Bedawi pronunciation.

By this time the work of the expedition has been brought to a close, and the exploring party is on its way home. They intended to break up their camp at Jebel Mûsa on the 20th of this month. They will arrive, therefore, at Suez, about the end of the month; but, as they are going to stop in Egypt to take some measurements of the Pyramids, and intend afterwards to pay a visit to Jerusalem, we must not expect them home much before the end of May.

This hasty and imperfect sketch of their work will prove at least that it has been conducted with all the energy and skill which ought to render it successful; and I am glad to be able to add, that, with the exception of the first journey from Suez to Jebel Mûsa, the exploring party have travelled entirely on foot—the only way, I believe, of satisfactorily examining such a country.

Whatever may be the results of this expedition, it will, I believe, be so far exhaustive, as regards the portion of the peninsula surveyed, that we shall feel that we know all that can be known about it; and even if we fail to lay down any one route as that taken by the Children of Israel to Mount Sinai, we shall at all events receive undeniable evidence that the character of the country does answer in a remarkable degree to what we should expect to find from the accounts given of it in Holy Scripture.

The PRESIDENT, in returning thanks to Mr. Holland for his paper, said that the subject had been put before the meeting with great ability, clearness, and modesty. The journey which it described was the fourth which Mr. Holland had undertaken to Sinai. It would appear, from what he had said, that he was merely the narrator of what other people had done; whereas, before the topographical survey by these able Ordnance officers was heard of—before Sir Henry James and himself suggested that there ought to be an accurate survey of this region—Mr. Holland had already laid down the great outlines of the country, and in previous communications had made them known to the Society. There was no doubt that an exact survey was most desirable, as it might lead to a more accurate interpretation of the narrative of Holy Scripture. He might ask Mr. Holland what extent of this region would be trigonometrically surveyed on the scale which he had spoken of?

Mr. HOLLAND replied that the two mountains Jebel Serbal and Jebel Mûsa would be surveyed on the scale of six inches to the mile; the rest of the region on a scale of two inches to the mile. It was not necessary, in a Biblical point of view, to survey the lower part of the country. There could be no Mount Sinai south of Jebel Mûsa; but it might be possible to trace the route taken by the Israelites northward from the Mount.

Mr. HOLLAND, in reply to a question by Mr. Bracebridge concerning the use of the aneroid barometer, stated that above 4500 feet they did not find

the aneroid accurate at all. They had five of these instruments working together, and they all differed; though at a lower level they all agreed.

Mr. Samuel Woods said he had read with great interest, a few years back, a book by the Rev. Charles Foster, called 'Sinai Photographed,' in which was laid down a system of interpretation, founded upon the discovery that the ancient Sinaitic letters agreed very nearly with those of the ancient Hebrew, but formed words in ancient Arabic. His interpretation was extremely interesting to the Biblical scholar, inasmuch as, simply aided by an Arabic Dictionary, it professed to give an accurate description of the circumstances of the Exodus engraven by the Israelites themselves upon the rocks at the time. It would be singular if a double system of interpretation were discovered, each giving a sense widely different from the other.

Mr. Holland said that on this point his tongue was tied. He had promised Mr. Palmer that he would not explain what could very easily be explained, because Mr. Palmer was himself anxious to make known the work that he had in his note-book. But he might call attention to the copy exhibited to the meeting, of a large inscription decidedly Sinaitic and Greek. The inscriptions occurred on granite, limestone, and sandstone. They were not all equally clear. Some were more weathered than others; some were made on stone with a dark external covering, so that the lighter character of the stone shone through when chipped away. Some were engraven more deeply than others; some had been washed by floods. A great number were quite as plain as on the day they were made. They had copied 2500 perfectly legible inscriptions: 12 of them were bilingual,—Greek and Sinaitic,—cut by the same hand, as far as could be judged.

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2. *Journey across the Great Salt Desert from Hanfila to the Foot of the Abyssinian Alps.* By Werner Munzinger.

[Abstract.]

In June, 1867, M. Munzinger, H.M. Consular Agent at Massowa, was employed by the British Government to explore the route which leads from Hanfila, on the coast of the Red Sea, to the Abyssinian highlands. This route, passing over the great salt desert so graphically described by Fathers Mendez and Lobo in the seventeenth century, has never since been traversed by any European capable of recording his impressions.

M. Munzinger had eight men with him, all armed with muskets, and he took a small supply of necessary provisions and medicines. His instruments were two watches, an azimuth compass, and an aneroid by Pastorelli. On the 10th of June he landed on the arid coast of Hanfila Bay, where there was neither tree nor shrub. The village of Hanfila consists of about twenty huts, and is ruled by a chief who remembered the visit of Mr. Salt in 1810, and whose mother, Alia, was famous in youth for her beauty, and in maturer years for great wisdom and a generous hospitality. But the people of the coast have no influence inland, and M. Munzinger had to make friends with Fridello, the principal chief of the Dumhoitas,

before he could proceed inland; who, after much negotiation, furnished him with a guide.

The ground is sandy with a few coral rocks, and a hollow sound under the feet often suggested caverns. A little grass and a few mimosa trees are the only vegetation, and wells occur at long intervals. On June 18th the party crossed a ridge formed of gypsum, with pieces of shell and quartz, and veins of talc, and from its crest they obtained a view of the great salt plain, bounded on the south by the volcanic Artali Range, and on the west by the mighty mass of Abyssinian Alps. Descending for a hundred feet, they encamped on the borders of the veritable salt plain, which is marked by a line of palm-trees. Here dwell a few families of the Woyta tribe, who live on the juice of the palms, and make huts of the leaves.

The first part of the salt basin is sandy, then clay appears on the surface with crevices full of powdered salt; further on the ground resembles a frosted ploughed field, and then the bed of salt becomes thicker and presents the appearance of a lake frozen over. It was a magnificent night, and the full-moon lighted up this grand and most striking scene. The illusion of snow and ice would be complete but for the heat. The hot wind during the day was almost unendurable, —their mouths and skins were full of salt, and their half-starved donkeys moved with difficulty. After a march of several hours they came to a piece of ground surrounded by trenches and heaps, where some men were working the salt; and next day this party marched with them. It consisted of camels and donkeys heavily laden, and also of some women and girls carrying salt.

The barometer indicated that the salt basin was below the level of the sea, and it is surrounded on all sides by a high wall of gypsum. To the south is the volcanic mountain of Artali, which forms a peak whence smoke continually issues. The east side of the basin is quite dry, while the west forms a morass in its whole length, and to the south there is a lake, 6 miles long and from 1 to 4 feet deep. From the centre of the basin rise the peak of Asali and two other hills, where there is a deposit of sulphur.

The Afars, who work the salt and prepare it for exportation to the Abyssinian highlands, live the whole year round, close to the plain, under palm-trees in caverns. They cut the salt into pieces resembling whetstones, which weigh about 1 lb. each.

An oblique plain, intersected by isolated hills, conducts the traveller from the salt basin towards the Abyssinian mountains; and M. Munzinger then ascended the gorge of the Labba torrent, where

there is almost always running water, finding more and more vegetation as the elevation increased. The bed of the torrent is only 20 feet wide, and is bordered on either side by walls of slate-rock, 200 feet high. Eventually they reached Ala, on an elevated terrace, where is the salt market of the Dumhoita people. There were about 2000 people on an open space, and salt was sold for dollars and stuffs from Massowa, brought by way of Abyssinia.

The country of the Afars is bounded on the west by the Abyssinian mountains, on the east by the sea; on the north it comes nearly to a point at the end of Annesley Bay, and to the south it ends at an imaginary line drawn from Zeyla on the coast to the mountains, beyond which the inhabitants are a different people and of a distinct type.

This triangle is divided into eight regions, namely, the coast plain, 10 to 20 miles wide; a hilly country between the coast and the salt basin; the salt plain itself; the country from the north end of the salt basin to Annesley Bay, consisting of volcanic hills and plains covered with shells and madrepore; the peninsula of Buri; a chaos of high volcanic mountains to the south of the salt basin; another salt plain south of the mountains, receiving the River Hawash; and terraces rising from the salt basin to the Abyssinian mountains, by an easy ascent.

M. Munzinger is of opinion that the salt plain formerly communicated with the sea by the gulfs of Zulla and Boka, when the present peninsula of Buri must have been an island. The low elongated plains, covered with shells, point to this conclusion. The whole of the eastern drainage of the Abyssinian Alps flows into the salt basin, forming a morass, which would be a great lake if it were not for the evaporation caused by intense heat. Not a single stream ever reaches the sea on this coast.

The people inhabiting this triangular region have hitherto been erroneously called Danakil. It is true that there are Danakil, but they form only a third and the least powerful part of the population. Salt found things as they now are, but he imitated the Arabs in calling the people Danakil, without himself obtaining accurate information respecting them.

The inhabitants form, in reality, simply a number of small tribes talking the same language, and this language creates a sort of nationality. The language is called Afar, and the people, as a whole, should most properly be called Afar also. The most powerful among the Afar tribes are the Dumhoita, who inhabit the Buri peninsula and the coast, while in the mountains the market of Ala belongs to

them. The Danakil are now subject to the Dumhoita, although about a hundred years ago they were the predominant tribe. The other tribes are the Dahimela, Bellesua, Hadarema, and Madeyto.

The Afar follows his own way, independent of any one else; the country is far too large for the requirements of the population, and between every village of twenty huts there intervene many miles of desert. Each tribe has a chief, called *Makaben*, who usually succeeds his father; but the most energetic or clever of the family is the successor. The colour of the people is generally black, but at the same time there are shades to the clearest brown. The features are regular, except the mouth, the lips being large and thick. The hair is short and straight, the women plaiting it like the Abyssinians. The men wear a piece of cotton as a cloak and another piece round the loins; and every man has a curved sword worn on the right side, a long heavy spear, and a shield of buffalo-hide. The women wear a leathern apron, embroidered with cowries round the loins, falling to the feet, and a few ear and wrist ornaments. Their houses are usually rude mat-tents, or conical huts of palm-leaves. Drinking-utensils are made of wood or leaves of the palm, very neatly worked. The Afars have camels, cows, goats, sheep, and asses; horses and mules are rare. The flocks and herds give very little trouble. They are in charge of the children and girls, and come of their own accord to the wells to be watered. Nominally the Afars are Mussulmans in religion and subjects of the Viceroy of Egypt in politics; but in reality they give as little to God as they do to the Viceroy. They acknowledge both, but pay no tribute to either. They neither pray nor fast.

The Afars are avaricious, obstinate, cruel, false, and very loquacious. The slightest dispute provokes blows with the knife, and murder is considered honourable. But they have some fine qualities. They pay great respect to old age, and have a profound disgust for stealing, which is an extraordinary virtue for so avaricious a people. Yet, in the whole of Africa, there is not a race more barbarous than the Afars.

The Abyssinian salt markets are five in number, at the foot of the main chain of mountains. Two are on the road to Agamé, and the others lead to Atsbi, the great central salt mart of Abyssinia. A camel carries 500 pieces of salt, a mule 250, an ass 200, and a girl 60.

Ala was the nearest point to the Abyssinian highlands that was reached by M. Munzinger, but, instead of returning to Hanfila, he turned north and reached the coast at Annesley Bay. After travelling across one corner of the salt basin he reached the valley of the River

Ragolay, where, to his surprise, he found land covered with grass and trees, and abundant supplies of water. This is the largest stream which flows from Abyssinia to the east, draining a very considerable area on the highlands, but it is exhausted long before it can reach the sea. An arid waste of hills and valleys extends from the Ragolay to Annesley Bay, which M. Munzinger traversed during the intense heat of the first week in July.

The Paper will be printed in extenso, in the 'Journal,' vol. xxxix.

The President said they ought particularly to return their thanks to Mr. Clements Markham for the manner in which he had condensed this paper. A very few weeks ago Dr. Blanc told them, when he was describing the great western region of Abyssinia, that that alone was truly Abyssinia, and that the chain of mountains which the British expedition traversed under Lord Napier, and which Mr. Markham described on a previous occasion, was merely the extreme raised edge of the country. We had now an account of a third region of Abyssinia in the paper of M. Munzinger—a region which had not been traversed for centuries, and which was of great interest to the geologist as well as the geographer. The cause of the abundance of salt was this: every torrent that descended from the mountains brought down in the mud a certain quantity of salt, which was then deposited in the great hollow of the salt plain, described in the paper, from which there were no rivers to carry it off. With evaporation remained the solid salt there. Then there was a volcanic region to the south which contained much sulphur. This region was absolutely shut off from the Red Sea by a great wall of gypsum.

Mr. Clements Markham said it might be worth while to mention that about 200 years ago two Jesuits were sent from Goa by the Portuguese Governor-General to attempt an entrance into Abyssinia by means of the route now described by M. Munzinger. They landed and marched until they came to the chief of a petty tribe, who gave them a guide. This guide took them the wrong way, and they were very nearly dead before they reached the valley. They described the salt desert exactly as M. Munzinger had done, and the valley they reached appeared, from their description, to be this very valley of Ragolay, which had now been re-discovered, and which had also been visited by Colonel Merewether. They then ascended the Abyssinian highlands. A curious mistake had always appeared upon maps of Abyssinia. Fathers Mendez and Lobo, the Portuguese missionaries, mentioned Senafé as being at the head of the pass by which they reached the highlands from the salt desert. When Rüppel, the German explorer, visited Abyssinia, about twenty years ago, he came on the real Senafé. Thereupon the map-makers placed Senafé in its proper position, but they also placed it, where it had been erroneously put originally, at the head of the pass. This mistake has been continued to the present day, and, to reconcile the discrepancy, the whole region between the two points has sometimes been marked as Senafé. The salt desert is most important to Abyssinia, salt being the currency of the country. M. Munzinger advised the British to take possession of the salt-market, and thus entirely destroy the currency of Abyssinia. But a shorter way of making our presence and power felt was found, and this advice was not followed. Not only had M. Munzinger made this difficult journey, but he had also explored another route before we went into the country, and made route-surveys and observations. He had also established relations with the people of Abyssinia. He went with Colonel Grant to Adowa, and afterwards went from Antâlo to within sight of Theodore's army at Dalanta, far ahead of the English force; so that, chiefly through his influence, the people

were induced to bring in supplies of provisions to our army. He deserved some acknowledgment of his services. What Government had done it was not for him to say; but he was happy to state that the Royal Geographical Society had shown their sense of his services by making him an Honorary Fellow of the Society.

Mr. TRELAWNY SAUNDERS suggested that Mr. Markham might have pointed out that the error with respect to the position of Senafé had been repeated improperly by the Government surveyors who accompanied Lord Napier's expedition, while it had been corrected by the private map-makers. In connection with M. Munzinger's journey, he wished to call attention to the probability of a considerable depression below the level of the sea in the region south of the salt desert. Some observations in that direction at Lake Asal, on the route from Tajura to Ankober, showed a depression of 570 feet below the sea-level. If there was such a depression extending for any distance it would be one of the most remarkable circumstances in the geography of the country.

The PRESIDENT said, if he had known that Colonel Grant had been associated with M. Munzinger, he should have called upon that gentleman in the first instance to speak in reference to the abilities of the author of the paper.

Colonel GRANT was very glad to have the opportunity of adding his personal testimony to the merits of M. Munzinger as a traveller, an explorer, and a thoroughly scientific man. He had the good fortune to be accompanied by him when ordered by Lord Napier on a mission to the Prince of Tigré. M. Munzinger did the whole work of their little expedition, and did it most admirably. He had for years been associated with the Abyssinians. For ten or fifteen years he had been in that country. He thoroughly understood the people, and they thoroughly understood him. Any reward the Government might bestow upon M. Munzinger would be richly deserved.

The PRESIDENT, in adjourning the Society, announced that he had received a very interesting letter from Mr. Lamont, formerly member of Parliament for Buteshire. Fortunately for science, having lost his seat at the recent election, he had thrown his whole heart into the cause of geography. He had spent 8,000*l.* or 10,000*l.* in fitting out a screw-steamer in the Clyde, which had already left Scotland, to explore the whole of the region beyond Spitzbergen, with a capital crew and a scientific man on board. All this was being done at the expense of a private individual, whilst our own Government had resolved not to expend more money in Arctic exploration. He could not conclude without asking them to return their thanks beforehand to Mr. Lamont, and to wish him God speed and great success in his undertaking.

Twelfth Meeting, 10*th May*, 1869.

SIR RODERICK I. MURCHISON, BART., K.C.B., PRESIDENT, in the Chair.

PRESENTATIONS.—*F. T. Mott, Esq.; W. Perkins, Esq.; Rev. Thomas Whitby.*

ELECTIONS.—*Capt. James George Cockburn; Thomas George Freke, Esq.; Henry Hodges, Esq.; James G. Hamilton, Esq.; John Gaunt Lye, Esq.; M. J. Lindsay, Esq.; Sir John Mantell; Edward A. Phillips, Esq.; Alfred William Ray, Esq.*

Accessions to the Library from April 26th to May 10th, 1869.—G. F. Lyon's 'Attempt to Reach Repulse Bay in H.M.S. *Griper*, 1824.' Donors, the Council of the Royal United Service Institution. Sir Vincent Eyre's 'Retrospect of the Affghan War, 1869.' Donor, the Author. H. F. Tozer's 'Researches in the Highlands of Turkey, &c.,' 1869. Transactions and Proceedings of Societies and other serial publications.

The President read the following letter, addressed to him by Mr. Lamont on the eve of his departure for the Arctic regions. Mr. Lamont, he added, was late Member of Parliament for Buteshire, and, he thought, had shamed our Government by undertaking what they had declined to do, and expending from 8000*l.* to 10,000*l.* in fitting out a screw-steamer to explore the North Polar regions:—

"S.S. *Diana*, Caledonian Canal,
20th April, 1869.

"My dear Sir Roderick,

"I promised to give you some particulars as to my outfit and contemplated expedition, before I finally take my leave of the shores of Britain.

"Ever since I was in Spitzbergen, in the two summers of 1858 and 1859, I have had an ardent longing to revisit that interesting country, and I have always entertained a strong opinion that by going early in the season, with a stout little screw-steamer, proper appliances, and a good crew, one might succeed in penetrating a long way into the unexplored regions beyond Spitzbergen. I always thought that the proper way to attempt this was by going well to the east of Spitzbergen, even, if necessary, close to the north-west coast of Nova Zembla, and then, if possible, working round the eastern end of the ice till you get hold of Gillies Land. Norwegian walrus-hunters have told me that they had been ashore on Gillies Land; and, although I rather doubt the truth of this statement, still there is no doubt that Gillies Land exists, and that it is a mountainous country lying to the north-east of Spitzbergen. For all that we know, this may be the commencement of an extensive continent stretching to the Pole, or far beyond the Pole; and I conceive that if we once get hold of the south-west corner of Gillies Land we may be able to screw up its west coast, keeping close to the land, for a long distance.

"I am the more inclined to believe in the correctness of my preconceived opinion that the east side of Spitzbergen is the proper route, and the best chance of finding open water, from the repeated failures of Lord Mulgrave, Captain Buchan, Sir Edward Parry, and of the Swedish expedition of last year, to effect any entrance into the ice to the north-west.

"I confess I am not very sanguine that either myself or any one else will ever be able to penetrate to the actual Pole, because I incline to believe, with Sir Leopold McClintock, that, after penetrating 100 or may be 200 miles farther than has yet been reached, we should then arrive at a prodigious wall of eternal and impenetrable ice, such as Sir James Ross discovered in the Antarctic Ocean, but it would be something even to demonstrate the existence of that.

"I utterly disbelieve in an open Polar Ocean, and I entirely fail to discern any evidence of its existence. However, I shall be very glad to *find it there*, and to get into it, if possible.

"My vessel is 251 tons burthen, and 103 tons register, with 30 horse-power engines. She is rigged as a three-masted schooner, with square topsails. She sails well and steams 7½ knots per hour, with a consumption of 2½ tons of coal per diem. I can stow 100 tons of coals, and I expect to eke these out in Spitzbergen by using quantities of the drift-wood which exists all along the

shores of Spitzbergen in enormous masses. I shall also endeavour to utilise the native coal, which I have seen cropping out of the precipices in various places.

"I think I have succeeded in getting together a first-rate crew, six of whom, besides myself, have had considerable Arctic experience. I have got a surgeon, Mr. Smith, who is somewhat of a naturalist, and anxious to make any scientific researches and observations in his power.

"I hope to be in Tromsö by the 1st May, which will give me full four months of good Arctic summer for my explorations.

"I am, my dear Sir Roderick, yours very sincerely,

"J. LAMONT.

"Sir R. Murchison, Bart., F.R.S."

The following Papers were read :—

1. *On the Evidences of the Gulf Stream in High Latitudes in the North Atlantic.* By Admiral C. IRMINGER, Corr. Member R.G.S.

Copenhagen, April 21st, 1869.

I HAVE read with the greatest interest the discussions in the Royal Geographical Society, at the Meeting, February 8th, between Mr. Findlay, Captain Sherard Osborn, R.N., and Professor Huxley, concerning the Gulf Stream.

For nearly thirty years I have, partly myself, partly through naval friends and intelligent ship-masters, who with me take interest in oceanic currents, made observations on currents and temperatures, chiefly of the Northern Atlantic Ocean. I have always, nearly every year, furnished them with well-corrected thermometers; and these observations on the water which comes from more southerly and more heated parts of the Atlantic, and also on the waters of what I believe to be the Gulf Stream, I take the liberty of submitting to the Royal Geographical Society.

The chart which I send [which was exhibited to the Meeting] shows the temperatures between Shetland and Greenland, and the accordance existing between the many annual observations in my possession, of which I have only marked the temperatures for a few years.

According to these observations, it can be said, with certainty, that the current in the Northern Atlantic flows towards the North, even up to the Icy Sea.

In a treatise on currents of the ocean (Havets Strömninger; Nyt Archiv for Söväesenet, 1853) I have published the observations, made with all possible accuracy, in one part of the North Atlantic, by seven of our men-of-war, provided with superior chronometers and other instruments; and a medium of these observations in different years gave :—

Between 59° 30′ and 61° 30′ lat. N. and 2° ,, 6° w. of Greenw.	in 17 days,* the current was found 4·7 nautical miles per day, N. 72° E. true.
Between 60° 0′ ,, 62° 0′ lat. and 6° 0′ ,, 10° 0′ w. Greenw.	11 days, 2·5 nautical miles per day, N. 60° E. true.
Between 60° 30′ ,, 62° 30′ lat. and 10° 0′ ,, 14° 0′ w. Greenw.	18 days, 0·8 nautical mile per day, N. 32° E. true.
Between 61° 0′ ,, 63° 0′ lat. and 14° 0′ ,, 18° 0′ w. Greenw.	25 days, 3·1 nautical miles per day, N. 47° E. true.

Between 62° lat. and the south coast of Iceland, and 18° and 23° w. of Greenwich (nearly the longitude of Cape Reikianæs, south-west cape of Iceland) in 32 days, 1·91 nautical mile per day, N. 33° W. true.

Between Fairhill and Greenland, the weather was frequently unfavourable for observations for correcting the longitude, but still a constant drift, or slow current of the ocean to the north was observed, and the mean of observations between 32° and 39° w. of Greenwich gave 3·2 nautical miles per day, N. This drift of the ocean in a northerly direction towards the coast of Greenland is besides observable in the temperature of the water.

This drift, or slow current, in the Atlantic is the cause why the harbours of Norway, even farther than North Cape, and as far as the Fiord of Varanger, are accessible for navigation during the whole year; just as the warm current, which passes Cape Reikianæs, and runs to the northward along the western shores of Iceland, is the cause of the south and west coasts of this island being clear of ice, so that, even during the severest winters, ships may go to Havnefiord and other places in the Faxe Bay of Iceland, where they always will be sure of finding open sea. If this current to the north in the Atlantic did not exist, the ice from the sea around Spitzbergen would float down to far more southern latitudes than is now the case; and certainly the coasts of Norway, as well as the sea between Shetland and Iceland, would frequently be filled with ice from the Icy Sea, and the influence of the ice would then be felt on the climate of the neighbouring coasts. But this is not the case; and we know that the ice from the Icy Sea (Greenland-ice) only can force its way to the southward between Iceland and Greenland, along the east coast of Greenland, rounding Cape Farewell and afterwards passing Labrador, Newfoundland, and farther south.

Along the north coast of Iceland the current is usually to the eastward, and along the east coast predominating to south; and I think these currents may be considered as eddies of the principal currents in the Icy Sea and the Atlantic.

The current and the ice-drift of the Greenland-ice are sometimes

* I reckon a day = 24 hours.

so considerable, that not only the sea between Cape North of Iceland and Greenland is blocked up with ice, but it also strikes against the north coast of Iceland between Cape North and the Bay of Skaye-strand, and then, favoured by the said eddies, closes the north and east coast of Iceland entirely. On the 24th of May, 1840, this ice was met with even about 100 nautical miles from the east coast. Still this ice never remains on these coasts later than the month of August, but generally leaves earlier, and then swings round in a north-east direction to the Icy Sea again.

The temperature of the sea seems to prove that the warmer current of the Atlantic approaches as well the east as the north coast of Iceland more in summer than earlier in the year.

It happens, notwithstanding, that a small part of that ice which now and then encloses the east coast is, by gales from north and north-east, carried to the south shore of the island; but as soon as it appears here it is carried away again with the north-westerly current from the Atlantic, passing Cape Reikianæs, and thus onward to the other ice, constantly blocking up the east coast of Greenland.

The enclosed description* of the currents and ice-drifts near Iceland will give more detailed information for those who may wish it; but I must observe expressly, that the ice which now and then encloses the above-mentioned coasts of Iceland never is met with in lower latitudes, as would be the case if the current or drift of the Atlantic were not towards the north.

By studying the temperature of the North Atlantic between Shetland and Cape Farewell, it will be observed that *streaks of warmer water* are found here, some of which I have indicated on the appended sketch. These warmer streaks are not to be found every year in the same longitude, and I think they have their origin from the Gulf Stream, which has retained this higher temperature, and that these warmer streaks, sometimes met with more easterly or at others more westerly, possibly may be caused by the pressure of the current coming from Labrador, passing Newfoundland, &c.; where this current influences more or less the limits of the Gulf Stream, causing its heated water to be inclined sometimes more easterly and at other times more westerly. Severe gales might likewise possibly have an influence on this deviation.

These warmer streaks, combined with the different tropical products constantly thrown on the shores of Norway, the Farōe Isles,

* 'Strømninger og Iisdrift ved Island:' a printed pamphlet, now in the Library of the Society.—[ED.]

Iceland, Greenland, &c., I believe also to be a proof that the Gulf Stream sends its waters far to the north.

Among the tropical products frequently found is the bean of the *Mimosa scandens*, one of which I send you, and which I found on the shores of Iceland. Near Husavik (North Iceland) I once picked up on the beach so large and fine a specimen of this mimosa, that I had a snuffbox made of it.

The enclosed description of the currents will show, that Capt. Södring, in the *Fox* (the same vessel which Captain Sir Leopold M'Clintock commanded on the Franklin expedition), on the 7th of March, 1860, in 66° 21′ lat. N., and 1° 26′ long. W., found the water on its surface, after the long winter's influence in these cold climates, still at 4° R. or 41° Fahrenheit.

With all these facts it appears to me, that the Gulf Stream can be followed through the Northern Atlantic, even up to the Icy Sea.

I have limited myself to the above short report, as many distinguished Fellows of the Royal Geographical Society are so well acquainted with the currents of the ocean, that I find it superfluous to add more circumstantial details concerning this matter.

Most respectfully,

C. IRMINGER,

Rear-Admiral, Royal Danish Navy.

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2. *On the Surface Temperature of the North Atlantic, in reference to Ocean Currents.* By NICHOLAS WHITLEY, C.E.

THE thermometrical observations on which this Paper is founded were commenced on the Cornish coast in 1849, and were afterwards extended to the Scilly Isles, the Seven Stones Light-ship, to Yarmouth, and to the Shetland Isles. And, further, in order to ascertain the temperature of the surface water across the Atlantic, extracts were made from the log-books of Cunard's steam-ships sailing between Liverpool and New York, for a period of five years; which have been reduced to monthly means at every five degrees of longitude, and are embodied in the table appended to this Paper.

The primary object was an endeavour to determine the influence of the Gulf Stream on the climate and agriculture of the British Isles.

In this Paper I purpose only to state the general results obtained, and to apply the evidence as a test of the existence of ocean currents.

The chart exhibited to the Meeting shows the surface temperature of the sea taken in five voyages in different years, and similar observations are given in the table at the end of this Paper.

In January the sea around the Scilly Isles is somewhat warmer than on the western coast of Ireland, and there is a decreasing temperature from 51° at the Seven Stones to 42° at Shetland, being a difference of only 9° in 700 miles of latitudinal distance. The January temperature of the water continues also to decrease down the eastern coasts of Scotland and England, until it reaches its minimum of 37° at Great Yarmouth.

We may, therefore, infer that the North Sea in winter derives its warmth rather from the strong tides which pass around the north of Scotland than from any warmer water flowing through the Straits of Dover.

The mean temperature of the sea in Penzance Bay, last January, was 50°, and between Hull and Hamburg 43°. In the same month, on the American coast, the sea is very cold, seldom rising above the freezing-point, and often from two to four degrees below it. The chilling effect of the Arctic current is felt far down the coast; but where the water is somewhat sheltered from its influence by the land of Nova Scotia and Newfoundland it rises several degrees in warmth.

The extent and greatest intensity of the Arctic current is sharply shown by the thermometer in every voyage. The cold water on the banks of Newfoundland reaches its mean monthly minimum of 30° in January, and its mean maximum of 52° in September, and its width is fully 400 British miles.

On the eastern side of the cold current, and in close proximity to it, there is a bed of very warm water having a mean temperature in January of 57°, being 27° warmer than that on the Banks, over a width of about 200 miles. This appears to be a strong eddy of the Gulf Stream, curving northward, and holding the Arctic current in its warm embrace.

From this part of the sea to near the Irish Coast the warmth is more equally distributed through the water, and the thermometer does not detect any well-defined branch of the Gulf Stream flowing to the N.E. There is, however, a decided rise in the temperature about the middle of the Atlantic, amounting to from four to six degrees above that of the sea at Scilly, and the figures on the chart appear to indicate that it lies in a S.W. and N.E. direction. It is most probably the drift of the Gulf Stream driven to the N.E. by the prevailing S.W. wind.

The observations at the coast stations on the west of Ireland

show a temperature of 3° below that of the open sea 350 miles to the west.

Our s.w. wind has its birthplace where the temperature of the sea is at least 55° in January, causing the thermometer on the Cornish coast, under its influence, to stand steadily at 52°, and the great warmth of the past winter resulted from the continued persistency of this wind rather than from any excess of heat in the sea.

The s.w. wind gives to Penzance a mean winter temperature of 44°, being the same as that of Montpellier; Cork falls short of it by only half a degree; and the Scilly Isles at this season exceed this noted winter resort by 2½°.

TABLE, showing the Temperature of the Surface-water of the Atlantic Ocean, at every 5° of Longitude, from the South of Ireland to the Banks of Newfoundland, on the course of Cunard's Steam-ships.

Months.	On the Banks.	Longitude West.						
		40°	35°	30°	25°	20°	15°	10°
January	30	57	53	54	55	54	52	51
February	31	54	53	52	53	52	52	50
March	32	54	54	55	54	54	52	51
April	34	57	55	55	52	54	53	52
May	34	55	54	55	56	55	53	53
June	40	60	59	58	56	58	58	57
July	45	60	59	58	59	60	58	59
August	50	61	59	60	59	60	60	59
September	52	59	59	60	59	60	59	58
October	47	59	59	56	56	57	57	55
November	44	58	57	58	59	57	54	53
December	32	55	54	54	54	54	53	52
Mean of the Year	39·2	57·2	56·2	56·2	56·0	56·2	55·1	54·2

Penarth, Truro, April 23rd, 1869.

The PRESIDENT, in returning thanks to the authors of the Papers, said that Admiral Irminger was a distinguished officer of the Danish navy, well-known for the interest he had taken in Arctic exploration during the time of the search for Sir John Franklin. Our own naval commanders would well recollect the kind services he then rendered them. He (the President) was proud to reckon the gallant Admiral amongst his own personal friends.

Mr. FINDLAY said he believed it an error to call the warm stream which flowed towards the western coasts of Europe the Gulf Stream; and he believed that known facts revealed some larger agent than the Gulf Stream at work in producing the mild climates of Western Europe. It was only within the last twenty years that it had been called the Gulf Stream. Rennell, Herschel, and all the older authorities, called it the North Atlantic current. The Gulf Stream, where it issued from the narrows of the Gulf of Florida, had a sectional area of only six square miles. It took about 220 days to travel from the Gulf

of Florida to the Land's End. At the outset the surface-temperature was 77·5°; at a depth of 1200 feet it was 55°. When it arrived at the Land's End the temperature was 51°. If this stream were continuous, as warm water, the following anomalies would have to be admitted:—Leaving the Straits of Florida in May, it would reach the Land's End in January. After an interval of ten days it arrives off Cape Hatteras, with a loss of 3° of temperature. In forty days it has lost 15°, and in fifty days the temperature is 57°. Further eastward it was 51°, then it got warmer, rising to 65°, and at last it attained an even temperature until it reached the Land's End. Taking the opposite season, the Gulf Stream, at its coldest, was 30° off Newfoundland. A strong and broad current came down from the polar basin, which cut off the northern or warmest edge of the Gulf Stream and neutralised its effects there, so that it was no longer to be called the Gulf Stream. The southern half of the stream travelled down the coast of Portugal, and there, turning to the eastward, passed round the middle basin of the North Atlantic. The quantity of water which passed through the narrows of the Gulf of Florida was 297 cubic miles per day; whereas the area which that water was claimed to cover off Western Europe was a million and a half of square miles, which would give a depth of only six inches of warm water per day. Therefore, it was not alone the Gulf Stream, but the prevalent south-westerly winds which drove the water from warmer latitudes northward to the western coast of Europe. Besides, there was the great Arctic basin, which contains another million and a half of square miles over which the so-called Gulf Stream has to prevail. The truth was, we were very insufficiently informed as to the extent of this great current; we were only at the beginning of our investigations. In our present state of knowledge he (Mr. Findlay) contended it was not the Gulf Stream that reached our shores as an uninterrupted stream of water from the Gulf of Mexico. The drifts which Admiral Irminger mentioned travelled only from one to three miles per diem, and at that rate it would take the Gulf Stream hundreds of years to cover so large an area with warm water.

Captain SHERARD OSBORN quite agreed with Mr. Findlay that it was too soon to make theories about the Atlantic or any other currents. We wanted facts rather than theories. He, however, did not agree in confining the width of the Gulf Stream to the current flowing between the Bahamas and Florida, because warm water flowed up both sides of the Bahamas.

Admiral Sir EDWARD BELCHER objected to the term Gulf Stream, inasmuch as the water which came from the gulf was heated to 86° on the south side of the Caribbean Islands, whereas, as it passed Cape Florida, the temperature was down to 71°. In all parts of the world there were certain currents which had not yet been accounted for. The warm current in its passage northward refused to mingle with the cold Polar current which came down southward, and there was a line of demarcation between them like a wall, so that the bow of a ship, as we learned from the log of Admiral Milne, might be in 46° and the stern in 27°. Those who had been accustomed to navigate off the banks of Newfoundland knew that the result of these two streams meeting was a terrific hurricane. At the present moment he was engaged in ascertaining, from an examination of an immense number of ships' logs, the general temperature of the ocean, with a view to enable sailing ships to select the best period of the year for making their passages. He hoped to be prepared with a paper on the subject at the next meeting of the British Association. For instance, the Pacific was warmer than the Atlantic; for when he was in Behrings' Straits at the time that the temperature off the coast of Ireland was 52°, off Icy Cape, in 70° north, the temperature was 54°. Again, he had ascertained that the temperature between Greenland and the Orkneys did not vary very much.

Colonel EVELYN said he had been struck by the great similarity that existed

between the great oceanic streams and the atmospheric currents above. It might be that they were acted upon by much the same causes. We knew little of the under currents of the ocean, and little of the upper currents of the air. It was the upper current of the ocean and the lower current of the air that principally came under our notice; and it was with difficulty that we obtained an imperfect knowledge of the others by means of aërial expeditions, or laborious deep-sea soundings. But there appeared good reason to believe that the upper and under currents of ocean and atmosphere correspond to a remarkable extent—that the under-currents of the ocean, like those of the air, come from the Poles, and that the upper counter-currents flow back in both cases towards the Poles. The under-currents of the ocean are, in fact, analogous to the trade-winds, and the surface-currents to the reflux of the trade-winds, which, descending to the earth in high latitudes, cause our prevailing south-west winds. The water, like the air, must also be affected by the difference in the rotatory velocity of the earth's surface depending on the latitude. This must give to Polar currents, either of air or water, an apparent westerly direction, and to Equatorial currents an easterly one.

Colonel Evelyn, in conclusion, pointed out the anomaly of calling a current of air coming from the east an easterly wind, whilst a stream of water coming from the same direction was usually called a westerly current. These anomalous terms increased the difficulty he experienced in offering a few impromptu remarks about currents of air and currents of water.

Admiral OMMANNEY reminded the meeting that bottles thrown overboard in the West Indies had been picked up on the coast of Norway. He mentioned this fact as strong evidence of the course of the Gulf Stream.

Sir ANDREW WAUGH was surprised that no notice had been taken of an admirable work by Mr. Croll, in which he entered into the physical question of the latent heat absorbed by water. The effect of his book was to show that the hot water coming from the Gulf Stream was quite sufficient to carry a body of latent heat to influence our climate.

Mr. FINDLAY admitted the pains taken by Mr. Croll, but it seemed to him that that gentleman had doubled the quantity of water which came out of the Gulf, and he took no account of the period which it took the Gulf Stream to reach its point of parting, nor of the great mass of cold water which poured down into it on its northern edge and there neutralised it. It was a question for geologists whether the shoals off Newfoundland were not formed by the antagonistic action of the Gulf Stream and the Polar current at that particular part.

Dr. RAE said he had studied the action of rivers as affecting the temperature of water, and he had heard from distinguished men in the navy and merchant service that the influence of the large rivers of South America, such as the Amazons, was felt one and two hundred miles at sea. He computed the body of the Gulf Stream to be fifty times as large as the Amazon or the Rio Plata, and if that was right the influence of the Gulf Stream would account for the warm currents which flowed upon the western coasts of Europe. The cold current which was met at Newfoundland would deflect the Gulf Stream, or if the cold water penetrated it, the warm water, being lighter, would rise above it. With reference to what Admiral Ommanney had said, he himself knew that in the Orkneys fruits and plants had been picked up which only grew in the West Indies. The influence of the warm current was so strongly felt there that he adhered to the old theory of the Gulf Stream. He had calculated that the Gulf Stream brought over to our coasts a body of warm water eight or ten fathoms deep, and 400 miles in width, which, flowing in a south-westerly direction along with our warmest winds, gives a very large heating surface.

Admiral Sir EDWARD BELCHER said, with regard to drift, within this year two sea substances which existed about Teneriffe had been blown ashore at Torquay, and within the last week a Portuguese man-of-war, or *Physalia*, had been cast ashore at the same place.

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3. *On Open Water in the Polar Basin.* By Captain R. V. HAMILTON, R.N.

THE idea of an open sea and milder climate in the vicinity of the Pole has, at all events, the merit of antiquity to recommend it, and has been adopted on scientific grounds by many of our modern eminent geographers—amongst them Maury, who endeavours to support the conclusions arrived at theoretically, by arguments drawn from modern Arctic explorers, and the celebrated drifts of the *Advance*, *Resolute*, and *Fox*. It would, indeed, be presumptuous on my part to dispute the justness of the scientific deductions of so eminent a philosopher; but, having the practical experience of two Arctic voyages, I trust to show the deductions he has drawn from the accounts of voyages are erroneous, and would not have been drawn had his personal experience of ice-movements been equal to his scientific knowledge.

Maury's arguments * may be briefly expressed as follows:—

1. He infers † that a warm under current sets through Baffin's Bay into the Polar basin, and eventually rises to the surface and ameliorates the climate.

2. On the indications of a milder climate as shown by the migration of birds.‡

3. On the open sea seen by Penny and Kane in Wellington and Kennedy channels,§ and an erroneous idea that Kane procured subsistence for his party on the borders of this "ice-bound sea."

4. On the assumption that the drifts of the *Fox* and *Advance* were caused by "a tongue of ice 1000′ long, coming out of the Polar sea *formed at the edge of open water in it*." ‖

It would extend beyond the limits of a paper to give full quotations from Maury: I will, therefore, endeavour to convey his meaning; and as it is principally with the last argument I intend to deal I shall reply very briefly to the three first.

He infers,¶ from the very exceptional case of icebergs having been seen drifting north, that an under current exists which must come from the tropics, and is therefore warm.

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* Eighth edition, 1861. † Pars. 424-484. ‡ *Ib.* 425. § *Ib.* 428-432.
‖ *Ib.* 431, 476-8. ¶ *Ib.* 424.

To this I reply that, beyond doubt, an enormous majority of bergs drift south; none have been seen to the westward of Barrow's Straits or Jones's Sound, or to the northward of the Parry Island, nor in the open sea of Kane, notwithstanding this supposed submarine current and its close proximity to the great nursery of bergs (if I may use the expression) in the head of Baffin's Bay. According to the drift of bergs, this current should be the other way; but as few are over 100 fathoms below the surface, and Baffin's Bay is probably much deeper, no argument for or against can, in my opinion, be drawn from their drift, and M'Clintock in December, 1857,* says, "Neither surface nor submarine currents were detected."

This warm under current may come to the surface and ameliorate the climate; but I am not aware of any cold Polar current coming to the surface and tempering the heat of tropical climates, and that cold under currents exist in the tropics is beyond dispute.

Regarding his second argument, Maury states, "The observations of explorers indicate the existence of a milder climate, which may also be inferred from the migration of birds to the northward, evidently in search of a milder climate, which can only be caused by the proximity of a large body of open water." †

In reply to this, I am not aware who the explorers are who have given practical proofs of this milder climate.

The following facts will show climate is not the cause of the birds migrating.

Ptarmigan were killed in numbers by the *Plover's* crew during their four winters in Behring's Straits. Some also at Port Kennedy by the *Fox's* crew in February, 1857, temp. 47°. Two were on Dealy Island all the winter of 1852, and shot in February.

M'Clintock and De Haven, during their drifts down Baffin's Bay, saw dovekies throughout the winter. Richardson mentions water-fowl, such as dovekies, wintering off Spitzbergen.

Water-fowl are always shot long before the disruption of the ice, in the cracks and lanes of water; and as most of them migrate from our latitudes to the Polar regions, it can scarcely be said they are seeking a milder climate; but, like the salmon that always returns to its native river, these birds' instinct probably lead them to return to their native haunts and open water, where they can breed undisturbed.

Regarding the open seas of Penny and Kane, and the subsistence procured by the latter for his crew in his Polynia, Penny's may be briefly dismissed, as we now know it was only a considerable space

* Voyage of the *Fox*, chap. v. † Par. 425.

of water with an icy barrier north and south of it, which was also apparently the case in 1853-4, and is therefore probably owing to local causes, such as strong tides or currents in the vicinity of Baillie Hamilton Island, certainly not to a warmer current rising to the surface or the thermometer would have indicated it.

Kane's, or more properly Morton's open sea, in Kennedy Channel, is of more considerable extent; but from his elevation, 480 feet, the visible horizon is only 25 miles off, and it was seen at the end of June and beginning of July. What was its state in winter? Certainly frozen, for Hayes in May, 1861, found ice there, but much decayed.* It must also be remembered that Morton, although doubtless an intelligent man, was only the officer's servant, and therefore his account must be received with caution.

"Seals were sporting and water-fowl were feeding in it." † With regard to the animal life seen in this sea as a proof of an open sea, the same might have been seen in any part of the known Arctic sea where there was open water. M'Clintock and De Haven both saw seals, dovekies, and narwhals in the lanes of water throughout the winter. At Port Kennedy a few seals were seen in February. At the Bay of Mercy a seal was killed in midwinter in the firehole of the *Investigator*. And in April, 1854, at Beechy Island, a bear was seen digging down into a deep snow-drift, and eventually brought up a seal, probably from its cave in the snow, where it had brought forth its young. These instances will, I think, prove that an open sea is not required for animal life, and conversely the presence of animal life is no proof of a warmer open sea. I should rather say the contrary, as the unusual warmth of this ocean-climate would probably be as unpleasant to Arctic seals and walrusses, as the tropics would be to Esquimaux suddenly transported there. So far from Kane procuring subsistence for his party, as Maury asserts,‡ on "the shore of this ice-bound sea," but for the Etah Esquimaux they would have starved,§ although he had Hans, an Esquimaux, and Petersen, a Greenland Dane, in his party, both skilled and enthusiastic hunters.

In March the Etah Esquimaux had been compelled by hunger to eat 26 out of 30 of their dogs, and in 1858 M'Clintock heard that Hans, who had remained behind amongst them, had been compelled to eat the sealskin which covered the framework of his kayak (the very last resource of an Esquimaux).

It is a curious fact that the coldest mean temperatures for the

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* American Philosophical Society's Transactions, Dec. 1861.
† Maury, par. 429. ‡ *Ib.* 432. § Kane's Voyage.

summer months and for the year are those of Dr. Kane and Sir Edward Belcher,—the three nearest winter-quarters to the supposed Polynia,—and that they procured scarcely any game. While Melville Island and Banks' Land abound in game, and the Polynia has never been placed near them.

We now come to Maury's last argument.* To support which, he asserts that the drift of the *Fox*, *Advance*, and *Resolute*, is sufficient of itself "to establish the existence of an open sea in the Arctic Ocean." He says,† every year a tongue of ice 1000′ long is projected out of it through Kennedy and Wellington channels down Baffin's Bay, and which he supposes to drift from the southern edge of the open sea "as fast as it is formed during the winter;" and it is "the compact and cold middle ice" of Baffin's Bay, which he asserts is much heavier when first encountered to the southward than when crossing to the west coast through it in the north water. "In this fact," he says, "we recognise another argument favouring the existence of an open sea." As the southern ice was formed early in the winter, consequently had longer time to grow thick, "while that which was formed at the edge of the open water in April or March would drift out, and not attain much thickness before it began to thaw," and consequently "experience has taught the whaler to look north for the first breaking up and the earliest passage through the middle ice." If this latter argument is correct the voyage to the Pole would indeed be an easy matter, for once having rounded the northern part of the middle ice, which is never done till June, when the formation of ice is over for the season, there would be no more to encounter. But Hayes and Kane, neither of whom were much impeded by the "middle ice," tell a different tale, and describe fierce tournaments with the icy guardian of the portal to the Polar basin, in which they were worsted, although their energy and perseverance to pass through Kennedy Channel deserved the success it did not command.

A glance at the chart will show how improbable it is that such a drift as Maury imagines should occur through the narrow and winding Wellington and Kennedy channels.

I unhesitatingly assert these drifts had nothing to do with any movements of the ice in the Polar basin, as, I trust, the remarks I am now about to offer on the formation of floes and a brief analysis of the drifts will show.

De Haven in his official report,‡ speaking of being frozen in at the entrance of Wellington Channel, says:—"Sept. 13th. There was

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* Par. 475. † Par. 459. ‡ De Haven's Report.

nothing to obstruct our progress but the bay ice (*i. e.*, young ice formed by the sea freezing), which with a good breeze blowing would not have impeded us much, but the wind failed. The snow, with which the surface of the water was covered, rapidly cemented and formed a tenacious coat, through which it was impossible to force the vessels. At 8 P.M. they came to a dead stand 10 miles east of Barlow Inlet.

"The following day the wind hauled to the southward and lasted till the 19th. During this period the young ice was broken, its edges squeezed up like hummocks, and one floe overrun by another, till it all assumed the appearance of heavy ice."

Again—"Sept. 22nd was an uncomfortable day, wind north-east, with heavy snow, the floes began to be pressed together with so much force that their edge was thrown up in immense ridges of rugged hummocks."

M'Clintock, speaking of the *Fox's* detention in Melville Bay,* says, on Oct. 3rd, "Up to Sept. 17th south-east wind prevailed, forcing the ice into a compact mass and urging it north-westward. Subsequently north-west winds set in, drifting it south, and separating the floe pieces; but the change of wind being accompanied by a considerable fall of temperature, they were either quickly cemented together again, or young ice formed over the newly opened lanes of water almost as rapidly as the surface of the sea became exposed."

Again, on Nov. 30th, he says—"For the last two months we have drifted freely backwards and forwards before north-west and south-east winds; each time we have gained a more off-shore position, being gradually separated further from the shore by fresh growths of ice, which invariably follow up every ice movement. *In this manner we have been thrust out* 80 *miles to the south-west from the nearest land, and into the free space which in autumn was open water.*"

These two paragraphs again refute the necessity of Maury's tongue of ice † thrust out of the Polar basin being necessary to account for the drifts of *Fox* and *Advance*.‡ On October 18th the young "ice three weeks old was 2 feet thick," and on November 29th "crushed up pieces of ice 4 feet thick;" and I think the extracts I have given justify my opinion, that floes are formed all over the known Arctic regions after the middle of September, either by heavy falls of snow falling on sea-water at its freezing temperature, which form at first a thick ice-creamy substance, congealing into a solid mass as the temperature falls. Or by the sea itself freezing—gales of wind and other causes breaking this ice up, and piling floe over floe, till, as

* Voyage of the *Fox*. † Maury, par. 477. ‡ Voyage of the *Fox*.

De Haven says, "it all assumes the appearance of heavy ice," and he might have added, the reality. The creeks, lanes, or openings thus made are again frozen over, again broken up, and so the process goes on through the long winter, in large spaces like Baffin's Bay, which is not solidly frozen over, but is always in motion. It is also to be remembered that by November this ice is 4 feet thick, and before the temperature has fallen very low—certainly not near as low a temperature as meteorologists assign to the unknown Arctic Ocean in winter, and where I see no reason for doubting that floes are being formed in a similar manner.

I now come to the drifts of the vessels.

The *Advance* was beset September 13th off Barlow Inlet, and drifted up Wellington Channel till the 22nd, when she was off Point Manning; from then till October 4th drifted but little, the winds being light and variable. De Haven * says—"All through October and November drifted to and fro by changing winds, but never passing out of Wellington Channel; for the last week of November was stationary 5 miles south-west of Beechy Island." On the 30th November, a strong breeze from the west started them down Lancaster Sound, and except that on December 7th and 8th a heavy easterly gale set them 3 miles to the westward, their drift was towards Baffin's Bay, which they entered January 1st.

The *Fox*, as I have already stated, drifted to and fro before changing winds till November 30th; was nearly stationary till December 7th, when she started on her voyage to the south, and, as M'Clintock observes, March 1st—"Except heavy south-east gales have drifted us backwards three times, have advanced 100 miles down Davis Straits." The remainder of her drift was to the southward.

I gather from these drifts that, when the *Advance* was first beset, she drifted up Wellington Channel to Point Manning; her drift was then up and down the channel before changing winds, but gradually making southing. It is evident there was at first open water near Baillie Hamilton Island, then ice began to attach itself to the land, and was gradually added to till the narrow northern exit was blocked up, while the wide outlet of Lancaster Sound was still open. This fast ice gradually extended and formed the thin end of the wedge which by degrees pushed the drifting pack to the eastward. The heavy easterly gale of two days' duration only drifting them back three miles, prove that there was no space for a retrogade movement of the pack; and as they felt no swell from the gale, it is evident there was a large body of ice to the eastward of them, and

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* *Advance*, De Haven's Report.

which must have been formed in a similar manner to that in which they were drifting, and did not come from the Polar basin, and that the fast ice thus gains is proved by Lancaster Sound being solidly frozen over every year.*

The drift of the *Fox* was owing to similar causes; she drifted north till the fast-ice at the head of Baffin's Bay had formed, leaving no room in that direction when her southerly drift commenced; and as she also was well sheltered by ice from feeling the swell of southerly gales, it is evident that it was formed to the south of her, and could not have been drifted out of the Polar basin; and therefore the open sea at whose southern edge Maury imagines the middle ice of Baffin's Bay to be formed and drifted from, at present rests only upon theory unsupported by a particle of practical proof.

That Baffin's Bay is not, as Maury appears to imagine, one solid floe, but consists of an agglomeration of floes and fields of ice kept from permanent union by gales of wind and tidal causes, is proved by the lanes and openings seen by M'Clintock and De Haven during their winter drifts. It is a curious fact that, even 200′ from land, M'Clintock speaks with surprise of the greater movements of the ice at spring tides.

Reasoning from analogy, I infer that the Polar basin, which is of much larger extent than Baffin's Bay, must consist of similar floes always in motion where there is an outlet, and therefore I doubt the practicability of spring sledge-travelling from Spitzbergen towards the Pole, and advocate the Smith's Sound route for sledge operations; and I also believe the best prospect of a ship making progress is by keeping close to the weather shore. No Arctic voyager takes the pack if he can avoid it. The facts I have now laid before you lead me to the conclusion—

1st. That there is no practical proof of a warm under current into the Polar basin, or ameliorated climate caused by its rising to the surface.

2nd. That the migration of birds is no proof of it.

3rd. The season at which the open seas of Penny and Morton were seen only shows that local causes produce an earlier disruption of the ice there than elsewhere.

4th. That the drifts of the *Advance*, *Fox*, and *Resolute*, were quite unconnected with any movements of the ice in the Polar basin, and owing entirely to local causes.

The PRESIDENT, in thanking Captain Hamilton for his interesting com-

* Reports of Esquimaux to Inglefield and M'Clintock; also crossed by Ross's and Pullen's travelling parties.

munication, observed that this Paper contained a valuable collection of facts, brought to bear with closeness of reasoning in support of the views he adopted.

Admiral Sir EDWARD BELCHER said the expedition in which Captain Hamilton was engaged under his command was in the narrow channel leading to Melville Island. In looking at the immense expanse of unknown sea on the map, one would naturally say there must be a belt of water there, and wherever a tide flowed there must be a vacancy for the tide to flow to. Beginning with Behring's Straits, which he explored in 1826 and in 1827, Admiral Smyth, who was sitting beside him, would tell them that he never saw an iceberg passing south. Admiral Kellett would tell them the same; nor had any man ever seen an iceberg passing down to the southward. But, pushing farther north the next year, he was nine days under the lee of the icebergs aground in 20 fathoms.* With regard to the formation of floe-ice, he had made experiments which satisfied him that the floe-ice never formed at a greater ratio than half an inch a day, and it never attained a greater thickness than seven or eight feet. In the expedition to Melville Island, which surveyed up to where Captain Hamilton met Captain Richards, the whole of that, as far as was known, was open sea. The first year, when they passed up the Victoria Channel, they stopped to build a cairn at the end of Penny's Channel, and while they were detained there the ice came in and jammed them, and thus prevented the vessels going any further. But they took to the boats and passed the ice, and there the sea was open, the ice moving by tide east and west. Next year he travelled over the same ground, and although the temperature had been 62½° below zero, there were air-holes in the ice which had never been solidly frozen over during the winter. He broke into one of them, and the current was running so fast that if he had not put his arms over the theodolite legs he would have been carried under the ice. All the soundings he attempted to take at the seal-holes showed a strong current running to the westward. However, the next year, when they reached the farthest limit east on the 20th of May, the sea was perfectly open to the north, small ice flowing east and west as the tide changed, where any vessel might have navigated with ease. He was perfectly satisfied that if they had not been caught the first year by the ice they would have found their way out somewhere about Behring's Straits. Until they knew positively that there was land to the north of the lines they had surveyed, he was firmly of opinion that there was a large Arctic ocean in motion to the northward. With respect to going up by Smith Sound, if we wanted to determine how far the land trended on that line, that was the only place where it could be done by continuous land travelling; but he believed that after we got to the northward of 80° we should find that the land terminated, and that the sea travelled in a circle there, performing the same sort of gyration which was seen in the Sea of Sargasso.

Mr. FINDLAY said, with regard to the last point, namely, warm water circulating round the Arctic basin, it was well known that the water circulated to the northward along the coast of Norway; but he did not see how, with our present knowledge, the Gulf Stream could get its water into the Arctic basin. But then there was this curious fact,—how was it that the water, which was running under the same physical conditions of the rotation of the earth, should run upwards to the Pole on the eastern side of the basin and then down on

* This was determined first by soundings, next by repeated patent-log distances between it and Icy Cape. For nine days, under strong gales, it remained at 70° 40′ N. to 70° 37′ N., Icy Cape being well fixed in 70° 19′ N. The 3-fathom bars off Icy Cape would arrest any ice I saw. On the 26th August (by my official letter) I recorded—"Lat. at noon 70° 37′; bore up E.S.E., and stood along the edge of the ice. At 4 P.M. passed the last *berg*." Also, "Bergs large and scattered."

the western side? It was the case that the cold water actually ran down inside the Gulf Stream right into the Gulf of Mexico. Why it ran in that way was a problem yet to be solved.

Captain SHERARD OSBORN thought we ought to be very lenient with the Americans upon the question of Polynias, because he remembered the time when the English had Polynias of their own, and when we had recourse to one, in order to keep alive the search for Franklin. When the expedition under the late Admiral Austen came back in 1850, they proclaimed that there was an impenetrable barrier, and that it was useless to pursue the search. Happily, there was a Polar basin discovered by Captain Penny, of Aberdeen, up Wellington Channel. It was with no *arrière pensée* that he adopted that theory. He believed as honestly then that there was a Polar basin accessible in that direction as Maury believed at this moment that Smith Sound was the entrance to his Polar basin. The expedition under the command of Sir Edward Belcher, in which he took part, put an end to that hypothesis. Since then, within the last four or five years, learned Germans had conceived that the Polar basin was to be reached by pushing beyond Spitzbergen; and he was bound to say that nothing could equal the energy and the ability with which Swedes and Germans had gone to work, though it was to the honour of those who sailed in former days, that, in spite of all modern appliances, no one as yet had touched the golden spot that Captain Parry reached in 1828. So far, then, their theory of a Polar basin had broken down. To come back to Smith Sound, he agreed with Captain Hamilton that here was a region which promised the richest harvest to the geographer and the ethnologist, and where the greatest discoveries were in store for those whose fortune it might be to be sent there. Look at the Esquimaux, for instance; they were a people cut off from all human associations, living almost in a primitive state, using the weapons, tools, and appliances, of the earliest stages of the glacial period. When we dropped theorising and were prepared to take up the question of Arctic discovery quietly and earnestly, he was convinced that we should give up the search for a Polar basin as valueless, but should find much that was important and valuable to the geographers and men of science of Great Britain.

Captain HAMILTON said he never heard of real icebergs in Behring Straits, for there were no glaciers in that quarter; and with regard to Sir Edward Belcher's open sea, the portion traversed by Captain Osborn, Sir Leopold M'Clintock, Captain Richards, and himself, showed no open sea in that direction. From an elevation of three or four hundred feet nothing but ice was seen; and they might as well assume that it was an ice-bound sea to the Pole, as Sir Edward Belcher assumed it was open sea to the Pole. He agreed with Captain Sherard Osborn that the Polynia of Captain Maury was placed up Smith Sound in order to work expeditions, just as the English had formerly put a Polynia up Wellington Channel in order to work an expedition there. With regard to the formation of floe-ice, in September, 1853, in H.M.S. *Resolute*, they were in open water; a heavy north-west wind and a snow-storm came on, and at 10 o'clock at night their vessels were brought up at a freezing temperature. The snow falling into the water at the freezing temperature, formed a sludgy mass, which next day was 20 feet thick. This was the way many floes were formed; or the young ice got piled up layer after layer, and a week after the commencement of the season it had formed heavy ice. Respecting the abundance of animal life, Captain Kellett procured 320 lbs. of animal food for each man of his expedition, Captain M'Clure procured 304 lbs., Admiral Collinson, at Cambridge Bay, caught 1200 salmon at one haul, and Sir John Ross caught a great number of salmon at one haul. If animal life was a proof of a Polynia, Melville Sound was the place where it ought to be found; not up Smith Sound, where Kane was nearly starved, nor

near Wellington Channel, where Sir Edward Belcher never served out a fresh meal to his ship's company.

Sir Leopold M'Clintock said he coincided with all the observations which Captain Hamilton had put forward in his paper; he should like to say a word as to the cause of these numerous water-spaces which were sometimes called Polynias. We never met with any of these water-spaces anywhere without also finding ample cause for them, in strong currents and tides. They were solely due to the action of tides sweeping away the ice as fast as it formed. They were common all along the coast of Greenland, and were known to the Esquimaux, who found the seals more abundant in them than elsewhere. Kane found a strong tide in Smith Sound, and it was there that his Polynia was placed, and it was there an abundance of animal life was found. Penny found strong tides in Wellington Channel, and there he also reported an "abundance of animal life." Of course, the ocean was frozen over elsewhere, and these animals sought out and congregated in large numbers wherever the sea was open, and this would account for the abundance of animal life; but it should be borne in mind that these spaces were exceedingly limited. With regard to land animals, they were more abundant in Melville Island than elsewhere, although the mean annual temperature of the island was perhaps as low as in any quarter where expeditions had wintered. He fully agreed with Captain Hamilton that nothing they had seen of late years led them to believe in the existence of a milder climate to the north. On the contrary, as far as we could see, the further we went to the north the temperature was more severe.

The President congratulated the Society on the admirable discussion which had taken place; a more instructive discussion he had never listened to. Their thanks were due to Captain Hamilton, and also to Sir Edward Belcher, Captain Osborn, and other Arctic officers, for the able manner in which they had marshalled interesting facts in support of their views.

ADDITIONAL NOTICES.

(Printed by order of Council.)

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1. *Letter from* T. K. Lynch, Esq., F.R.G.S., *on* Consul Taylor's *Journey to the Source of the Euphrates.*

Dear Sir,

I have just received from Mr. John George Taylor, her Majesty's Consul at Erzeroom, the following account of the country in the immediate neighbourhood of Diadeen, and as it mentions the discovery of an active volcano, and some very peculiar sulphur springs, and enters minutely into the actual state of the country at the source of the Murad Su, or Euphrates, I have deemed the subject of sufficient interest to communicate it to the Society, particularly as the above features have not been described, as far as I am aware, by any other traveller. Texier, who travelled from Van by Ala Koë and Merec, passed too far to the eastward, and Mr. Brant, who skirted the lake from Van to Akhlat, and proceeded from that place by the Sapirs Dagh and Ardjish to Bayageed, and crossed the Ala Dagh far to the westward, over, as his account states, its highest range, where he notices the several rills which,

pouring down the northern slopes of that mountain into small basins, formed, he says, the source of the Euphrates; so that neither of these celebrated travellers, one passing to the eastward, the other to the westward, noticed the country now for the first time described by Mr. Taylor, who fortunately determined on a new path, an intermediate one, which he found extremely interesting, particularly in the immediate neighbourhood of Diadeen.

After visiting every place of interest round Lake Van, Mr. Taylor struck out an intermediate route, direct between Diadeen and Becgir Kalah, an old Armenian town, on the hills to the northern extremity of Lake Van; the road was good throughout, and the country on either side, though without trees, exhibited fine pasture and grass lands; half way to Diadeen, he came upon an active volcano, called the Soonderlik Dagh (oven mountain), not mentioned in the maps. Smoke was coming slowly out of the crater, and a rumbling noise was heard in the earth, reminding one of the portentous groans which, as is reported, preceded the great rupture of Vesuvius when Herculaneum was destroyed.

The volcanic formations about Diadeen were found to be extremely curious. The whole bed and valley of the Murad Su there is full of active sulphur geysers, too hot for the hand, some of them quiescent, and others burst up to the height of some eight or ten feet, every now and then subsiding as suddenly as they burst forth. At one place close to Diadeen, and to these sulphur springs, the Murad Su flows through a natural tunnel, at the top of which were seven or eight sulphur springs, which, as they overflow and run down the slope into the Murad Su on the south side, form sulphuric and saline deposits, which have become misshapen soft rocks, easily cut with a knife. Close to these rocks other springs of hot water form beautiful stalactites and petrifactions in all kinds of colour and form. The stench and steam, however, at this point are most disagreeable, formed by the boiling sulphurous stream flowing down the sides and mixing with the cool clear water of the Murad Su fifty feet below. The main sulphur source was originally lower down the stream and in the plain, but the severe earthquake we had at Erzeroom three years ago effected a perfect change, the latter source having dried up, and those above mentioned having taken its place, and consequently the formations formed by these springs, which bulge out in irregular masses down to the river, date only from that period.

Passing through the tunnel, the river occupies the centre of a deep basalt gorge, with steep perpendicular sides, composed of irregular blocks of that stone from the mountains of the Ala Dagh. The gorge looks like an artificial ditch, purposely constructed to defend the small plain of Diadeen.

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2. *Notes on the Burmese Route from Assam to the Hookoong Valley.*

By Henry Lionel Jenkins, Esq.

(Communicated by F. A. Goodenough, Esq., F.R.G.S.)*

Wishing to satisfy myself as to the practicability of opening out the old

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* Extract from Mr. Goodenough's letter:—"Calcutta, 9th February, 1869. Dear Sir,—My friend, Mr. Henry Lionel Jenkins, has recently accomplished a trip to the top of the Patkoi range, which divides Upper Assam from Upper Burmah. Mr. Jenkins performed the journey in the hope of the sanction of the local Government here being granted to an exploration of the country between Assam and China, and in the general interests of science. The Patkoi range is very little known, but few explorers having ever surmounted its height; amongst whom I may mention Mr. Griffiths, in 1837, who went from Suddya to Bhamo and

Burmese * route from Assam into Upper Burmah, I started on the 15th of last month from Makoom, the last outpost in that direction, and travelled along the old path as far as Lake Nonyang, on the south side of the Patkoi range. The following notes of the trip may perhaps prove interesting to persons connected with Assam :—

December 15*th*.—Started from Makoom in the morning. There is no road eastwards or southwards beyond this point, except the natural bed of the Dehing River. It is necessary to cross the river at every bend: this is not difficult at this time of the year; there is not more than two or three feet of water at the outside. Encamped at night at the mouth of the Terap River.

16*th*.—Continued to travel up the bed of the Dehing, and camped at night at a small Singfoo village a short distance below the Kerrimpanee, an affluent of the No Dehing River.

17*th*.—Reached the new Beesa of the maps. Bunka, the most influential chief of the Assam Singfoos, lives here. He accompanied me across the Patkoi.

18*th*.—Camped at night at the mouth of the Dionpanee, another affluent of the No Dehing.

19*th*.—Continued up the Dehing, and camped at night at the mouth of the Namchik River.

20*th*.—Above the confluence of the Dehing and Namchik rivers the main river is called the Namroop. This day we travelled up the Namroop, and camped a little below Sonkaph Purbut.

21*st*.—Continued up the Namroop, which here runs through a narrow gorge between Sonkaph Boom † and Miting Koo; camped at night at the mouth of a small stream called Namgoi.

22*nd*.—As I found much time was lost in dragging my two small canoes over the rapids, I resolved to leave them behind; and, loading my baggage on my elephants, marched up the stream of the Namroop till I reached the Namphook village, which consists of eight Singfoo houses.

23*rd*.—As this was the last village I should see, it was necessary to lay in a stock of provisions. This day was spent in bargaining for rice, and in arranging with the able-bodied men of the village to accompany me as guides. I had some difficulty in arranging with these men. It was necessary that they should consent to act as porters, if required, and Singfoos have a particular objection to carrying loads for other persons.

24*th*.—Started from Namphook village, course due south, across the Namroop, over some hilly land, covered with forest, two hundred feet higher than the bed of the river. After a two hours' walk we came again on to the Namroop, and waded up its stream till the evening, leaving the bed of the stream now and then at the bends of the river, in order to keep as straight a course as possible.

Both banks of the river were covered with a forest of immense timber-trees, and underneath the larger trees was a rank growth of jungle, through

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Ava; Captains Hannay and Burnett; whilst Lieut. Wilcox (1827) went due east from Suddya, or nearly so, and thus never touched the Patkoi range at all. I do not remember ever having heard of the Nonyang Lake before. I do not think that previous explorers speak of it; but perhaps the records of the Society can give information on this point. You will observe that Mr. Jenkin's route was far to the east of that pursued by Mr. Griffiths (1837). There is another pass to be found by following the course of the Namchik River, and there are others farther to the west and south-west, by one of which the Burmese army crossed in 1820, as marked in my map deposited with the Society by Sir Andrew Waugh."

* See Wilcox's survey map.

† In Singfoo, Boom is a mountain; Koo, a hill.

which we could not have made our way except for the tracks of wild elephants. Along these tracks, when it was necessary to leave the bed of the river, we could walk very well, and with a little cutting of the creeping and climbing plants, the ponies could be made to follow, but the tracks were neither high enough nor broad enough to admit of elephants with their loads passing along them, so I sent back my elephants to the village, taking on as little baggage as possible, partly carried by the Singfoos and partly by the ponies. The Namroop was for the most part shallow, but occasionally we came on very deep pools of very clear water. The quantity of fish * in these pools is astonishing. The Singfoos speared a great number during the day time.

Camped at night on the banks of the Namroop.

25*th*.—Continued our march up the Namroop much in the same manner as on the previous day, striking occasionally into the jungle to avoid going out of our course, which was still south, until we reached the mouth of a small stream called Nambong, when we left the Namroop, and waded up the Nambong to the mouth of a still smaller stream. Up this latter stream, the Nunkee, we travelled till evening, and encamped on its banks.

The country, during the early part of the day, was undulating, and gradually became hilly. The principal rock was a soft blue slate; occasionally a thin stratum of sandstone appeared. The strata were faulty, and in some places very much tumbled.

26*th*.—Continued to walk up the Nunkee with slow uncertain steps, for the bed of this stream is composed of large round slippery boulders. After travelling about an hour up the stream we left it, and commenced the ascent of the Patkoi by a narrow and not very well marked path. The ascent was not steep: the ponies had no difficulty, except when we came to a fallen tree or some other obstruction caused by the living jungle. The path was very nearly straight; there was hardly any attempt to lessen its steepness by altering the direction. As we ascended, the forest trees seemed to improve in size, and the undergrowth of jungle to be less thick. Of the timber trees common to Assam I particularly noticed the Saw† and the Mekahi. These trees average at least twelve feet in girth; the latter, a noble tree, grows to the height of sixty to seventy feet without a branch. On the summit I found a good deep soil covered with bamboos, canes, and forest trees growing luxuriantly, but not so rankly as in the plains below. Many of the plants and trees were common to the plains; others were new to me, particularly a cane bearing an edible fruit, which I do not recollect having seen before. I found the tea-plant abundant on both sides, but more plentiful on the southern than on the northern slope. The Singfoos gathered the leaves, and commenced to prepare tea after their own fashion. They told me that tea was to be found in the jungle near any spot where there had formerly been a Shan or Singfoo settlement. As far as I could see, there is a dip in the Patkoi range at this point, and it is to be supposed that the Burmese would not have selected this for their main route to Assam unless it had possessed considerable advantages over every other path. The present path rises probably from 2500 to 3000 feet, but to cross the range with a road it would certainly not be necessary to rise more than 2000 feet.

On the Assam side I could see little but the tops of the hills below me, on account of a heavy fog; but southward the air was clear, and I had a very fine view of the country. The most striking object on the Burmah side is a large open plain, dotted with a few trees, some eighteen or twenty miles long, by seven or eight broad. At the western end of this plain, and almost imme-

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* If this route is opened out, the immense quantity of fish in all these rivers may prove of economical importance. The most numerous are *Cyprinus lyocheilus*, *Barbus macrocephalus*, and *Barbus hexagonolepis*.

† *Artocarpus Chaplasha*.

diately beneath the Patkoi, is an open sheet of water, perhaps three miles long, and exceeding a mile in breadth, called Nongyang * by the Singfoos. The lake stretches nearly from east to west. It contains a triangular-shaped island near its south-east extremity, where its waters are drained off by a small stream called Loglai, which running southwards, falls into the Sooroong, and this latter river falls into the Denai, or Kyendwen of the maps.

The Kyendwen, it is well known, falls into the Irrawaddy, or Milee, as the Singfoos call the great river below Ava.

After examining this lake, and satisfying myself that its waters did run southwards through the Loglai, I returned to the top of the Patkoi and encamped there. I was anxious, if possible, to get a view of the Assam side, so as to gain some idea of the best line of road to Makoom. The nearest of the Hookoong villages are on the banks of the Sooroong, lying under a hill called Gadak, which was pointed out to me, and which appeared to be about twenty-five miles south of Nongyang as the crow flies. In the evening two Singfoos came into our camp from these Sooroong villages, and I learnt with surprise that they had slept two nights on the road since they left their homes. They had travelled up the bed of the Sooroong, and then up the Loglai. The devious course of these streams, and the difficulty of wading over shingles and boulders, must account for the slow progress made.

The villages on the Sooroong, they informed me, did not number more than fifteen houses, and that very little rice would be procurable. From their villages to the Denai is a two days' march through forest. They described the country on each bank of the Denai as well cultivated and thickly populated. From the Patkoi to the Denai the path did not lie over any steep hills.

The Singfoos who accompanied me had only agreed to take me as far as Nongyang, and I failed to induce them to go farther south with me. It was their busiest time of the year. The only crop they grow was being reaped, and they could not afford to lose any more time in securing it.

It will be seen that the only difficulties to be encountered on the road between Assam and Hookoong are caused by the denseness of the jungle. The intervening country is a wilderness, consisting of a forest of many useful timber trees of immense size. Below the larger trees is a tangled mass of smaller plants, most of them climbers, twisting about the larger trees, and wrestling with each other in an intense struggle for life. The only paths by which man can move are the natural beds of rivers or mountain streams. It would be impossible to leave these channels except for the tracks made in the jungle by herds of wild elephants. Progress along such paths is very slow, and the distance to be travelled very much increased, owing to the necessity of often following the windings of the streams.

The Burmese Government in former days took care that there should be a village, or rather a military settlement, every twelve or fifteen miles along the route; and it was the business of the people living at these stations to cut the jungles occasionally, and to remove fallen trees and other obstructions from the path. The route has now fallen almost entirely into disuse, on account of the posts having been one by one deserted. Since August last only three trading parties have come this way from Hookoong into Assam.

Traders now usually travel by a more circuitous and very difficult path through the Naga hills, passing from one Naga village to another so as to obtain supplies. It is to be wondered at that the Namroop route should be used at all by traders, considering that each man must carry fifteen pounds weight of rice for his own consumption on the journey, besides his load of

* *Nong*, a lake; *Yong*, the name of Shan chief, who held this post for the Burmese.

goods: but the Moolook Singfoos and Dooaniahs * are not hill-men, and, to avoid climbing the steep scarps which the Patkoi presents at every other point, they form depôts of provisions along this route, much in the same manner that the later Arctic explorers have adopted in their expeditions on the ice. They carry forward rice, and bury it at convenient intervals along the road, and then return for their loads. What is wanted is about ninety miles of road from Makoom to Kyendwen. There is a sufficient amount of Naga and Dooniah labour to be obtained in the neighbourhood for the construction of an ordinary "cutcha" road, and the cost of it would not exceed one thousand rupees per mile. Such a road would enable the trader from Hookoong to reach Makoom in one-third the number of marches that the journey now occupies, and it would render an examination of the country easy, and thus pave the way for a more scientifically constructed road or a railway.

On my return I fell in with a party of eight men returning to Hookoong. They had brought over amber ornaments and ivory for sale. Two of the party were taking back about thirty yards each of the poorest description of calico, † and another had some sulphur. The rest had invested in opium.

These men assured me that there was more than one well-used trade-route through Moonkoong, and through the Lepahee Singfoo country to Tali and other places in Western China. The question of opening up China to India is of so great importance that it is not likely to be lost sight of now that it has once attracted attention, but the magnitude of this subject should not make us pass over the value of improving the communication between the Brahmaputra and the Kyendwen. The great want of Assam is population to cultivate the soil. We can obtain labourers from Bengal, but we have also to a great extent to import their food, and this in a notoriously fertile country.‡ That Bengalees have not settled to any extent in the province is, no doubt, a good deal owing to the illiberal policy of Government with respect to the selling or leasing of waste lands; but it is also in part owing to the fact that the climate does not suit most Bengalees on their first arrival in the province. If Assam is to be re-populated, it will be from the East. That the existing population has been mainly derived from this quarter is shown by the language, customs, and physical appearance of the people. At the present time the Phakial, Dooaniah, and Singfoo population is increased annually to a small extent by the influx of emigrants from Hookoong and the Shan States. That people do not come in greater numbers is, I believe, entirely owing to the hardships that persons reared in a cultivated country and unaccustomed to the jungles must encounter on the road. It is said that numbers of persons who leave Hookoong for Assam never arrive here. They lose the path, and, wandering about in the jungles, starve to death, or are killed by wild animals.

I do not know what difficulties there would be in obtaining a right of way from the Burmese Government, but through considerably more than half the distance the road would lie in British territory, and the opening up of a road only as far as the watershed of the Patkoi would prove of no small value to the province.

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* The Dooaniahs are the descendants of Assamese, who were taken into slavery by the Singfoos and Burmese, and Phakials.

† I am not sure about the name of this cloth. It is composed chiefly of starch, with a small portion of cotton to give toughness to the fabric. It is never seen in any civilised place; but the Manchester manufacturers know well how to suit savage customers, who must have cheap clothing and do not wash their clothes.

‡ The ground is cropped year after year, and no manure is used, yet the yield is on the average about 45 cwt. of paddy to the acre.

3. *Notes to the 'Journey from Ningpo to Shanghai.'* By Christopher T. Gardner, Esq., F.R.G.S.

Note I.—On Cotton Cultivation in China.

Perhaps a few remarks with regard to cotton cultivation in China, and the Che-kiang province particularly, may be of interest. Before the American war had made raw cotton a desideratum in Europe, and before our last treaty with China, entailing a rapidly increasing demand for cotton fabrics, the raw material was not much cultivated in China, and it even formed an article of import. The American war, however, raising as it did the price, made the cultivation of cotton a most lucrative species of agriculture in China, more especially in the northern provinces, where the crop, by its long staple, is most suitable to our English machinery. Large crops there, and in the central provinces of the sea-border, created a demand for it in the western provinces, which are more suitable for other cultivation. In Che-kiang especially, land utterly devastated and laid waste by the rebellion has been devoted to the growth of cotton until last year, when, though all calculations must partake more of rough guesses than of reliable estimates, I should imagine there were over 100,000 acres planted with cotton, yielding a crop of about 25,000,000 lbs. In 1866 the Cotton Supply Association sent about 1 cwt. of Egyptian cotton-seed to be planted in this province as an experiment. Unfortunately it was a complete failure, and for many reasons:—1st. The quantity of seed was not sufficient for a fair experiment. 2nd. It arrived in a very bad condition. 3rd. The climate of Egypt does not in the least resemble that of the province of Che-kiang. What I would suggest is that the trial should be made on a much larger scale with New Orleans seed, carefully packed, and that the mode of cultivation in use at New Orleans should be likewise imparted. Land in this province is principally cultivated by small proprietors, and is generally hereditary property, held in trust for the benefit of all the members by the head of the family. Chinese law puts every obstacle in the way of the alienation of land from hereditary owners, and, as primogeniture is not in vogue here, every Chinaman has a plot of ground, or rather share in a plot, belonging to his family or clan. The few large landed proprietors in the province do not farm their own ground, but sub-let it in very small lots. Hired agricultural labourers are very few, since the members of a family all work together on land in which they have a common interest, communism of property in Chinese families being carried to an extent wholly unheard of, I believe, in any other nation of the world; when, however, labourers are hired, they receive ordinarily the following wages:—By the day, 1*s.* 3*d.*; by the month, 25*s.* This, of course, refers to strong-bodied men for ploughing, &c., and even they have to buy their own food. In the cultivation of cotton, hired labour is almost unknown; the watching the crop, the picking the cotton, &c., being performed in nearly every instance by the female portion of the owner's family, while the men are engaged in the more disagreeable and laborious work of the paddy fields.

With regard to the quantity of labour available in this province, it is unlimited. The Chinese, though a contented and happy people, among whom pauperism is an unknown thing, live in unhealthy huts, and feed most sparingly. The reason of this being that, in spite of the natural industry of the people, this province is over-populated, and there is not work enough for them to do. The annual rent of land, including Government land-tax, is about 4*l.* an acre. A very slight injury is done to cotton by a sort of locust or cotton fly, and none, I believe, by worms. As far as I know, the only way that the injury done to cotton by locusts is attempted to be obviated in this province, is by keeping a child in the cotton-fields to drive the insects away in June, this being the only

time when their ravages are of importance. After June the cotton-fly either disappears or finds the cotton-plant unsuited to its palate. Other causes of injury to the cotton crops are the overflowing of the river and consequent swamping of the low-lying fields. (It is not, according to the Chinese, the salt, so much as the moisture, that spoils the crops.) Strong winds, at the time of the flowering of the cotton, occasionally make great havoc; and lastly, heavy rains, which fill and rot the cotton. These climatic influences are provided against by a reference to the almanack and the choice of a time for sowing the seed, so that the plant may be in such condition at the time of their occurrence as to receive as little injury as possible. Many of the weather prophecies of the Chinese almanacks are as unreliable as those of Zadkiel, &c.; but recorded observations of many centuries of weather, and the Chinese system of lunar months instead of solar (the moon affecting, as it does, the tide and weather more than the sun) gives the Chinese prophecies, with regard to rain, &c., far greater correctness than such prophecies possess elsewhere. In the beginning of May, the cotton cultivator, having consulted the almanack as above explained, and taken the advice of a fortune-teller as to a lucky day and one likely to appreciate *fêng shui* (influences of geomancy), sows the cotton-seed. In five days the seed sprouts. In the end of May the cultivator covers his field with a manure of wood-ash. In August the plant flowers, and it is ready to be gathered in September or October, after which the ground is refreshed by having beans planted on it. Cotton is never grown on the same fields as rice. Hemp, corn, and the egg-plant, are used to alternate cotton crops, though cotton is often grown several years successively on the same land. The best cotton in this province grows on the low plains, and is manured by what the Chinese call "vegetable cake," that is, decayed plants pressed into a cake about 6 feet in circumference and 4 inches thick, the addition of a little oil giving the cohesion necessary for its convenient transportation. The Chinese idea is that one man can work about an acre of cotton. The cotton grown in this province is chiefly for export to the western provinces, and is shipped unpressed in spite of the heavy expenses of freight, since the primitive nature of the Chinese machinery renders it difficult for the natives to work pressed cotton. Besides the cotton exported, a large amount is used for local consumption.

Note II.—Translation of the Chinese 'Government Gazetteer' with regard to the Origin of Chê Kiang Sea-barrier.

Various dynasties have been engaged in constructing the sea-barrier at Chien tang, Yen lio and Ning hai, in the prefecture of Hang-chow. According to the Ti li chie geography book, published in the time of the Tang dynasty, a salt commissioner put up the road on the top of the sea-barrier for 224 li. It was the first year of Kai Yuan that it was again made. (N.B. The Liang che yin fu, which states, with regard to the expression "again made," that it is evident the work was not begun in the first year of Kai Yuan: when the work was begun there are no means of discovering.) According to the Liu lin records, a book of the Hsien Shun reign, the Hang-chow people for a long time suffered from the river being affected with the sea-tides, when, at the time Pai lo tien was sub-prefect, two or three Wên chang were written and presented with prayers to the spirits of the river, setting forth that human force was of no avail. That previously to this, in the time of the Chang dynasty, in the eighth moon of the fourth year of Kai ping, Ch'ien Prince of Wu-so, was the person who first built the river-wall outside the ancient Hou Ch'as and present Lung Chiang gate (of Hang-chow), as, the tide beating up by night and day, the (previous) wooden breakwater had proved of no avail, so he ordered several hundred men with powerful catapults to shoot at the head of the tide; meanwhile he earnestly prayed at the Hsu-shan-szu, and wrote a

poem, which he closed and sealed, and placed in the Hai-mun-shan (Sea-gate-hill); that after this the tide retreated from Chien tang and went last to Szu-ling. He immediately made a bamboo frame-work, which he filled with large stones, and planted therein great trees, which thus made an efficient sea-wall. After some time had elapsed, the city of Hang-chow was built. Chu-lo, which is the same as the present Ping-lo, was at that time part of the river. The 'Ho chū chi' (record of rivers and creeks), a book of the Sung dynasty, states that the Chi River joined the sea, and daily received two sea-tides; but that in the time of Kai-ping, of the Liang dynasty, Chien Prince Wu-so commenced to prevent the encroachment of the sea by making a sea-barrier outside the Hou chao mên of Hang-chow. The barrier and bank being solid, the people dwelling there were at ease. At the time of Ya Chiung, of the Sung dynasty, in the fifth year of Chiang-fu, the Hang-chow people reported that the tide of the river Chi had broken down and destroyed the west and north barriers, and the flood was but very little way from the city. The people were in a fright, so officers were appointed, namely, Chieh Lun, sub-prefect of Hang-chow, and Chen-Ya, salt commissioners, to devise means of protecting the bank. Chieh Lun and the others took soldiers and felled timber in order to protect the bank from the breakers. In the seventh year (of Chiang-fu), Chieh Lun, &c., departed, and in their place were sent the salt commissioners Le Po and the palace officer (eunuch) Lo Show Ch'ing, who, considering that the thing was not as it ought to be, requested that the ancient plan of *Ch'ien* might be resorted to, viz., of piling and filling in bamboo framework with stones. In order that the barrier might be solid, stakes were piled, the barrier was increased, and made for 7 li, at which there were several myriad workmen required for the collection of the materials. Next year the work was finished, and was perpendicular from ridge to base, in order to stop the force of the tide so that not even the bores, which are several tens of feet high, could do any injury. At the time of Chiung yū it is stated that the stone bank of the Chih River, not having been repaired for a long time (got out of repair), and people feared they would be drowned. Chang hsia, Assistant Secretary of the Board of Works, was accordingly deputed to look after the affair; he ordered the military officers and soldiers who were stationed about the river to collect stones and material for mending the barrier. Wherever it was broken there he mended, so all the people were in security. For this the men of the neighbourhood erected a shrine to him, and the Emperor also rewarded his merit, and bestowed upon him the posthumous title of Ning Chiang how (Earl of Ningpo River).

According to the 'Yū hsien ching chuan' (Life of Yū hsien ching), a book of the Sung dynasty, while Yū hsien ching was Counsellor to the Emperor, and one of the tutors in the Imperial Palace was Prefect of Hang-chow, a mighty storm arose, and the tide of the river broke the barrier; he sent a multitude of troops to dig in the western hills, and made a bank of several tens of li in length, so that the people were at ease. The 'Wâng li Hâng Chow foo chieh' (the records of Hang-chow, published in the time of Wan-li) states that, in the third year of Ching yuan, an Imperial edict was issued highly praising Yû hsien chiang, &c.

..—Table of Observations for Heights in the Peninsula of Sinai. By the Rev. F. W. Holland, F.R.G.S.

Date, &c.	Place.	Aneroids. No. 104. Index Error 0·071−	Aneroids. Private H. Index Error 0·365+	Boiling Water.	Temp. Fahr.	Result of Observations. Aneroids. No. 104.	Aneroids. Private H.	B. P.	Mean of Observations.
1867.					°				
Nov. 1 at 1 P.M. ..	J. Catharine	21·925	21·675	196·5	62	8939	8702	9010	8665
,, 2 ,, 11.10 A.M.	J. ed Deir	23·475	23·125	199·25	58	6874	6811	7294	7068
,, 3 ,, 3 P.M. ..	J. Mûsa	22·95	..	199·0	52	7466	..	7360	7413
,, 7 ,, noon ..	Head of W. Sebaiyeh	24·45	24·05	..	71½	5908	5866	..	5887
,, 8 ,, 11 A.M.	J. Umm Shaumer	22 30	21·925	197·5	57	8362	8286	8319	8321
,, 13 ,, 11.30 A.M.	J. eth Thebt	22·675	22·375	198·0	59	7917	7748	8048	7940
,, 16 ,, 11 A.M. ..	J. Abu Mas'ûd	23·45	23·20	199·5	62	6994	6771	7201	7041
,, 22 ,, 3 P.M. ..	J. Sena	23·85	23·525	201·0	65	6981	7772	6359	6867
,, — ,, 4 P.M. ..	J. Allojah	23·625	23·350	200·5	65	6825	6632	6654	6691
,, 27 ,, 1.30 P.M.	J. Umm Alowee	23·45	23·25	200·0	66	7051	7439	6962	7103
Dec. 1 ,, 11 A.M. ..	Pass at head of W. Sigillyeh	25·05	24·70	..	50?	4975	4930	..	4952
,, 1 ,, noon ..	J. Serbal, E. peak	23·60	23·325	..	55?	6690	6525	..	6607
,, 14 ,, 10.30 A.M.	J. Um Zayreg	27·10	26·55	..	60	2848	2972	..	2910
,, 19 ,, 11.45 A.M.	J. Sahara	25·75	25·45	204·25	67	4362	4217	5039	4664
,, 29 ,, 4 P.M. ..	J. Zib eb Baheir	25·75	25·50	..	40?	4120	3926	..	4023
1868.									
Jan. 18 ,, 2 P.M. ..	Top of Nukb Huthera	27·25	26·80	..	65?	2722	2737	..	2729
,, 20 ,, 8.45 A.M.	Ain es Suflah	29·30	28·80	..	44½	637	6921	..	6646
,, 21 ,, 9.15 A.M.	Ain el Alya	27·85	27·40	..	32	1958	1973	..	1965
,, 23 ,, 8.45 A.M.	Ain el Akhdar	26·15	25·80	..	50?	3779	3715	..	3747
,, 24 ,, noon ..	J. Odjmeh, centre peak ..	24·90	24·65	..	50	5380	5166	..	5273
,, — ,, 1 P.M. ..	,, S. peak	24·80	24·55	..	50	5258	5052	..	5155
,, 27 ,, 2.15 P.M.	J. Tinia	22·90	22·70	198·3	58	7622	7333	7875	7676
Feb. 4 ,, 3.30 P.M.	J. Serbal, centre	23·60	23·40	..	39	6467	6222	..	6344

Computed and Tabulated by Staff-Commander C. George, R.N.

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