THE

TRANSACTIONS

OF THE

BOMBAY GEOGRAPHICAL SOCIETY.

FROM MAY 1857 TO MAY 1858.

(NEW ISSUE.)

EDITED BY THE SECRETARY.

VOLUME XIV.

BOMBAY:
SMITH, TAYLOR & CO.

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PREFACE.

The publication of the Transactions of the Geographical Society has of late year fallen into someting like confusion, for which some explanation is requisite, by the late Secretary and Editor.

A large portion of the sheets, of No. XII. the number last issued had passed through the press in 1856, when I found myself unexpectedly compelled to visit England. I was absent from January to October 1857, when it seemed so desirable to expedite publication as much as possible, that "the reports of the proceedings" usually forming a section by themselves preceding the papers, was omitted. The present issue in consequence embraces the proceedings of two years and the papers of another,—occasioning an apparent confusion—the cause and the nature of which requires to be explained.

Having changed our printer we found we had committed ourselves to an establishment which could not boast of either celerity or correctness, and the want of the latter the reader will readily comprehend as to the former, it is sufficient to say that close on two years have been occupied in passing 140 pages through the press.

Neither of these annoyances will, it is hoped, require a second time to be apologised for.

Though no longer Secretary to the Society I have been premitted to continue my editorial duties till the publication of the present number was completed, the preparation of which I commenced; and have now to take a final, respectful, and affectionate leave of those who have for sixteen years been the most indulgent of constituents.

GEO. BUIST.

Bombay, 4th August 1859.

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PROCEEDINGS

OF THE

BOMBAY GEOGRAPHICAL SOCIETY.

1856-57.

The Ordinary Monthly Meeting of the Bombay Geographical Society took place in their rooms on Thursday, August 15, 1855.

PRESENTS—No. XII. of the Bombay Government Records, new series, containing miscellaneous information connected with the Mahee Kanta. Presented by Government.

2. No. XIII. Do. Do. History of Sind ; Do. Do.

3. Memoir of the Province of Bagdad, by Commander Jones, I.N. Presented by Government.

4. No. XIV. of the Bombay Government Records, new series, containing information relative to the Physical character of the Nerbudda. Presented by Government.

5. Report of the Grant Medical College for the Session of 1854-55.

6. 24th Volume of the Journal of the Royal Geographical Society.

7. A Collection of Journals of the Bengal Asiatic Society.

8. Administration of Civil Justice in British India, by Col. Sykes, F.R S. Presented by the Author.

The following letters were laid on the table:—

LETTERS.—No. 2263, 2426, 2969, and 3359 ; from Secy. H. L. Anderson, Esq. ; from C. E. F. Erskine, Esq.; from the Secy. Royal Geographical Society, London; from John Peet, Esq., Acting Principal, Grant Medical College; from D. F. McLeod, Esq.; from Messrs. Nicol and Co.

The first subject brought before the meeting was the result of an experiment in evaporation, which seemed at one time interesting and mysterious. The evaporation from the surface of water exposed to the breeze, but shaded from the sun, was in Bombay about a quarter of an inch daily during the dry weather; the absolute amount of evaporation could hardly be ascertained while the quantity of water contained in any ordinary sized evaporating dish became so heated in the sun, beyond any mass with which nature presented

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us, as to show an excess, while that in the shade exhibited a defect actual quantity, but was of the two the much more exact mode of rimenting. It became matter of much interest, to know the rate at the drying of the soil diminished during the fair season as the mo receded from the surface; and with a view of determining this, a cylind tin, three feet in length, and five inches in diameter, fitted up w glass guage tube at the side, was resorted to. This was filled up wi ascertained weight of carefully dried red earth, and into this poured as much water as filled the vessel and tube to the brim amount being carefully measured and noted. As evaporation proce a regular series of tides made their appearance within the tube, the reaching its highest about three o'clock, then descending till seven morning, rising again at three, and so repeating the fluctuation, which cended about an inch and descended about an inch and a half daily. experiment was originally made in 1849, and noticed in the *Athen* at the time. It seemed so mysterious, that it was this season repe with the greatest possible care for a period of two months, and being endlessly diversified, it appeared that the cylinder with its e and water, after all only constituted a very clumsy thermometer, earth open as it was, being sufficiently obstructive to cause the fluctuations by expansion and contraction to be observed in the tube. It would have been very unphilosophical to abandon the enquiry so long as a mystery seemed to attach to it, or it promised to be productive of any result of value, and it was persevered in accordingly. The case was one of many constantly encountered, in which weeks or months of anxious labour and investigation were expended without fruits. Publication of details in this experiment became superfluous, as they were simply the records of so much work thrown away, and we appear as yet without any means of ascertaining the fact originally desired to be enquired into.

On Globe or Ball Lightning.—*By the Secretary.*—See last Transactions, No. xiii p. 148.

On the Movement of the Clouds in the Upper and Lower Regions of the Air.

Dr. Buist stated that he bad been for some time engaged in investigating this subject, and had at the present juncture brought it under consideration in consequence of the publication in the "Edinburgh New Philosophical Journal," of an account by Mr. Thomas Stevenson, of a contrivance similar to one which he had laid before the Bombay Society in 1852, and which he had been in the habit of using ever since for determining the fact. Both Mr. Stevenson's instrument and his own, consisted of a piece of mirror, placed so as to reflect the clouds near the zenith. In Mr. Stevenson's contrivance the glass was ruled into compass points, and regulated by a needle; in the other it was simply divided into squares and placed in the meridian by compass. A very convenient addition was to have a second mirror placed over the first, so as to throw the reflection of the clouds in the direction of where the observer

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usually sat, and to furnish him at any time with the means of examining them. Mr. Stevenson's assumption that this instrument might be made a substitute for the common vane, or used for the purpose of predicting when the wind would change, seemed altogether unwarranted, though it might be valuable as an addition to our stock of Moteorological instruments. It seemed likely that in no case where two or more strata of clouds were visible at different elevations, would they be found to move in the same direction, when the intervals between them were considerable, and yet it by no means followed that the winds in the upper regions ever descended towards the surface. The most experienced Aeronauts had observed, that in the north of Europe the current of air was at the elevation of ten thousand feet invariably from some point betwixt North and West, whatever might be its direction at the surface. Nearly the whole of last year,—and the case might probably be the same every year were it observed—the upper clouds at Bombay during the north-west monsoon had drifted from south-west. It was the lower clouds only which followed the direction of the land and sea breezes, the drift even of these often continuing in the direction of the latter, which was the predominating wind, even when the former was blowing. In January 1853 the balloon set off from Byculla only followed the direction of the sea breeze to the altitude of 500 feet, when it ascended vertically for about a mile, and then pursued a path almost the opposite of that it had originally taken; and the conclusion then drawn was, that probably at all seasons of the year there was a strong upper current from the south-west, whatever might be the direction of the breeze on the surface. Dr. Buist then went on to explain the doctrine of vertical currents, now being universally accepted as throwing light upon these matters, expressing his regret that so little attention should be bestowed on this division of the subject by Meteorologists in India, who seemed to rest satisfied with following out the instructions sent to them from Europe. It was impossible for the philosophers who prepared these instructions, and whose experiences were confined to the cold and cloudy climate of the North of Europe, to know the points to which attention ought specially to be directed in those torrid regions which furnish the true field of Meteorological enquiry, and where observers on the spot must work out these matters for themselves. Were vessels proposing to make a voyage from Bombay to Kurrachee in December, observing the cloud drift from the south-westward, to wait according to Mr. Stevenson's views till the upper current descended to the surface, they must remain in harbour till the month of June, when they would probably find more wind than they wanted.

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The Ordinary Monthly Meeting of the Bombay Geographical Society was held on Thursday the 20th September,—Admiral Sir Henry Leeke, President, in the Chair.

PRESENT.

Lady Jackson; Lady and Miss Leeke; Mesdames Malet, Young, Leith, Jenkins, Hale, Haines, Spring, Edwards, Scovell; Misses Edwards; Sir C. Jackson; Hon'ble Mr. Malet; C. J. Erskine, Esq, C.S.; J. M. Erskine, Esq, C. S.; Col. LeG. Jacob; Brigadier Hale; Colonel Grant; Dr Don; Dr. Edwards; Rev. Dr. Wilson; Dr. Coles; Dr. Peet; H. L. Anderson, Esq. C. S.; H. Young, Esq., C. S.; Captain Russell; Captain MacGregor; F. Hutchinson, Esq.; W. F. Hunter, Esq; Rev. Messrs. P. Anderson, F. J. Spring, and T. G. Clark; Mr. Scovell; Mr. Clerk, I. N.; A. Robertson, Esq.; J. Robertson, Esq. C. S.; J. Stuart, Esq.; Professor Sinclair; Mr. Boswell; Mr. Peyton; Mr. Firth; Dr. Impey; J. F. Hutchinson, T. L. Jenkins, Wolterton, Cursetjee Jamsetjee, Juggonath Sunkersett, Venayekrow Juggonathjee, Narrayen Dinanathjee, Dhunjeebhoy Framjee, Govindjee Narrayen, Bhow Dajee, Narayen Dajee, Kaikesro Hormusjee, and Dosabhoy Framjee, Esquires.

The following Letters and Papers were laid on the Table:—

LETTERS.

From the Hon'ble the Colonial Secretary of Colombo.

From H. L. Anderson, Esquire, Secretary to Government.

From the Secretary to the Royal Geographical Society, London.

From Dhunjeebhoy Framjee, Esqaire.

PRESENTS MADE TO THE LIBRARY BY GOVERNMENT.

1. Bombay Government Records, New Series, No. XV., containing Miscellaneous Information on the Province of Kutch.

2. Captain Wingate's Report on the Badamee and Bagulkote Talookas, Belgaum.

3. Do. Do. on Survey and Assessment for Rutnagherry.

4. Do. Do. Do. for Khandeish.

5. Do. Survey Report on certain Talookas in the Dharwar Collectorate, also Extract from Mr. C. J. Manson's Report on the History of Khickodee District, Belgaum.

6. Lieutenant Colonel Walker Scott's Report on the Management of Canals and Forests in Sinde.

7. Lieutenant Chapman's Report on proposed Canal and Railway in Sinde.

8. Reports by Lieutenants Webster, Lester, and Dickson on the Districts lately resumed from Meer Alli Morad, in Sinde.

9. Inam Commissioner's Report on a claim to the village of Modugay in Belgaum.

10. Mr. C. E. F. Tytler's Report on the Kownaee Talooka, Nassick.

11. Lieutenant P. M. Melvill's Reports on portion of Ahmedabad Col-

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lectorate, also Captain J. Cruickshank's Report on the portions of the Dus-croee Purgunna, Ahmedabad and Kaira Collectorates.

12. Captain J. Cruickshank's Report on certain Pergunnas in the Ahmedabad and Kaira Collectorates.

13. Lieutenant J. T. Jameson's Report on the District of Sahitee.

14. Mr. R. N. Goodine's Report on the Deccan Village Communities.

15. Deaths of Bombay during 1851, by Dr. Leith.

16. The Journal of the Indian Archipelago Vols. VIII. and IX.

17. A Grammar of the Huzvarash, or Proper Pelvi Language, by Dunjeebhoy Framjee, Esq. By the Author.

Mr. Scovell and Mr. A. Robertson were proposed for ballot at next Meeting.

The Secretary stated that as they had no business before them, the half hour usually devoted to this, might be occupied by the examination of some tank plants that had been brought for examination. The first was the Lotus or Sacred bean of India, now in magnificent flower in a tank in Mahim Wood, and in another at Bandora. The leaves produced were from a foot to a foot and a half in diameter, many of the flowers measured from six to eight inches across when expanded naturally, or upwards of a foot when the petals were stretched out. The peculiar position of the seed, the half of which exposed itself naked from the top of the inverted cone, forming the *stigma* in the flower, was particularly noticed. Four varieties of beautiful water lily, white, blue, blood red, and pink, all now in flower, were exhibited. The root of one of these was shewn in a glass jar throwing out fresh leaves. The root was covered by a fine brownish down, which, when narrowly examined, represented a cocoanut grove. The individual trees are about half an inch long and of the thickness of a horse hair; when a hand approached the jar they disappeared, being in fact beautiful microscopic worms; the ciliary movements around the mouth, the digestive processes, and circulation of the blood, being all visible under a moderate magnifier. On the table was a glass box or Aqua-Vivarium, filled with a beautiful little white flowering plant, called the *Meneanthes Indicus*, or Buck bean. This formed a pretty decoration for the drawing-room table, throwing out a succession of flowers for weeks if kept floating in water, in a jar or jelly glass. It was stated that this, together with all the lilies, would flower readily in ordinary tubs or large flower pots, and greatly exceeded in beauty the plants we were accustomed to.

LECTURES.—The first two Lectures on the Notice List, were "On the Steamer Tracks from Bombay to Aden, recently pursued by the packets during the South West Monsoon," and "On the bottle logs of the Arabian Sea"; Charts illustrative of both of these subjects were exhibited and explained, but the Lectures were postponed to give place to Colonel LeGrand Jacob.—*See Transactions* xiii. p. 149.

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A numerous and influential audience assembled in the Town Hall on the afternoon of Friday, the 12th October, to listen to the interesting lecture of Colonel LeGrand Jacob on his very recent travels in the Archipelago, Australia, New Zealand, and Tasmania. Among the ladies and gentlemen present we observed the Right Hon'ble the Governor, in the chair; Miss Leeke; Mrs. Peet; Miss Willoughby; Miss Spencer; Mrs. and Miss Hough; Admiral Sir Henry Leeke; Dr. Buist; Major Woosnam; Colonels Jacob, Willoughby, Lyon, Grant, Bates; Drs. Don, Peet, Craig, Impey; Captains Barr, Russell, Mylne, Elphinstone, Elliott; Reverend W. K. Fletcher; Reverend W. W. Peyton; Professors Fraser and Sinclair; Captain Selby; Brigadier Parr; Messrs. W. P. Adam, Cursetjee Jamsetjee, J. H. Standen, Sorabjee Jamsetjee, C. Leggat, Burgoyne, W. H. S. Crawford, Dunjeebhoy Framjee, Narayen Dinnanathjee, Dosabhoy Framjee, N. Spencer, A. Johnstone, C. and W. Swanseger, F. Hutchinson, C. Durham, J. Stuart, Bomanjee Pestonjee, Ardashir Framjee, &c. &c.

The following gentlemen proposed at last meeting were duly elected:—

J. M. Erskine, Esq., C. S., Captain Hamilton, I. N., Munguldass Nathoobhoy, Esq., W. C. Sillar, Esq., W. T. Roper, Esq.

The following gentlemen were proposed for election at next meeting:—

Sorabjee Jamsetjee, Esq., proposed by Admiral Sir H. Leeke, seconded by Colonel LeGrand Jacob.

C. Leggatt, Esq., proposed by Dr. Buist, seconded by Dr. Impey.

Dr. A. Thomson, 43rd Ben. N. I., proposed by Dr. Buist, seconded by Professor Sinclair.

After the disposal of the ordinary business of the Society Col. Jacob gave a continuation of his former lecture on Borneo &c.

The Ordinary Monthly Meeting of the Bombay Geographical Society took place on Thursday the 17th January, 1856, William Frere, Esq., Sudder Adawlut, in the Chair. A large collection of Maury's Wind and Current Charts, mounted and arranged, was exhibited, and it was pointed out that, though the British Government had the same results in view, the method desired to be pursued for their attainment, was likely to differ materially from that of the Washington Astronomer. The Secretary then gave the following short outline of the Physical Geography of India, taking his illustrations from the Geological Map of Mr. Greenough, and a large collection of Colored Physical Maps, prepared to illustrate a work on the subject. It was explained that a Lecture Map ten feet by twenty, constructed by the Messrs. Johnston of Edinburgh, together with several hundred square feet of drawings, had been lost on board the *St. Abbs*:—

"General Description.—Our recent conquest have extended our north-west frontier to almost everywhere beyond the Indus, and the British do-

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minions now stretch from the sea to the mountains, all around from Soonmayanee in Scinde to Arracan in Burmah; and the region to which the following remarks pertain is the same in its physical as its political boundaries and area. It forms a vast irregular lozenge, composed of two triangles, one of them nearly equilateral, resting on opposite sides of the 22d parallel. The peninsula of Hindustan proper—of about 1200 miles each side, extending from the latitude of Cutch and Calcutta, and so southward to Ceylon, in latitude 70—constitutes the southernmost of these and is bounded to the south-east and south-west by the Bay of Bengal and the Arabian Sea; the other, which rests on this, base to base, is obtuseangled and scalene, its apex reaching north beyond Attock, and its base extending along the shores of Scinde to Cape Manze, and those of the Bay of Bengal to the mountains eastward of Chittagong, or from the 67th to the 90th eastern meridian. It comprises an area of 1,309,200 square miles surrounded by a boundary of 11,260, or one-half the circuit of the globe. Of these square miles 800,788 belong to England, 508,412 to native states.

The features of this vast country are almost endlessly diversified. A huge range of mountain walls it in on the north-west, with a general equatorial direction, bending at the extremities south-east and south-west. A magnificent chain, constituting the Western Ghauts, runs nearly parallel to the shore, along the whole western sea-board, from Goozerat south to Ceylon. A large equatorial mass, forming the Vindhya range on the north and Satpooda on the south, bending eastward from this, constitutes the basin of the Taptee and Nerbudda. The Goomsoor and Rajmahal hills which bound the delta of the Ganges on the west, constitute almost independent masses; and the range along the eastern side of the peninsula towards the seaboard is, as compared to the Western Ghauts, irregular in structure and inconsiderable in elevation. Shelving or sloping gently from the inner sides of the latter of these, is the vast table-land of the Deccan, resting on the highlands of Malwa on the north, under the 20th parallel, and extending eastward and southward, till terminated by the mountain spur which stretches from the Nilgherries towards Madras. Stretching again from the base of the mountains on both sides of the peninsula into the shore, and so extending all round the sea-coast, is a low border on the eastern or Coromandel, and the Concan on the western or Malabar Coast. It varies from 5 to 50 miles in breadth, and its average elevation is about 30 feet above the level of the sea. A large portion of it is obviously of very recent marine origin; and on the northern and southern portion of the shores of Western India it is broken up into numberless islands, of which the group of fourteen—of which Bombay is one—is the best known and most beautiful.

It will be thus seen that the peninsula of Hindostan consists of three distinct parts—a central table-land, of an average elevation of about 1500 feet, and a maximum of about 2500 feet, sprinkled with magnificent isolated conical hills, some 20,000 above the plain and 4000 above the sea, of a vast circumvallation of mountains spreading out into a great mass on the north-west,

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and presenting on the west two stupendous groups, rising at Mahabaleshwar, near Bombay, under the 18th parallel, to the elevation of 4500 feet,—the Nilgherry group, under the 12th parallel, attaining an altitude of 8500 feet—and thirdly of the low land on the seaboard bewixt the foot of the hills and the shore.

Without at present taking into account the Soolimani and the Himalaya mountains, India, beyond the limits of the peninsula northwards, exhibits four grand divisions of surface,—1st. The great river deltas of the Indus and Ganges, consisting of almost pure alluvium, yearly adding to its mass, and which furnish by far the most fertile portions of the country; 2d. The Doabs, which may be described as the converse of the deltas—the latter being the rich lands which lie around the mouths, the former those which separate the branches of our principal rivers; both being to a greater or less extent subject to inundations, the Doabs being particularly accessible to artificial irrigation; 3rd. The Great Desert, which lies to the eastward of the Indus, and southward of the Sutlej, towards Delhi, and which long formed the defence of the British frontier; and lastly, The Terai, or gravel belt, which skirts the base of the mountains,—a tract of comparatively inconsiderable size, but so sigular in point of structure as to be deserving of a separate notice.

The Terai, or Tauri, is a large gravel belt, filling, to the depth of from 15 to 150 feet, a narrow, basin-shaped hollow, from 5 to 15 miles in breadth, and from 500 to 600 in length, skirting the base of the Himalayas. It is so penetrable to water, that rivers, after traversing it for a short distance, sink down and disappear under its surface, re-appearing again when a fault, dyke, or other obstruction, is met with, once more to disappear when this is passed. The marshes thus formed are so malarious, that the husbandmen by whom portions of the Terai are tilled hasten away from it as evening approaches, and make their abode high up amongst the hills. The insalubrious character of this singular region, at certain seasons of the year, pervades the vast Saul forests which skirt its margin all along; they are waterless, rivers sinking beneath them, and emerging in the Terai; and Nepaul is girt around by a border at times so dangerous to human life that for months together no one attempts to traverse it.

River Systems of India.—In India we have two stupendous river systems—the Himalayan and Hindustanee—drawing their supplies from totally separate sources, and traversing or surrounding the whole of the districts subject to the visitation of famine. The Indus, with its five magnificent tributaries which intersect the Punjaub, and the Ganges and Brahmapootra, with their gigantic branches derive their principal supplies from the melting of the snows; and the more fiercely the sun shines on the hills and the more insufferable that are the heats below, the more plentifully do these gelid storehouses give up their treasures. The whole of the Hindostan system of rivers, again, consisting of the Sabermutti, the Mahee, the Nerbudda, the Taptee, all discharging themselves into the Gulf of Cambay, in Western India; the

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Godavery, the Krishna, and the Cauvery, falling into the Bay of Bengal, originate in the western mountains, and are fed by the rains which fall over these, to the extent of 100 inches on an average, during the months of June, July and August. Both systems, whether fed by snow or rain, are in flood at the same period of the year, that being just the season when moisture is most required. Both draw their supplies from mountains too rocky or barren to require moisture, and too steep to retain it, and which send to the ocean, through tracts of the finest country in the world, supplies of water sufficient to transform them into one universal garden.

The following table is given by Hamilton of the probable length of some of the rivers of India:

		Miles to the sea.
1.	Indus,	1700
2.	Jamna (to its junction with the Ganges 780 miles),	1500
3.	Satlej (to the Indus 900),	1400
4.	Jhelum (ditto, 750)	1250
5.	Gandak (to the Ganges, 450)	980
6.	Godavery,	850
7.	Krishna,	700
8.	Nerbudda,	700
9.	Mahánadí,	550
10.	Táptí	460
11.	Cavery,	460

Remarkable Cataracts.—Girsappa, Western Ghats, top of fall to surface of basin, 828 feet, depth of basin, 300—total, 1183; from 300 to 600 feet across during the rains. Yena, Mahableshwar, 600 feet. Cavery, Mysore, 300 feet. Bouti, in Bandelkhand, 400 feet. Katra, in Bandelkhand, 398 feet. Chai, in Bundelcund, 362 feet. Keuti, in Bundelcund, 272 feet. Gokák, near Belgaum, 150 feet, 70 feet across.

When we find India generally talked of as one country of moderate extent, and nearly uniform condition and characteristics, it is not wonderful that the phenomena of the atmosphere should be spoken of with as much looseness as the geography of the land. The climate of India is in reality still more various and diversified than the features of the country. In the south, showers are frequent all the year round; on the southern Coromandel Coast three months of violent rain occur in winter, the rest of the season being dry; while a few degrees to the north of this on both sides of the Bay of Bengal, and all over Western India the precise converse of this is the case. In Central India the rain becomes extremely light, and occurs mostly about midsummer; in the north there are both the summer and winter rains; in Sindh and Beluchistan there is no rainy season whatever, and the heavy showers which occur irregularly, and at intervals of years are productive of sickness, and are considered injurious to the country.

From the conjoined influences of the heat of the sun and the rotation of the earth, there are two vast currents of air constantly circling round the globe from east to west, called the north-east and south-east

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trade-winds, the two being separated from each other by a belt of turbulent and irregular currents, and frequent precipitation, called, the "Rains," calms or variables. These three great bands of air move somewhat to the north and south, according as the sun is to the northward or southward of the line; and where they impinge upon a continent or peninsula stretching towards the equator, a branch is broken off, and a current, varying according to the season of the year, produced, called monsoon. On the western side of India, north to the Gulf of Cutch, and on the western shore of Burmah and the peninsula of Malacca, this blows, for betwixt two and five months in summer, according to the latitude, from south-west; for the greater part of the rest of the year from north-west, and interval of storms and calms occurring in both cases at the period of change. It is usually held that this takes place about a week or ten days after the passage of the sun northward or southward over the parallel of the place, and that the rains which always accompany it follow and retire a few days afterwards. On the eastern side of the peninsula again, fromCeylon to considerably northward of Madras, lying in the lee as it were of the land, the monsoons blow from north-east and south-east, the former of which occurs in midwinter, being their rainy season.

Few things can be more striking than the state of the atmosphere or the aspect of the sky just as these periodical alterations are about to arise. From the beginning of November to the end of May the sky has been perfectly cloudless, and not a shower has fallen. Regular sea and land breezes setting in before noon and daybreak respectively, the former blowing from north-west for ten or twelve hours, the latter from due east for five or six, with intervals of calm between, have filled up the day and night. While this state of matters still continues, and not the slightest indication is given of coming changes, the stranger observes to his astonishment a sudden and simultaneous bustle amongst the whole community. The tents occupied by the troops, and the flimsy dwelling-places which had hitherto afforded accommodation to the European population, are suddenly pulled down and swept away, as if their occupants were fleeing before some fearful pestilence. The most substantial buildings, if thatched, have their roofs stripped off and renewed, and in any case have them thoroughly repaired, while all doors and windows facing the south-westward are boarded up, matted over, or in some way or other secured. Square-rigged vessels strike their upper mats, lower their yards, and make immediate provision for a storm, while as yet there is nothing whatever to warn the stranger of coming change; and the lighter native crafts are hauled up beyond the reach of the waves, and thatched over with a thick roofing palmyra leaves. Large clouds at length begin to make their appearance daily about noon over the western mountains, and advancing up the sky eastward, right in the teeth, as it would seem, of the wind then blowing, exhibit the most magnificent display first of sheet, afterwards of forked lightning. This goes on from day to day for about a week, the electrical displays becoming more vivid and intense every night. Until the rains actually fall, the clouds invariably disappear immediately after dark, and two hours

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after the sun has gone down surrounded by the emblems of coming tempest, the stars shine out everywhere down to the very edge of the horizon, and not a flock or film of vapour is to be seen staining the deep blue of the serene expanse from side to side of the firmament. Suddenly, and in general after a day of unusual tranquility, a little after sunset, a blast at once darts forth from the east, followed by a gush of rain as if the windows of heaven had been opened, the thunder roars and lightnings flash incessantly, the quivering light of a continuous succession of flashes being sometimes sufficient for five or ten seconds on end to permit the smallest print to be read. Sometimes it shoots upwards from the earth, sometimes it seems to rain down in long streams, like a string of red-hot beads, reaching from the clouds to the sea; most frequently it darts in long zig-zags horizontally from cloud to cloud, or bursting in all directions from a single point like a shower of coruscations shot on every side. This state of matters generally lasts from one to two hours, when the wind veers to round to south-westward, blowing with increased steadiness and diminished force, and the voice of the thunder, which had just before pealed in a succession of tremendous claps or roars, is heard lowly bellowing in the distance.

It may be mentioned in passing that although all our continued storms blew on us from the south-west, and the sea breezes during the fair weather are north-westerly, that our casual blasts invariably burst upon us from the mountains to the east of us, as if these formed the grand magazine of thunder and storm. The first burst of the monsoon seldom lasts more than a single night and part of a day, and the second dawn presents the most wonderful change in the scene than can be imagined. The burnt and parched earth seems now washed and refreshed everywhere, long spikes of grass of the tenderest green already shoot up from what a few days before were brown and barren plains; deep and filthy pits and unseemly tracts half choked up with rubbish, straw, and withered leaves, are now the basins of pellucid pools and lakes or the channels of magestic streams. The rays of the sun, no longer fierce and intolerable as they were a week before, shaded by intervening vapours or transient clouds, present that interminglement of alternating light and shade in the landscape which beautiful in itself, becomes doubly delightful from the contrast it exhibits to the uninterrupted and unceasing glare of the previous part of the year. After a few days' weather of this sort the rains return with redoubled violence, and continue to pour down for forty or fifty days, at an average of above an inch a-day, the ordinary fall in June, July, and August, amounting at Bombay to about 70 inches. Within a week or ten days of the commencement of the rains, so soon as the surface of the soil is fairly saturated, and occupied everywhere by rivulets or pools of standing water, the whole earth seems to swarm with fish. They are of four or five different varieties such as abound in the sea along-shore, and can live either in fresh or salt water. They vary in size from an inch in length to that of the forefinger, and are caught in myriads in baskets or in nets affording sport to the boys, and an agreeable article of food. Though their

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appearance has been mentioned by every one who has attempted to describe the rains for the last two centuries, it has never been so satisfactorily accounted for as could be desired. Colonel Underwood of the Madras Engineers, mentions a case where he was overtaken by a furious shower in the midst of the dry season, when the earth was at once covered with fish, which must have fallen from the heavens. But this scarcely seems to account for those which appear some ten days after the burst of the monsoon. Equally remarkable with this, though without its mystery, is the appearance of myriads of frogs of the most enormous dimensions, which occurs at the opening of the rains. At night their croakings fill the air whenever a shower falls; and they are seen in hundreds by the margins, or in the waters of every pool—at times resting on the lotus leaf, at times hurrying from the pursuit of the water-snakes which hunt and devour them. They are of a bright greenish yellow, and measure from six to seven inches from snout to vent, often bounding from six to nine feet at a spring. The rains slacken off early in August, and after the first full moon an offering is made, and a festival held by the natives to propitiate the ocean god, and vessels laid up in the end of May prepare for sea. After some weeks of open weather the Malabar Coast is usually visited in the end of September or beginning of October by a furious burst of thunder, rain, and easterly wind called the Elephanta, from its occurring as the sun enters the constellation of the Elephant, this finally closing the rainy season.

On the Bengal side the rains are about a week later in setting in than at Bombay. The amount of fall at Calcutta is nearly the same, but seems more violent while it lasts, and is somewhat less continuous. Along the whole of Eastern and part of Central India, the rains are preceded by furious whirling squalls, called north-western, from their coming down from the direction of the Himalayas, as our eastern squalls do from the Ghats; three or four of these occur during the months of April and May, and are frequently accompanied by furious hail-storms, the hail being on an average about the size of walnuts, frequently that of duck's eggs; single hailstones have occasionally been found from one to three pounds in weight. There are, indeed, four cases on record within the last 70 years of masses of ice having fallen from the firmament of from half a ton to a ton and a half in weight. Recent observations have shewn that the maximum fall of rain occurs, as might be expected, at the ordinary altitude of the principal layers of rain cloud, between 3000 and 5000 feet above the level of the sea, and the amount of fall regularly decreases above this as the higher regions of air are attained. The discharge where this sea of vapour impinges on a cold mass of mountains is tremendous. At Mahabaleshwar it amounts to betwixt 260 and 300 inches, it exceeds 200 on the same level at the Nilgiris, and at Cherapunj in the Kashia Hills northwest of Calcutta there is an average fall of no less than 610 inches, above 20 feet occasionally falling in the month of June.

In the north of India there are both winter and summer rains, though the former are always the lighter of the two. The regions of the leeward of the

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mountain walls, against which the clouds borne up from the sea first dash and discharge themselves, are comparatively dry, and the suddenness with which the transition takes place is often most remarkable. At Panchghani, 500 feet lower down, and ten miles farther east than Mahabaleshwar where from 250 to 300 inches fall, they have seldom more than 20 inches, while the average of the tableland of the Dakhan scarcely exceeds 25. When the rain clouds approach the arid plains of Sindh and Cutch, they appear to ascend and become absorbed by the air, passing on to precipitate themselves on the mountains the northward. There is much reason to believe that the fall of rain is diminished by the absence or destruction of trees. Were vegetation, sufficiently fostered in Sindh by means of irrigation, it might cause it to have its regular rainy season like the lands around.

Two events strike with surprise the ornithologist on the approach of the monsoon. Nearly all the kites, hawks, vultures, and carrion birds disappear from the sea-coast, while the crows begin to build their nests and hatch their young just at the season that seems most unsuitable for incubation, when the eggs are often shaken out, or the nests themselves are destroyed by the storm, and the poor birds are exposed in the performance of their paternal duties to all the violence and inclemency of rain and tempest. At the instigation of a sure and unerring instinct, the carnivorous birds, as the rains approach, withdraw themselves from a climate unsuitable to the habits of their young, betaking themselves to the comparatively dry air of the Deccan, where they nestle and bring forth in comfort, and find food and shelter for their little ones. The earth, once saturated with rain in the low country, abounds in grubs, snails, and worms, the food of the young crows, which the parent pick up in the soft and moistened soil, the rising generation coming forth just as the means of supplying them with suitable sustenance become plentiful. The scenes connected with this, which follow the conclusion of the rains, are curious enough. While the Muhommedans bury, and the Hindus burn, the Parsis expose their dead in large cylindrical roofless structures called Towers of Silence, where birds of prey at all times find an abundant repast. Their family cares and anxieties for the season, over the carrion birds, which had left in May for the Dakhan, return in October to Bombay, and make at once for the usual scene of their festivities, now stored with a three months' supply of untasted food. As they appear in clouds approaching from the mainland, the crows, unwilling that their dominions should be invaded, hasten in flocks to meet them, and a battle ensues in the air, loud, fierce, and noisy; the flapping of the wings, the screaming and cawing of the combatants resounding over the island, till the large birds succeed, and having gained the victory, are suffered thenceforth to live in peace.

It is just after the rains have well set in, that those beautiful exhibitions of thousands of fireflies flashing out in concert become visible. These brilliant little insects are generally seen dancing alone amongst shrubs and underwood, occasionally congregating in vast multitudes around isolated trees, which they at times render wholly luminous. At times the whole countless host flash

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out for a few seconds, and simultaneously at intervals of similar amount, becoming dark again, and so they flash and flash for hours on end. Sometimes they shoot in long columns into the air, like the coruscations of fire-works, becoming bright and dark by turns, or having reached a considerable altitude they seem to pour down in a shower of sparks. *

Principal Falls of Rain in India—Eastern India and Bay of Bengal.

	Height.	Lat.	Long.	Fall of Rain.
Cherapunj	4500	25° 16	91° 43'	610 in.
Sylhet	5000	24 40	92 40	209 ,,
Tavoy	sea level	14 5	98 10	203 ,,
Moulmein	sea level	16 30	97 37	175 ,,
Sandowy	..	18 26	94 18	178 ,,
Akyab	sea level	20 8	92 54	155 ,,
Darjiling	7000	27 3	88 18	125 ,,

Shores of Western India.

	Height.	Lat.	Long.	Fall of Rain.
Mahabaleshwar	4500	17° 43'	74° 35'	248 in
Attagiri	2200	11 25	..	170 ,,
Khandalla	1740	18 30	74 30	168 ,,
Atrimallay	6000	11 30	76 20	164 ,,
Dhapulí	900	18 33	74 2	138 ,,
Angara Kandy,	Malabar Coast.	9	76 30	124 ,,
Cannanore	Ditto.	12	75 20	121 ,,

Average fall of Rain—At Bombay for 30, and Calcutta and Madras for 8 years, near the level of the sea :—

	Madras.	Bombay.	Calcutta.
January	3.50	.0	0.71
February	2.00	.0	0.55
March	0.25	.0	1.10
April	0.22	.0	2.95
May	5.00	.0	4.59
June	1.80	22.13	12.74
July	2.80	24.88	13.15
August	3.30	16.77	16.82
September	5.50	11.05	7.83
October	9.40	1.25	4.83
November	10.30	.0	.82
December	8.20	.0*	.50
Total	52.27	76.08	66.59

REMARKABLE FALLS OF RAIN IN INDIA.—At Mahabaleshwar, in 1834, 302 inches fell in one hundred days; on the 4th of October 1846, 10 inches fell

* Occasional showers occur at Bombay some times all the year round, of which no account has been published in the Register. The majority of years are rainless from October to June.

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at Chittledrug in twenty-four hours; at Bombay, in 1825, 16 inches, and in 1844, 75 inches fell in twenty-four hours, 2 inches fell in seventy minutes; on the 1st July 9.43 inches, on the 10th, and on the 26th July 1840, 12 inches.—Sykes, Phil. Trans. 1850; Rep. Brit. As. 1849.

At Rajkot, on the 26th and 26th July 1850, 26 inches fell in twenty four hours, and 35 inches in 36 hours; 7 inches fell in one hour and a half at Ahmed?

With this general review of the principal physical features and climate of India, we may next pass to some of the leading peculiarities of the ocean which surrounds it.

'It is more than probable that besides the currents occasioned by the trade-winds, monsoons, and sets of the tides—we have a group of movements intermingled with these', dependent mainly on evaporation. When it is remembered that on the western shore of the Arabian Sea, including in this the Red Sea and Persian Gulf, from the line northward, we have an expanse of coast of no less than 6000 miles, and a stretch of country of probably not less than 100 miles inland from this, where the average fall of rain does not amount to four inches annually, where not one-half this ever reaches the sea, and where to the best of our knowledge, the evaporation over the ocean averages at least a quarter of an inch daily all the year round, or close on eight feet annually, some idea of the enormous abstraction of water in the shape of vapour may be formed. On the assumption that this extends no further, on an average, than 50 miles out to sea, we shall have no less than 39 cubic miles of water raised annually in vapour from the northern and north western side of the basin, which must be supplied from the open ocean to the south, or the rains on the east. The fall of rain on the western side of the ridge of the mountain chain from Cape Comorin to Cutch averages pretty nearly 180 inches annually, and of this at least 160 is carried off to the sea: that on the Konkan to 70 inches, of which probably 30 flow off to the ocean or betwixt the two over an area of twenty miles from the sea-shore to the Ghats, and about 1200 miles from north to south, or an area of 24,000 square miles in all, we shall probably have an average discharge of nine feet, or close on forty cubic miles of water,—an amount sufficient, were it not diffused, to raise the sea on our shores three feet high over an area of 72,000 square miles.

The waters of the ocean cover nearly three fourths of the surface of the globe; and of the thirty-eight millions of miles of dry land in existence, twenty eight millions belong to the northern hemisphere. † The mean depth of the ocean is somewhere about four miles—the greatest depth the sounding line till of late has ever reached is five and a quarter miles. The mean elevation of the land again is about one thousand feet—the highest point known

† Since the above was written, Lieutenant Walsh, of the United States Navy, has sounded to the depth of about six miles, and in October 1853, soundings were made in Lat. 46° 49 S., long 37° 6' W., from on board Her Majesty's Ship Herald, with an American line, to the depth of 7706 fathoms, or above 7 miles.

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to us is nearly as much above the level of the sea, as the greatest depth that has been measured is below it. The atmosphere again surrounds the earth like a vast envelope, its depth, by reason of the tenuity attained by it as the superincumbent pressure is withdrawn, is unknown to us, but is guessed at somewhere betwixt fifty and five hundred miles, its weight and its constituent elements have been determined with the utmost accuracy. The weight of the mass is to equal that of a solid globe of lead sixty miles in diameter. Its principal elements or oxygen and nitrogen gases, with a vast quantity of water suspended in these in the shape of vapour; and communicating with these a quantity of carbon, in the form of fixed air, equal to restore from its mass manifold, the coal that now exists in the world. In common with all substances, the ocean and the air are increased in bulk, and consequently diminished weight by heat; like all fluids, they are mobile—tending to extend themselves equally in all directions, and to fiill np depressions in whatever vacant spaces will admit them; hence, in these respects, the resemblance betwixt their movements. Water is not compressible or elastic, and it may be solidified into ice, or vapourized into steam; air is elastic, it may be condensed to any extent by compression, or expanded to an indefinite degree of tenuity by pressure being removed from it—it is not liable to undergo any change in its constitution beyond these, by any of the ordinary influences by which it is affected. These facts are few and simple enough—let us see what results arise from them. As the constant exposure of the equatorial regions of the earth to the sun must necessarily here engender vast amount of heat,—and as his absence from the polar regions must in like manner promote an infinite accumulation of cold,—to fit the entire earth for a habitation to similar races of beings, a constant interchange and communion betwixt the heat of the one and cold of the other must be carried on. The ease and simplicity with which this is effected, surpass all description. The air heated near the equator by the everpowering influence of the sun, is expanded and lightened: it ascends into upper space leaving a partial vacuum at the surface to be supplied from the regions adjoining. Two currents from the poles towards the equator are thus established at the surface, while the sublimated air, diffusing itself by its mobility, flows in the upper regions of space from the equator towards the poles. Two vast whirlpools are thus established, constantly carrying away the heat from the torrid towards the icy regions, and these becoming cold by contact with the ice carry back their gelid freight to refresh the torrid zone. Did the earth, as was long believed, stand still while the sun circled round it, we should have two sets of meridianal currents blowing at the surface of the earth directly from north and south towards the equator, in the upper regions flowing back again to the place whence they came. On the other hand were the heating and cooling influences just referred to to cease, and the earth to fail in impressing its own motion on the atmosphere, we should have a furious hurricane rushing round the globe at the rate of 1000 miles an hour—tornadoes of ten times the speed of the most violent now known to us, sweeping everything before them. A combination of the two

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influences, modified by the friction of the earth, which tends to draw the air after it, gives us the Trade-Winds—which sweep round the equatorial region of the globe unceasingly at the speed of from ten to twenty miles an hour: the aerial current, quitting the polar regions with the comparatively tardy speed from east to west imposed on it by the velocity due to the 70th parallel, is left behind the globe, and deflected into an oblique current as it advances southward, till, meeting the current from the opposite pole near the equator, the two combine and form the vast stream known as the Trades,—separated in two where the air ascends by the belt of variable winds and rains. Impressed with the motion of the air constantly sweeping its surface in one direction, and obeying the same laws of motion the great sea itself would be excited into currents similar to those of the air were it not walled in by continents and subjected to other control. As it is, there are constant currents flowing from the torrid towards the frigid zone, to supply the vast mass of vapour there drained off; while other whirlpools and currents, such as the gigantic Gulf Stream, come to perform their part in the same gigantic drama. The current just named sweeps from the Cape of Good Hope across the South Atlantic to the Gulf of Mexico, and by the Straits of the Bahamas. Here it turns to the eastward again, travelling along the coast of America at the rate of from forty to a hundred miles a day: it now stands once more across the Atlantic, and divides itself into two branches—one finds its way into the Northern Sea, warming the adjoining waters as it advances, and turning back, most likely to form a second great whirlpool rejoining the original stream near Newfoundland. The main branch seeks the northern shores of Europe, and, sweeping along the coast of Spain and Portugal, travels southward by the Azores to rejoin the main whirlpool. The waters of this vast ocean river are to the north of the tropic greatly warmer than those around: the climate of every country it approaches is improved by it, and the Laplander is enabled by its means to live, and cultivate his barley in a latitude which everywhere else, throughout the world is condemned to perpetual sterility. But there are other laws which the great sea obeys, which peculiarly adapt it as the vehicle of interchange of heat and cold betwixt those regions where either exists in excess. Water, which contracts regularly from the boiling point downwards, at a temperature of 40° has reached its maximum of density, and thence begins to grow lighter. But for this beneficent provision, the various recesses of the frozen ocean would be continually occupied with a fluid, at the freezing point, which the least access of cold would convert into one solid mass of ice. The non-conducting power of water, which at present acts so valuable a part in the general economy, so far from being a blessing would be a curse. No warmth could ever penetrate to thaw the foundations of the frozen mass—no water find its way to float it from its foundations, so that, like the everlasting hills themselves, rooted immoveably in its place, every year adding to its volume, the solid structure would continually advance to the south-ward, hermetically sealing the Polar Ocean, thus condemned to utter desolation, and encroaching on the North Sea itself. Under existing

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circumstances, so soon as water is cooled down to 40° it sinks to the bottom, and, still eight degrees warmer than ice, it attacks the bases and saps the foundations of the icebergs—themselves gigantic glaciers which have fallen from the mountains, into the sea, or which have grown to their present size in the shelter of bays and estuaries, and by accumulations from above. Once forced from their anchorage, the first storm that arises drifts them to sea, where the beautiful law which renders ice lighter than the warmest water enables it to swim, and floats southward a vast magazine of cold to cool the tepid fluid which bears it along—the evaporation at the equator causing a deficit, the melting and accumulation of the ice in the frigid zone giving rise to an excess of accumulation, which tends along with the action of the air and other causes, to institute and maintain the transporting current. These stupendous masses, which have been seen at sea in the form of church spires and Gothic towers and minarets, rising to the height of from 300 to 600 feet, and extending over an area of not less than six square miles, the mass above water being only one-tenth of the whole, are often to be found far within the tropics. A striking fact dependent on this general law, has just been brought to light; there is a line extending from pole to pole at or under the surface of the ocean, where an invariable temperature of 39° .5 is maintained. The depth of this varies with the latitude; at the equator it is 7200 feet—at lat. 56° it ascends to the surface, the temperature of the sea being here uniform throughout. North and south of this the cold water is uppermost, and at lat. 70° the line of uniform temperature descends to 4500. But these, though amongst the most regular and magnificent, are but a small number of the contrivances by which the vast and beneficent ends of Nature are brought about. Ascent from the surface of the earth produces the same change in point of the climate as an approach to the poles; even under the torrid zone, mountains reach the line of perpetual congelation at nearly a third less altitude than the extreme elevation which they sometimes attain: at the poles, snow is perpetual at the ground, and at the different intervening latitudes reaches some intermediate point of congelation betwixt 1000 and 20,000 feet. In America, from the line south to the tropics, as also in Africa, within similar latitudes, vast ridges of mountains covered with perpetual snow, run northward and southward in the direction of the meridian right across the path of the Trade-Winds. A similar ridge, though of less magnificent dimensions, traverses the peninsula of Hindustan, increasing in altitude as it approaches the line,—attaining an elevation of 8500 feet at Dodabetta and above 6000 in Ceylon. The Alps in Europe and the gigantic chain of the Himalayas in Asia, both far south in the temperate zone, stretch from east to west and intercept the aerial current from the north. Others of lesser note, in the equatorial or meridianal, or some intermediate direction, cross the paths of the atmospherical currents in every direction, imparting to them fresh supplies of cold, as they themselves obtain from them warmth in exchange; in strictness, the two operations are the same. Magnificent and stupendous as are the effects and results of the water and of air acting independently on each other, in equalising

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the temperature of the globe, they are still more so when combined. One cubic inch of water when imbued with a sufficiency of heat will form one cubic foot of steam—the water, before its evaporation, and the vapour which it forms being exactly of the same temperature, though in reality, in the process of conversion 1700 degrees of caloric have been absorbed or carried away from the vicinage and rendered latent or imperceptible; this heat is returned in a sensible and perceptible form the moment the vapour is converted once more into water. The general fact is the same in the case of vapour carried off by dry air at any temperature that may be imagined (for down far below the freezing point evaporation proceeds uninterruptedly), or raised into steam by artificial means. The air, heated and dried as it sweeps over the arid surface of the soil, drinks up by day myriads of tons of moisture from the sea—as much indeed as would, were no moisture restored to it, depress its whole expanse at the rate of four feet annually over the surface of the globe. The quantity of heat thus converted from a sensible or perceptible to an insensible or latent state, is almost incredible. The action equally goes on, and with the like results, over the surface of the earth, where there is moisture to be withdrawn, as over that of the sea. But night, and the seasons of the year, come round, and the surplus temperature thus withdrawn and stored away at the time it might have proved superfluous or inconvenient, is reserved and rendered back so soon as it is required; and the cold of night, and rigor of winter, are modified by the heat given out at the point of condensation, by dew, rain, hail, and snow.

The settings in of our Monsoons present us with phenomena of such singular harmony and beauty, and they depend on the application of so many simple and thoroughly intelligible principles, as to furnish us with some of the most magnificent poetry of Nature. The explanation of nearly all the phenomena is perfectly simple, and has long been thoroughly understood by men of science. They can be watched only by the European during his short sojourn in India, and seen only to perfection by the sea-shore, and as it is to be feared that a considerable majority of those, who may regret afterwards not having made better use of their ears and eyes, view the approach of the rains with pretty nearly the same amount of intelligence and inquisitiveness as the natives themselves, I shall make no apology for endeavoring to give a short explanation of the causes and leading phenomena attendant on the monsoon, although aware that the bulk of these are perfectly understood. The term monsoon simply signifies season, although we speak here of the south-west monsoon almost by this name exclusively, that being the period of the year most abundant in striking phenomena. It must be remembered at the outset that all bodies, whether solid, liquid, or aeriform, the last most conspicuously of all, increase in bulk when heated, and so diminish in weight mass for mass. If for example a hundred cubic inches of air weighs, as it does pretty nearly, thirty one grains at the freezing point, a hundred cubic inches when expanded by heat to double its volume will weigh fifteen grains and a half, and on this principle hot air balloons are constructed, the light air when

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enclosed in a bag of sufficient size rising through the heavy, and carrying a considerable load along with it. The simplest illustration of this is to be seen in lighting a fire in an open grate, when feathers, scraps of paper, and other light materials will rush towards the fire place and so up the chimney—and the same thing will be seen on a smaller scale by approaching any light substance to the base of the funnel of an argand lamp. Let these things be well remembered—simple and familiar as they are, they furnish us with the key to the whole phenomena of all our atmospheric movements; the sun being the open fire or argand lamp heating the air under him, creating a perpetual upper current, the place of which must be supplied by lateral streams at the surface of the earth.

When such great Promontories as those of America, Africa, Hindustan, and the Malayan peninsula intrude themselves into the region of the Trade Winds, they interrupt their continuity and disturb their course; and the sun which warms the sea to a temperature nearly uniform of about eighty between the tropics often heats the land above a hundred. He plays the part in fact of a gigantic pump, the air on the surface of the earth continually rushing towards that point on which his rays are concentrated. From the middle of August to the middle of May accordingly, there is a great rush of that vast sea of air which the mountains and table land of Central Asia have cooled, perpetually flowing past us towards the south, and this gives us our north-west monsoon. Steadily as the sun crossing the line marches towards the northward, our winds become less northerly, and more and more westerly, when from the middle of May to the middle of August we have a similar rush from the southward which constitutes our south-west monsoon. Nothing however can be more opposed to each other than the character of the two masses of air thus set in motion: that from the north is cold and dry from the expanse of arid desert which it has traversed, and where it has thrown off all its superfluous moisture in the shape of snow, winter rain, or dew—that again from the south-westward sweeping over a surface of betwixt two and three thousand miles of sea before it reaches us, comes saturated and loaded with moisture, which it is ready to precipitate on any body colder than itself. This is illustrated by an example familiar to every one, that of the damp appearing on the surface of a tumbler when a piece of ice is put into it, the surrounding air becoming cooled to the point when it can no longer hold the moisture previously dissolved in it, throwing it down on the surface by which it was cooled. But there is another law that must be kept in view to explain the phenomena of our monsoons correctly. A cubic foot of air weighing, as before stated, thirty-one grains, will hold in solution at 85 temperature, 12.35 grains of water, with the barometer at 30 inches but the same cubic foot if expanded by the pressure being removed, so as to contain half this weight, will only dissolve half as much moisture nearly. At Mahabaleshwar the Barometer which stands at 30 inches at Bombay, sinks to 26, on the Nilgiris to 22, and the Gerards ascended the Himalayas till they saw the mercury at 14 inches, where a cubic foot of at-

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mosphere would contain less than half the quantity of actual gaseous matter which it did at the surface of the ground, holding a proportionably diminished quantity of moisture in solution. Along our shores it is found that the air during the south-west monsoon approaches nearest the point of saturation at about three quarters of a mile, that is from two to four thousand feet above the level of the sea, and that here a vast sheet of atmosphere, probably a thousand feet in the thickness, prevails ready to discharge its treasures the moment it comes in contact with any thing colder than itself, or is forced upwards by an obstructing ridge of mountains so as to diminish its capacity for moisture. If these facts have been clearly stated, and are distinctly remembered and understood, the whole phenomena of our rainy season will dawn upon the reader at once. The wet south-west wind is at once obstructed by the ghats—which near their summits are colder than the air striking against them—this they at once cool and drive upwards, producing the double result of cooling and rarifying, both tending to precipitation when a huge gush of rain is the immediate result. As the season advances so does the cooling process which reaches its maximum about the month of July, when we have our heaviest falls. On this side of India Mahabaleshwar reaches the point of greatest precipitation, nearly thirty feet of rain being frequently measured—above this, as the experiments on the Nilgiris shew us, it diminishes to less than a fourth part of this—and as the air sweeps over the Dakhan, it is found in great measure deprived of its moisture, and at Puna scarcely a tenth falls of that measured at Malcolm Peth. But the most beautiful illustration of our doctrines, is that furnished by our travelling northward. At Surat the great ridge of the ghats begins to retire eastward; by the time we reach Broach it has receded seventy miles from the sea, and from the Gulf of Cambay to the mouth of the Persian Gulf, we have scarcely any thing deserving the name of mountain land near the shore. The moist sea of air flowing from the south-west which had given us seven feet of rain at Bombay and thirty at Mahableshwar, finds nothing either to cool or obstruct it in Mekran or Sindh— it becomes damp and cloudy, but passes over the burning desert without reaching the point of precipitation, and accordingly no rain falls until it reaches the mountain ranges and vast table lands to the northward of the Indus, where it follows the same law as it had followed on the Malabar Coast. We shall not here enter on the electrical phenomena of the monsoons, or attempt to describe how magnificently the mountains and clouds, in opposite states of excitement, exchange their lightnings with each other, the same things occurring with the different banks of clouds themselves. For the sake of simplicity we have spoken as if these phenomena were confined to Western Hindustan, instead of being of general prevalence, and have purposely avoided all allusions to the complications and modifications attending them, or with which they must be received, which though as familiar to the meteorologist as are the whole statements we have made, would only perplex and confuse the ordinary reader to whom we address ourselves as supposed to stand in need of instruction.

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The Ordinary Monthly Meeting of the Bombay Geographical Society took place on Thursday evening the 17th April, 1856, Admiral Sir Henry Leeke, President in the Chair.

The minutes of last meeting being read, the following letters and donations were placed on the table :—

From Government forwarding a volume of miscellaneous information connected with the native states in the Pahlunpoor Districts. From Government forwarding Mateorological Reports from stations under the Madras Presidency. From Commander Hardy, R. N., forwarding a circular in reference to the Beaufort Testimonial. From Sir Robert Hamilton forwarding a table of heights and distances between Bombay and Agra, starting from Surat, the course of the projected railway.

From Government.—A geographical and statistical report of the district of Beerbhoom—Report of the Schlaginweits' Magnetic Survey in the Himalayas. On the Harbours and Ports of the Northern Circars.—Journal of the Indian Archipelago.

Mr. Kingcome and Capt. Mylne were elected members, and Mr. Kennelly was proposed to be bollotted for at next meeting.

Amongst the curiosities on the table was a beautiful collection of large and magnificently carved rock crystal vases, of sword hilts, and vases in pale greenish and yellowish jade, richly inlaid with gold and rubies, the property of Colonel Guthrie, of the Bengal Engineers.

In reference to six Skeleton Charts of the World, four sheets each, forming Maps of 36 by 48 inches, the Secretary explained that they originated in this way. Dr. Lyon Playfair had complained to him of the want of a good large Skeleton Chart of the World, and of which a few of the outlines of the chief matters in Physical Geography should be laid down, such as Isotherms and the like. The Messrs. Johnston of Edinburgh, always ready for any enterprize that had the promotion of Geographical knowledge in view, however financially unpromising, immediately took up the scheme on a hundred copies being subscribed for, and the production of the beautiful maps now before them was the result. These were sold for two shillings the sheet, or eight shillings for the map—it would probably cost six rupees properly put on canvas. It was intended to be colored geologically, meteorologically, ethnologically, or botanically, as might be deemed expedient ;—it was meant to embody the information of naturalists as collected, but was eminently suited for lecture or school-room purposes. By such means as these a first rate Geographical or Physical Atlas might be obtained. Scarcely any attempt but that laid before the Society some weeks ago had as yet been made, and the only Atlas we possess for educational purposes might reasonably be exhibited as a curiosity in its way.

The President in laying before the meeting subscription lists for the Beaufort Testimonial stated, that it was superfluous for him to enlarge on the merits of Sir Francis Beaufort as a Hydrographer—his name in his own department was known over the world, and as a personal friend he felt a d ¿

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licacy in stating what he knew to be deserved. The promoters of the Testimonial at home had asked the Society to leave the subscription paper in their rooms, and perhaps their friends upstairs, whose rooms were more frequented, would not object to a similar privilege.

Dr. Buist said that the occasion was one on which it became matter of regret, that no part of the funds of the Society could be devoted to such purposes as the present—otherwise the claims on them by Sir Francis Beaufort were of the highest description. I need not enter, continued he, on the world-wide celebrity of the name of the Hydrographer to the Admiralty—or the commendations he has personally received every where, and from every one who has come in contact with him—otherwise I might speak of his urbanity, his uniform accessibility, the kindness of his attentions to every one interested in Geographical pursuits, and his anxiety to assist in the promotion of physical science in every department. In 1845 I had occasion to bring under his notice a scheme of concerted Tidal and Meteorogical Observations for the Eastern Seas, similar to that so soon afterwards instituted and carried out with such admirable perseverance and success by the Astronomer of Washington.—Our plans were examined in detail with the utmost care and minuteness, and so warmly approved of, that through the instrumentality of Admiral Beaufort, a grant of £350 was obtained from the Admiralty for the purchase of instruments. It was no fault of his that the work was not carried into effect as intended, and that the grant has never become available. Every thing was done by him that could be desired, and the sources of obstruction which afterwards proved too powerful, appeared in quarters where they were least to have been looked for. In 1850 Sir Francis Beaufort had been entrusted with the expenditure of £200 to purchase Globes, Atlases, and other things intended to constitute the elements of the Ross Testimonial, and laboured as diligently in the task as if his life had depended on its successful performance. Not content with this, he contributed to the testimonial a complete set of all the Maps and Charts pertaining to the East, prepared under the authority of H. M.'s Government, and up to the present time scarcely any thing has been published by the Admiralty of which this Society has not been presented with copies. This, conjoined with the contributions made by the Court of Directors and various Governments of India, has supplied us with a collection of Charts and Maps the like of which is no where to be met with, save in America, out of Europe. When I saw him two years ago, though then bending under the load of four score years, and on the point of devolving his duties on other and on younger hands, he was active and alert as ever he had been, and as much alive as ever to every thing pertaining to his profession. Lieutenant Maury was then in Europe, enlisting the sympathies of all connected with navigation in his plan, and endeavoring to organize that system of concerted observations we at Bombay are allowed to have been the earliest to endeavour to work out. Sir Francis Beaufort requested me to proceed to the convention at Brussells as representing the Hydrographers of the East, where I should join and co-operate with Admiral Beechy, the re-

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presentative of the British Government. Sir Francis Beaufort went over *seriatim*, and with the most surpassing clearness of apprehension, all the points of the American scheme, discussing each of them in turn, and shewed me an admirable plan of his own, projected more than twenty years before, on the same general view, which the sluggishness of the Admiralty prevented being carried out, and of which his own modesty deterred him from claiming the merit. To him, to his successor Captain Washington, and to his coadjutor in the same department, Captain Beecher, and to Admiral Beechy, under the Hydrographic department of the Board of Trade, I am indebted for many hints as to the improvement of the sub-surface current measuring instrument, as well as for the construction of the Skeleton Atlas of the Eastern Seas published in June 1854, and now in use amongst us—and I only regret to have been compelled to introduce my own name where subjects of Geography were alone intended to have been touched upon. I have done so to shew that there was nothing so slight or minute as not to be considered to have claims on the attention of the Hydrographic department of the Admiralty under the gallant officer now retiring from it.

The President stated that he hoped what Dr. Buist had said would be reported at length, as evincing the special claims of Admiral Beaufort on the respect of the Bombay community.

The Lecture of the evening was, on the numberless geological disclosures made by the recent excavations for water. It was stated that so much has been published on this subject, and that it had been so repeatedly before the Society, that it was not likely that much could be said worthy of publication as entirely new—every dry season it had formed the topic of discussion, when a considerable number of facts were added to those previously collected.

The Ordinary Monthly Meeting of the Bombay Geographical Society, after the Monsoon vacation, took place on Thursday the 21st August 1856, Juggonath Sunkersett, Esquire, in the Chair. The following Donations were laid on the Table :—

PRESENTS.

From the Bombay Government—Barometrical Sections of India. By Surgeon Balfour, of the Madras Army.

A Report upon Education in Sind.

Nos. IV. and VI. Vol. IX., of the Journal of the Indian Archipelago.

Printed copy of Selection No. XXXI. from the Records of Government, new series, containing Report by the Inam Commissioner on the Deccan Surinjams.

Abstracts from the Meteorological Observations taken at the stations of the Royal Engineers in the years 1853-54. By Lieutenant Colonel James, R.E.

Correspondence illustrative of the practice of the Peshwa's Government regarding adoptions, and the circumstances under which adopted sons could succeed to property held from the state.

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Correspondence regarding the concealment by the hereditary officers and others of the Revenue records of the former Government, and the remedial measures in progress :—I. Correspondence exhibiting the nature and use of the Poona Duftur, &c.—II. A Selection of Papers explanatory of the origin of the Inam Commission, &c.

Various Meteorological returns, viz :—From Master Attendant at Cocanada for May 1856.—From Master Attendant at Cuddalore for May 1856.—From Bhooj for June 1856.—From Baroda for June 1856.—From Bhagdad for May 1856.—Observations at the Dharwar Jail Hospital for April, May, and June.

From the Director of P. Instruction—Papers relating to the examination held at the Elphinstone College, Bombay, in December 1855.—Papers relating to the examination at the Poona College in December 1855.

From the Geological Society at Vienna.—36 Nos. of a Geological work in German, some of the numbers full of fine plates.

From London.—Vol. XXV. of Journal of Royal Geographical Society—Vol. XVI., Part 2, of Journal of Royal Asiatic Society of Great Britain and Ireland.

A List of books printed for the Oriental Translation Fund.

From Norton Shaw, Esquire—a French Pamphlet giving a Biblio graphical Sketch of the Libraries of various Geographers.

Received from Government, to be laid on the table of the Geographical Society for the general information of the members, and to be returned when done with, three printed reports, by the Messrs Schlagentweit, engaged in the Magnetic Survey of India.

The donations from Vienna were admired for their great magnificence, and the Society had reason to congratulate itself on the occasion which had opened up this new channel of intercourse betwixt them and Germany.

The proceedings of the day consisted chiefly in discussions as to the accuracy of Barometric measurements, generally prized more highly than they deserved to be. It was often boasted, that altitudes taken by the Barometer and Theodolite corresponded with each other to a foot or two. The occurrence of this must be very rare : where it was to be met with, it was ascribable purely to accident. Two Barometers of exactly the same construction, placed side by side and read by the same party, would not be found to agree with each other for twenty four hours on end. The altitude of a mountain would come out differently every time it was measured by a Barometer. Major Shortrede points out that the Barometric altitude of Poona, as referred to as a Bombay standard, differed from each other at different hours of the day ; and the Gerrards had long ago given illustrations of the same thing in their observations amongst the Himalayas. The great difficulty experienced by travellers, was to obtain a reference Barometer sufficiently near to be of service to them ; the Barometric measurements obtained from Persia, Affghanistan, and other remote quarters, must be received with large allowances, as having no means to refer to a Barometer for comparison within hundreds or

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sometimes within thousands of miles. The Secretary stated, that in travelling some twenty months ago through Kattiawar and Guzerat, he frequently found his Barometer to stand higher than that of Bombay in the same day and hour, leading to the inference, that the level of the interior was lower than the sea shore. On one occasion, the Barometer fell so as to indicate a very rapid ascent, where to the eye the country appeared level —this was afterwards found to be ascribable to a storm at Kurrachee some couple of hundred miles away, which left the mercury at Bombay unaffected. All these errors were very small in amount when reckoned in feet; and the Barometer was in reality an invaluable instrument where the level or the theodolite could not be resorted to, as being near enough the truth for all ordinary purposes; only its indications were to be received with a certain measure of reservation, and the idea scouted of its being comparable with the instruments of the Geometer. In India, from the smallness and regularity of its range, it became doubly convenient, and to assist in supplying the difficulty as to references, sets of tables had been published of the point at which the mercury stood every month of the year and every hour of the day in reference to all the places where trustworthy observations had been made, with other tables of altitudes ascertained trigonometrically by the officers of the great survey. By these means Barometric altitudes might be taken with very considerable confidence through more than half the year, without any reference to the Barometer at all, if the observer was within less than a thousand miles of some of the points referred to, and discarded all observations made during atmospheric disturbances; and the state of matters must improve as facts become multiplied. It was remarked on Dr. Balfour's Barometric sections, which gave rise to these observations—the Bombay Government having requested the opinion of the Society as to their merits,—that they furnished a very valuable contribution to Physical Geography, for which the Meteorologist and Geologist must feel most grateful. The Society were not in a position to test their accuracy, but from the fame of Dr. Balfour, there could be no doubt that every precaution had been taken to render them correct.

It was ultimately agreed by the Society, that in replying to Government to this effect, it should be suggested that it would be of very great value that a set of similar sections be prepared for the western Presidency, taken from the altitudes given by the trigonometrical survey and the levellings on our railways, with any such additions as the Barometer might supply; and that these would form a valuable appendix to the collection of Geological papers preparing for publication under charge of Dr. Carter.

On laying the Meteorological Observations taken at the stations of the Royal Engineers, edited by Colonel James, Superintendent of Ordnance Surveys, before the meeting, it was stated that these went far to upset many of the doctrines in reference to the atmospheric pressure long considered by us established. There was no reason to question their perfect accuracy on the vast number of points to which they referred, which rendered them of the

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utmost value.—From these and other researches now in progress it was obvious, that old Meteorologists must now set about studying the laws of atmospheric pressure anew.—

Mr. Berkley mentioned that in the comencement of the Railway Survey, a large number of observations had been made by the Aneroid, which were supposed likely to supply them with tracings which were expected to assist the Surveyors in discovering the best line to be followed with the level, but it was given up as far too loose. He then laid before the meeting a long list of levellings, made from Bombay right across the country until united with the railway levellings taken from Calcutta northward. This furnished the elements of two sets of sections from the east and west of the Peninsula extending north to Agra.

The great value of Mr. Berkley's communication was acknowledged, and a hope expressed that the altitudes now given, or hereafter collected, might be added to those already published.

The Ordinary Monthly Meeting of the Geographical Society took place on Thursday, October 16, 1856, Captain Jenkins in the Chair. A letter was laid on the table from Major Barr, offering his services to make observations while with the Persian Gulf Expedition provided he was supplied with instruments. The Society ought to thank Major Barr for an offer valuable under any circumstances,—peculiarly so from the zeal and ability with which Major Barr performed whatever he undertook. As the Society were at present somewhat short of supplies of instruments, it was resolved that Government should be applied to, to provide those which were deficient, as the Medical Storekeeper is understood to have lately received a large stock from Europe. The Chairman then stated, that on leaving England a few months since, he had undertaken to draw the attention of the Society to the very important expedition at present in contemplation under Captain Burton, of the Bombay. Army, into the interior of Africa, departing from Zanzibar, and to solicit assistance and information such as might help to promote the objects of the expedition. It was stated that it did not quite appear in what way the services of the Bombay Society could be made available on the occasion, but they would endeavour to do every thing that could be desired of them. A paper was laid before the meeting, by Captain Kempthorne, on some ruins of much importance in the Persian Gulf. As this had not been received till after the issue of the notice lists, intimating papers on other subjects likely to occupy the time of the meeting, its reading was deferred. The writer was desired to be thanked for his contribution. There being no other business before the meeting, the first paper read was on the late discussions in reference to the rotation of the moon round her axis.

Discussions on the Axial Rotation of the Moon.

Dr. Buist said,—I should scarcely have troubled the Society with the discussion of a subject on which men of science are so perfectly unanimous, and on

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which I have nothing to say that is new, but that I happened some time ago to have made up a little machine to illustrate one of Mr. Simmons' positions where it appeared to me that the examples selected by him for the proof of his theory was one of the best he could have chosen for its refutation. The same remark appears to have been made at the British Association, in reference to the apparatus exhibited and examples adduced by him. It is not however mentioned what these were, and it is quite possible that what I am now about to exhibit may be something altogether different from the contrivance shewn at Cheltenham. Whether it be so or not, it will afford the meeting some illustrations of the development of certain varieties of double rotatory motion, which may interest them. Mr. Simmons does not question the truth of any of the doctrines of astronomy, but conceives the nomenclature, so far as the actual rotation of the moon is concerned, delusive and affirms that our satellite only revolves, and not otherwise in the same sense in which a peg in the tier of a wheel may be said to revolve on its axis, exhibiting as the moon does the same aspect always to its centre. The examples of this most familiar to us in these times, may be found in the crank of a steam engine—the crank pin may be supposed the moon, its centre of revolution the paddle shaft represents the earth, to which certainly it does always turn the same side, but it exhibits all its sides in turn to the spectator, and to the rod connecting it with the working beam or cylinder which drives it. That the crank is endowed with double rotation will be seen by any attempt to key it or stop it on its own axis, when it will instantly be arrested in its orbit—that is, the engine will stop or break. But this being granted, the similitude between the moon's motions and those of the crank pin still remains to be shewn. If a single impulse would give the moon both its motions, then Mr. Simmons might claim something in the way of support. But if I take a piece of stone, say a cube represented at figure II., and project it forward into space, it will go right on without any axial revolution, or rotation of any kind, until it falls upon the ground. Now the parabolic curve here described by the stone is exactly that which the moon describes, only I have not given it force sufficient to project it far enough, otherwise it would have fallen beyond the earth and gone round. All motion is naturally rectilineal, and bodies projected forward will hold on for ever in a straight line through space, until some other force be impressed upon them. The constraining force in both cases is that of gravitation, which draws both stone and moon towards the earth—the latter strikes for want of force, the former goes on under the joint influence received at first by it from the Creator, modified by gravitation and centrifugal force. Had it been the will of the Creator to project the moon into space by a single force, she might have circled for ever round the earth, presenting to us all her different sides in turn, without any axial rotation. Instead of this, two separate and distinct motions were impressed upon her —one impelling her round the earth, and one impelling her round her own axis, the time in which the two revolutions are accomplished having been made the same. In this, the correspondence with the crank pin altogether

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fails. Mr. Simmons says, in a letter to the *Times*, that were we to stop the moon in her circuit round the earth, the moon would cease simultaneously with this to rotate round her axis. Although we cannot perform the experiment on a large scale, the end may equally be obtained through a model.

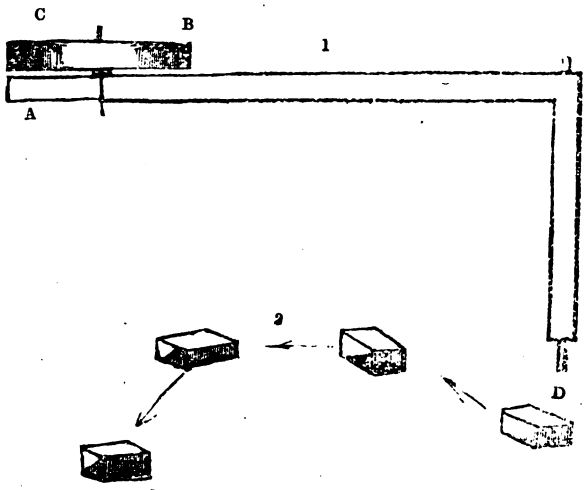

Figure I. represents an upright axis with an horizontal arm. The axis revolves freely in a socket and collar, permitting the arm to sweep rounds On the end of the axis is an iron wheel, in this case a foot in diameter—the dimensions and proportions are immaterial, the present has been assumed as matter of conveniency merely. The wheel is permitted to revolve freely on its axis, with as little friction as may be. When I start the arm suddenly forward in the direction of C A, the subsidiary wheel will be seen to revolve backwards in the direction of A C B. After two or three revolutions it will come to rest, revolving on the arm, but not apparently on its own axis. If I now suddenly stop the arm, still in a state of rapid motion, the iron wheel will keep flying round for some time in the direction of B C A, the reverse of that in which it at starting moved. This last meets the assertion of Mr. Simmons, who affirmed that when orbitual motion ceased, axial motion would cease also. The three movements admit of easy explanation. The whole mass of the wheel receives initiatory motion in the line of its own axis, and had this proceeded straight, the wheel would not have revolved at all. But the inner part of the wheel traverses in each circuit a less sweep than the centre, a less one still than that of the outer rim. The force required to put any body in motion is a joint function of the mass to be moved, and the speed at which it is to be so. It requires a greater force to move the rim at A than at B, where there is a less velocity, and therefore A falls behind, while B goes forward, the axial motion having been impressed at the point half way between them. The wheel comes to rest by and bye by the fric-

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tion of its axis, but for this it would have revolved backwards as the arm which carried it swept forwards. Having been brought to rest from the previous round motion through this cause, all parts of the wheel acquired the speed of the part of the arm nearest it, so that A is now revolving much more rapidly than B. When the arm is stopped suddenly, A keeps moving round at its former speed, the wheel now revolving in advance, until friction once more brings it to a state of rest. It will thus be seen, that if the moon which has no friction were arrested in the line of her centre, she would go on wheeling for ever round her own axis, though standing still in space. It thus becomes plain that the motions of Mr. Simmons and his few followers have become confused on these subjects altogether, from the Author of Nature having seen meet to make the moon, through different causes altogether, to perform her orbitual and axial motions at the same time, just as a crank pin or a spot on the earth's surface, under totally different circumstances, performed their orbitual and axial motions simultaneously.—This is not, properly speaking, a geographical subject, but we are not very rigid in the limits which we assign to our discussions, and it has been long understood that we might advantageously take up subjects of popular excitement at home, even when not Geographical, and though there was not very much new to be said upon it. I do not consider these remarks in any way deserving a place in our *Transactions*, though they are at the service of the local newspapers, should they be deemed worthy of a share in their space.—Dr. Sinclair in going over the subject expressed his entire concurrence in the views of Dr. Buist, who he said had mainly confined himself to a discussion of Mr. Simmons' own illustrations. The libration on the moon's axis, which Dr. Sinclair illustrated by throwing up a ball with a pencil through it, afforded an example of a separate class of motions which had no similitude to any thing a crank exhibited. Dr. Sinclair's illustration will be understood by the diagram No. III. where the axis of our satellite in librating while it revolves describes a couple of cones, with their apices to the centre. The discussion was of much interest and some duration, and was hailed as an approach to the home system, where the best part of the proceedings of learned societies often consisted in the debates which followed the reading of a paper.

The next subject taken was the encroachments of the sea on the shores around. As this consisted mainly of a collection of the facts which have from time to time appeared in our pages, it does not seem requisite to give a report

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The Ordinary Monthly Meeting of the Bombay Geographical Society took place on Thursday, December 16, 1856, Lieutenant Kennelly, I. N. in the chair. The following donations were presented :—

Received since last meeting, from Government, Official Correspondence regarding the Ford Wah in the Shikarpoor Collectorate, Sind, 1855-56.—From London, two books of the address at the anniversary meeting of the

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Royal Geographical Society, 26th May 1856; two books of the meeting of the members of the Royal Institution of Great Britain.—From Greenwhich, Magnetical and Meteorological Observations for 1856.

The following letters with reference to the African Expedition were laid before the Society.

From H. L. Anderson, Esq., Secretary to Government.

To George Buist, Esq., L.L.D.,
Secretary to the Bombay Geographical Society.

26th November 1856.

SIR,—I am directed by the Right Hon'ble the Governor in Council to request, that you will be so good as to express to the Geographical Society the wish of Government, to be favored with the loan of any Charts of Zanzibar, and the African Coast adjacent which may be on its records, for the use of Lieutenant R. F. Burton, who is proceeding in command of an Expedition to Equatorial Africa, under the patronage of Her Majesty's Government,—I have &c.

H. L. ANDERSON Secy. to Govt.

Bombay Castle, 26th Nov. 1856.

To H. L. Anderson, Esq., Secretary to Government.

Sir,—In reference to your letter, No. 5379 of 1856, dated 26th November, I have the honor to forward three Charts of the Coast of Zanzibar, by Captain Owen of the Royal Navy. These form part of the contribution of Her Majesty's Lords of the Admiralty to the Ross Testimonial, and can therefore only be lent. It seems probable at the same time, that copies of them may be found in the Draftsman's Office.

Captain Burton, for whose use they are intended, is no doubt already in possession of the information in reference to this part of Africa in the Church Missionary Society's publications, as also in the Transactions of the Royal Geographical Society of London, and the Bombay Geographical Society.

I have &c.

Bombay, 27th November 1856. GEORGE BUIST, Sec. to the Society.

From H. L. Anderson, Esq., Secretary to Government.
To the Medical Board, Bombay.

17th December 1856.

Gentlemen,—I am directed by the Right Hon'ble the Governor in Council to acknowledge the receipt of your Secretary's letter, No. 3246, dated the 3rd instant, and to inform you, that Government approves of your recommendation therein contained with reference to the Medicines and Instruments

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to be supplied to Mr. Assistant Surgeon Steinhauser, in the event of its being finally decided that he is to proceed with the Expedition into Equatorial Africa under the command of Lieutenant Burton, of which due intimation will be given you.

I have &c.

(Signed) H. L. ANDERSON,
Secretary to Government.

Bombay Castle, 17th December 1856.

To G. BUIST, Esq. Secretary Geographical Society.

17*th December* 1856.

Sir,—I am directed by the Right Hon'ble the Governor in Council to acknowledge the receipt of your letter dated the 8th instant, relative to the Expedition into Equatorial Africa under the Command of Lieutenant R. F. Burton of the 18th Regiment, Bombay Native Infantry.

2. In reply, I am desired to request, that you will have the goodness to communicate to the Committee of the Bombay Geographical Society, the thanks of the Right Hon'ble the Governor in Council, for the valuable suggestions contained in your letter.

3. It being very desirable that Lieutenant Burton should be provided with proper instruments for determining the height of mountains, &c., advantage will be taken of the expected arrival in Bombay of the Messrs. Schlaginheweit on their way to Europe, to procure from them, if practicable, some of the instruments which they have had in use in the Himalayas, and to forward them by the first safe opportunity to Lieutenant Burton.

4. I am further desired to transmit, for the information of the Geographical Society, copy of a letter from the Acting Secretary to the Medical Board, No. 3246, dated the 3rd instant, and of my reply of this date.—I have &c.

Bombay Castle, 17th Dec. 1856. H. L. ANDERSON, Sec. to Govt.

From W. C. Coles, Esq., Act. Sec. Medical Board
To the Secretary to Government.

3*rd December* 1856.

Sir,—With reference to your letter, No. 5469, and adverting to the remark of Captain Burton in the 2nd para. of his letter dated 25th November to your address, that Dr. Steinhauser "is a proficient in Natural History, and will be a most useful companion where fever abounds and medical skill is at a premium," the Medical Board beg respectfully to recommend, that Dr. Steinhauser should be furnished with such medicines and surgical appliances as he may consider necessary, to be obtained at the Aden Depot upon indent, countersigned by the Superintendent at Aden.

2. Further, that to assist in the advancement of scientific research, the Meteorological Instruments as stated below may be obtained from the Me-

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dical Stores, Bombay, and placed at his disposal. The instruments being forwarded hence to his address by the next steamer.—I have &c.

(Signed) W. C. Coles, Asst. Surgeon,
Act Sec., Medical Board.

List.	No.
Mountain Barometer	[two 2]
Daniell's Hygrometers	[two 2]
Æther	[lb. ½]
Maximum and Minimum Self-Registering Thermometers	Sets 2
Common Thermometer	No. 6
Thermometer for Altitudes, &c	No. 1

From H. L. Anderson, Esq, Sec. to Gov.
To George Buist, Esq, L.L.D.
Secretary to the Bombay Geographical Society.
29th Nov. 1856.

Sir,—I am directed by the Right Hon'ble the Governor in Council to transmit to you, for the information of the Bombay Geographical Society, copy of a Despatch and of its enclosures, from the Honorable the Court of Directors, No. 38, dated the 24th September last, regarding the employment of Lieutenant R. F. Burton of the 18th Regiment Bombay Native Infantry, to command an Expedition about to proceed into Equatorial Africa under the patronage of Her Majesty's Government.

2. In forwarding these documents I am desired to state, that this Government will be happy to take into its consideration any suggestions which the Bombay Geographical Society may wish to offer, having in view the furtherance of the success of Lieutenant Burton's Expedition.—I have &c.

H. L. Anderson, Secretary to Government.

Bombay Castle, 29th November 1856.

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15 *White Hall Place, 6th June* 1856.

Sir,—I have the honor to acquaint you, for the information of the Court of Directors of the Honorable East India Company, that the Council of the Royal Geographical Society has arrived, after a full investigation of the subject, at the conclusion—that the Exploration of the unknown regions of Equatorial Africa, by means of an Expedition from the East Coast, might now be advantageously undertaken.

Proposals to this effect have, at different times, been laid before the Society by various persons, among others by Captain Turner, R. N., Lieut. Ormsby, I. N., and Mr. W. Bollaret, which, for want of the requisite means, have not

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been entertained. The present proposition has, however, been favorably received by Her Majesty's Government, and it is hoped that the Honorable the Court of Directors, having long taken an active interest in this part of Africa, will also contribute towards its success.

The great achievement lately performed by Dr. Livingston, in penetrating from the Cape of Good Hope, through the centre of the Continent to within ten degrees of the Equator, has thrown new light upon the interior of the African continent, and displayed its resources under highly favorable aspects. Other information has also from time to time been received through the Church Missionary Society from Native traders, relating to the countries north eastward of Livingston's route, and to those parts this Society is now anxious to direct its efforts.

In this direction the Interior has been penetrated for any distance by Europeans, but the enquiries of the Missionaries and the investigations of our most learned geographers sustain a report which has prevailed during three centuries that a large body of navigable water exists there, to which access is obtained by various routes constantly traversed by Arab and Native traders, who form caravans from Mombas and other places on the East Coast to the Interior. Although this great mass of water, or inland lake, called by some "a sea," has long since found a place in our Maps, and the Missionaries affirm that they have seen snow mountains to the northward of it, yet no effectual steps have yet been taken to explore this interesting region.

The existence of the lake has been further confirmed in communications from Mr. Consul Brand and the Portuguese Government, describing journeys made by a party of Arab traders, who after traversing the continent from Zanzibar on the East Coast to Benguela on the West, have recently returned from thence to Mozambique. The Arabs described their routes as being well occupied by settled populations, rich in cattle, cultivating the soil, and having plenty of ivory, valued by them at a very low rate. In Dr. Livingston's opinion, active European traffic with that part of the interior which he traversed, would have the effect of developing great natural resources, and the various routes known to be followed by Natives towards the adjacent countries proposed to be explored, favor a similar conclusion.

The Society has, in a former communication, dated March 11th 1850, alluded to the benefits which science has derived from the interest taken by the East India Government for many years in this part of Africa, leading to several successful examinations of the Coast and various journeys inland, accounts of which have been printed in the Journal of this Society. The establishment of an Officer of the Bombay Army as British Consul and Agent for the Company in the Territories of the Imaum of Muscat, for some time past, is also calculated to pave the way for a Mission to the interior the advantages of which are further pointed out in a paper by the present Chairman of the Hon'ble Court, printed in the 23rd Volume of the Society's Journal.

The object of the proposed Expedition, is to penetrate to the Interior of

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Equatorial Africa, from the East Coast in the direction of the lake, to ascertain the nature of the drainage generally of this part of the continent, together with its other natural features, the position of its inhabited places, the character of its people, their resources and condition, and the best means of establishing intercourse with them. The discovery of the Lake and of the parting between the rivers flowing into the East Coast, on the one hand, and towards the North and West on the other, would naturally lead in the direction of the long-sought sources of the Nile, which have never before been attempted to be reached from this quarter. The attempt to solve this problem alone would suffice to attract the interest of the world to the proposed Expedition.

To carry out this important object, the Council places great dependence on the experience and energy of Captain Burton, of the Hon'ble Company's Bombay Army, under whose command it is proposed that the Epedition should be placed. The qualification of this officer as an explorer were laid before the Hon'ble Court by the Council of this Society, in a communication addressed to you, Sir, and dated December 22nd 1852. Since that time, Captain Burton's memorable Journey to Mecca and Medina, and his bold expedition to the African City of Harar, have fully sustained the opinion then expressed. The Council therefore hope, that the Court will be pleased to empower CaptainBurton to engage in the proposed undertaking, his full pay and allowances, while he may be so occupied, being granted to him.

In submitting this proposal to the Hon'ble Court of Directors, I am glad to say, that it has not alone already received the approval of Her Majesty's Government, but, as I am informed, the assurance also of its support to the extent of £1,000 (one thousand pounds.)

It is contemplated that the journey may extend over a period of two years, and as it is necessary that Captain Burton, should be accompanied by assistants, capable of making scientific observations, that he should be provided with presents for the Chiefs, and that his party should be of sufficient strength for the usual emergencies. The Council further trust, that the Court of Directors will take the possible additional expenses of the journey into their consideration, and extend such aid towards it as they may think necessary, not only to secure the effectual exploration of those unknown regions, but also the probable establishment of commercial intercourse with the people of the Interior.—I have &c.

(Signed) NORTON SHAW, Secretary R. G. S.

East India House, 30th *August* 1856.

Sir,—I have the honor to acknowledge the receipt of your letter of the 6th June last, calling the attention of the Court of Directors to a proposed Expedition, aided by Her Majesty's Government, for the exploration (from the East Coast) of the unknown regions of equatorial Africa, and soliciting the assistance of the Court towards the furtherance of this important object.

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In reply I am directed to inform you, that the Court of Directors are willing to co-operate with Her Majesty's Government, in giving effect to a measure which, they believe, will contribute to the general advancement of science, and the development of Eastern commerce, and are therefore prepared, in compliance with the request of the Council of the Royal Geographical Society, to authorize the employment of Captain Burton, of the Bombay Army, on this special service for two years, without prejudice to his position as a regimental officer, on full pay and regimental allowances.

I am directed to add, that the Court of Directors, still further to promote the success of the Expedition, are prepared to issue such instructions to the authorities in India as may be calculated to facilitate its operations, with special reference to the exercise of their influence with the Imaum of Muscat, from whose territory it is proposed that the Expedition should start. I am &c.,

(Signed) J. D. DICKINSON, Dep. Sec.

OUR GOVERNOR IN COUNCIL AT BOMBAY.

1. We transmit to you herewith copies of a letter from the Secretary to the Royal Geographical Society, and our answer thereto, regarding the employment of Lieutenant R. F. Burton of the 18th Regiment of Bombay Native Infantry, with an Expedition, that is about to be despatched in Equatorial Africa by the Royal Geographical Society, with the approval and under the patronage of Her Majesty's Government. Lieutenant Burton has been informed, that he is permitted to be absent from his regiment, and to draw his pay and allowances whilst so employed for a period not exceeding two years, to be calculated from the date of his departure from Bombay.

2. With reference to his correspondence, we desire that you will adopt such measures as may appear to your Government likely to contribute to the success of the Expedition.—We are, &c.

(Signed) W. H. SYKES
,, R. D. MANGLES,
and other Directors.

London, 24th Sept. 1856.

H. L. ANDERSOM, Esq. Secretary to Government.

Political Department.

Sir,—In reference to your letter of the 28th November, being number 3,400 of 1856, with accompaniments from the Hon'ble the Court of Directors, and the Royal Geographical Society of London, regarding the Expedition into Central Africa under Captain Burton, I am instructed by the Committee of the Society to reply: that it appears to them, that some of the following suggestions might probably be deemed worthy of consideration. They are made in compliance with the wish of the Right Hon'ble the Governor in Council, to meet a merely possible contingency—the Committee not

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doubting that Captain Burton, is fully instructed from higher authorities, and duly impressed with the responsibilities, and duties of the important and honorable enterprize committed to his charge.

2. From an application by Captain Burton to the Society, for the use of an Aneroid, it appears that he has been disappointed in the receipt of his own Mountain Barometer, and that his only instruments for measuring elevations by pressure, are a couple of boiling-point Thermometers.

3. As Captain Burton, is about to cross a great mountain ridge, or table land, and to endeavour to survey a vast Lake, or chain of Lakes, which appear to absorb the River systems of Central Africa, or form the source of the Nile, or some of its branches—questions of altitude become of more than usual interest, and he ought to have a more than ordinarily liberal supply of the means of prosecuting his enquiries. The Committee would therefore recommend that he should have with him at least three or four Barometers, one to be left at Zanzibar for reference, the rest to be carried on along with him (one he has taken with him from the stores of the Society.) That he should have two Aneroids, serviceable chiefly from their portability, with two or three mountain Simpisometers—if the instrument is to be had good at the Presidency,—a matter the Committee deem doubtful. The Society has already provided him with one strong serviceable Barometer by Adie, two or three others should be sent after him—the Government supplies being abundant. He will probably carry one of each kind along with him, and leave a like number at Zanzibar. Captain Burton is doubtless aware, though too many travellers seem to forget, the fact that the value of pressure observations, where accuracy to within 400 or 500 feet is aimed at, depends mainly on having some trustworthy instrument to refer to at the seashore, or at some point of known altitude above it, and that this should be as near as possible to the elevation to be determined. We have no Barometric observations whatever from Zanzibar; the party applied to by the Society and provided with a Barometer in 1849 having failed to carry their wishes into effect.

4. The nearest reference point of known pressure is Aden,—above a thousand miles away, a distance under any circumstances much greater than is desirable—the evil being in the present case aggravated by the prevalence of violent squalls betwixt the Persian Gulf and Cape Guardafui, which sometimes throw down the mercury by half an inch, and thus might create an error in altitude of 500 feet. Captain Burton will, on reaching Zanzibar, be able to judge of the means of carrying on his supplies; and if the Instruments recommended are found more cumbrous than convenient, they need only be left behind.

5. In the course of a Pilgrimage expected to extend over two years, he will have frequent occasion to communicate with the Sea Coast, or may not improbably be joined by companions: in either case he will be able to avail himself of the supplies in his rear.

6. The Society not being aware of the state of his Instruments and instruc-

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tions beyond what has been communicated to them officially, do not in this matter venture on any further suggestion. Captain Burton will doubtless be impressed with the importance of enquiring into the amount of the fall of rain, and of evaporation, in regions abounding with Lakes and Rivers, but which, so far as has been ascertained, send no supplies to the ocean. Geological specimens are so cumbrous that they are not to be expected from the Interior; but the vessel which carries the travellers to Zanzibar may bring back with her, without inconvenience, any amount from the Sea shore; and it will be eminently interesting to know, whether the great Limestone formation—extending in one vast continuous band from the banks of the Burrumputra to those of the Tagus, and from which Captain Burton forwarded valuable specimens from the Somali country—prevails as far south as the Line, and to what distance it extends into the interior it will be desirable to ascertain, whether the upheaved Sea beach—such as that which forms the Esplanade, and is the favorite habitat of the Cocoanut groves around—prevails along the shores of Africa:—and whether, if so, it manifests those signs of a double depression or upheaval, which characterize it in most parts of the world. Both facts may in all likelihood be determined by the appearance of the shore, the inspection of any wells or excavations in the neighbourhood or by enquiries of the people as to whether, in digging downwards, they have met with blue clay, or tree roots underneath the beds of gravel—loose or hardened into masses—forming the upper surface of the beach. Of the £300,000 worth of commerce betwixt Eastern Africa and Western India—the principal part being that of Zanzibar—gums and gum resins form an important part—nearly £20,000 worth being exported from Zanzibar. The most valuable of these are Copal and Gum Animi—the principal supplies being found under ground, from which they are washed out by streams and torrents. Like the Dammer of Singapore and some of the most important Gum Resins of Australia, they may be regarded as semifossils—the produce of forests which have long since disappeared. Our information regarding them is most defective,—anything tending to increase or improve it would be highly prized. We should like to know: whether the *Valeria Indica* which produces it, still abounds as a Tree, as also, what may have been the extent, what the position and circumstances of the extinct Forests, of which it now constitutes the principal trace. The refuse of the Gum Resins used frequently to reach Bombay as *packing*—being deemed of no value. Copal has of late years become so scarce, so much in demand, and so dear that what was formerly thrown away would probably now be considered of value in the market, and there are few of the investigations a traveller can undertake, the people of England value so highly, as those that can be turned to commercial account. Materially to reduce the price of coach varnish would probably be considered to entitle Capt. Burton to a larger share of the gratitude of his countrymen than the measurement of the elevation of the Mountains of the Moon, or the determination of the sources of the Nile. Having thus, in compliance with the wishes of the

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Right Hon'ble the Governor in Council thrown out such suggestions as occurred to them, the Committee direct me again to repeat an expression of their entire confidence in the Expedition, as fully competent to judge of whatever is valuable or attainable.

(Signed) GEO. BUIST, *Sec. to the Society.*

Captain BURTON, Eden Hall.

Geographical Society, 29th Nov. 1856.

Sir,—In reference to your letter of this day's date, applying to the Geographical Society for the the use of an Aneroid—as you had been disappointed in a mountain Barometer expected by the Mail, and no good article of the kind was to be found in Bombay,—I have the honor to state :—

That the Geographical Society has no Aneroid in store, but that they are likely to be had on sale at Smith, Elder & Co.'s or Thacker & Co.'s. Failing this, there are two excellent Aneroids in the Museum, the property of Government, the places of which might be supplied from home, by the time they come to be required by that Establishment. They have been carefully rated by me with the Standard Barometer, as per margin, and it will be seen that No. 8203 differs from this by 00.030.

Temp	80
Bar	29.810
Ane 1,613	29,670
Diff	140
Bar	29.840
Ane 8203	29.830
	0.130

The Society has two strong Barometers by Adie for sale, and two by Newman, the property of Government, which you may have immediately, as I have no doubt your application will be sanctioned by Government. There is a large supply of beautiful new instruments by Newman in the Medical Stores, while others, I believe, are in the Chief Engineer's Department—to be had by order of Government, or by indent or purchase by sanction of the Military or Medical Board.—I have &c

GEO. BUIST, *Sec. to the Society.*

Dr. Buist then made the following observations on the recent earthquake in the Levant :—It is a curious characteristic of all volcanic commotions of which the earthquake is the most notable, that they are always accompanied by meteorological disturbances. It is probable that the connection is an electrical one ; and that the equilibrium of the electric fluid in the earth becoming disturbed, that of the air is affected. Whatever the cause may be, there is no doubt whatever as to the fact. The late earthquake in the Levant gives us an additional illustration of phenomena, of which we are already sufficiently familiar. Egypt, which on the present occasion has suffered so severely, has in general from the earliest ages been remarkably exempt from earthquakes. So far as is known, the region over which the recent shock was experienced, extended eastwards and southwards to Grand Cairo ;—northwards to Rhodes ; and west as far as Naples. The extreme points are distant from each other about 1200 statute miles. The diameter of the area

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due east and west, seems to be about 1000 miles ; north and south about 600. The following are the points from which accounts have been received, with their longitudes and latitudes. I begin with the westernmost. I have given longitude in time as well as space for Malta, Rhodes and Alexandria, these being the only three for which the hour of the shock is given.

	Lat.	Long.	Time. H.	M.
Naples	40.51 N	14.15 E		
Calabria	35. 0 N	16.28 E		
Malta	35.45 N	14.30 E		059
Corfu	30.37 N	19.55 E		
Rhodes	36.25 N	28.15	1	53
Smyrna	38.30	26.48		
Alexandria	31.12	30.00	2	0
Cairo	30	31.19		
Suez	29.58	32.34		

I have set down Suez on the authority of a Cairo correspondent of the *Morning Herald*, who states that here the earthquake was accompanied by a violent hail storm. If this statement be correct, it is singular that no direct information should have reached us on the subject, especially as the event must have occurred close on the time when the home passengers were on their way through. There is but a small number of the points enumerated from which we have trustworthy accounts of the time at which the earthquake occurred—they are the following. I have given local time first, adding Greenwich time in the second column : subtracting the difference, brings them to a point common time, and shews the rate at which the shock travelled :—

	Local Time.	Greenwich Time	Difference.
Malta	1.49	0.59	0.50
Rhodes	2.40	1.53	0.47
Alexandria	2.55	2. 0	0.55

The distance from Malta to Alexandria is about 1000 miles, and this was travelled in five minutes ; that from Alexandria to Rhodes about 400 ; and this was travelled over in seven minutes.—So that if the time be accurately given the wave was moving nearly thrice as fast westward as northward.—I trust by and bye we may receive tidings of the precise time at which it was observed at all the various points where it was experienced.

There is the more reason to look for this, as most of these were considerable seaports, where the ships' watches may be referred to and depended upon. The railway clock at Cairo was stopped twelve minutes later than that at Alexandria ; unfortunately no reliance can be placed on the time at the latter locality. I have already stated that hail showers were said to have fallen at Suez, but that here, the vibration was very slight. At Cairo the successive vibrations continued for about a minute, and about one hundred and fifty houses with a couple of minarets were shaken down. At Alexandria few old walls tumbled. No substantial damage was occasioned, but the people

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were thrown into a tremendous panic. At Malta several of the steeples were thrown off the plumb; many of the houses were cracked and rent; the sea rolled back by nearly three feet; but luckily there was no loss of life. At Naples and in Calabria the shocks were long and severe, and mount Ætna vomited forth an unusual amount of smoke and flame. At Rhodes fifty houses were said to have fallen, and the loss of life in the neighbourhood was said to have been heavy. The Austrian Lloyd's steamer *Adria* felt it at sea fifty miles from Rhodes, and the St. Andrew's steamer three hundred miles on her way from Malta to Alexandria, lost one of her masts, and was so severely strained, that she sprung a leak. The usual meteorological phenomena made their appearance. Water-spouts, squalls of wind and violent rain were experienced all around Malta. Here a heavy drought had prevailed for nearly a couple of years, and from the 26th of August to the 16th of October not a drop had fallen. At the latter date there was an alarming gathering of clouds in the air, followed the succeeding morning by a furious thunder-storm with perfect deluges of rain. A farm house was struck by lightning and a man and woman killed. The steeple of Queen Adelaide Church was likewise struck; as also a house in Valetta, in which several people were killed. The storm drew off towards night-fall, but was renewed again with still greater fury next day, when several buildings were again struck with lightning, and those which had been injured by the earthquake were deluged with rain. The Naval authorities were able to collect 14,000 tons of water for the use of the shipping.

Since the admirable papers of Major Baird Smith, published in the *Transactions of the Bengal Asiatic Society* in 1843, we have had no regular accounts of our Indian earthquakes. I have for the last fifteen years regularly cut out from the newspapers, and pasted together, all the published information available on the point, but have never, for want of time, been able to turn it to any further account than making a few catalogues or chronological list. One of these,—in state of tolerable completeness, will be found on the Map accompanying my paper on Indian volcanoes published in our Transactions for 1852. The present year has been rather fertile in earthquakes; the past was somewhat barren. On the 11th February 1855, a severe shock of the earthquake which lasted full twenty seconds, visited Meerut and Roorkee, just after day-break; while a shock was felt at Kurrachee, the same morning about three. On the 17th March a succession of shocks were felt at Meerut, Allyghur, Delhi, and Muttra; and on the 19th of June a slight shock at Jacobabad upon the Northern Scind frontier. These are all I find set down in my list for last year. On the 17th of January a severe shock of earthquake occurred at Delhi. On the 2nd of March last, a series of tremendous earthquakes and volcanic eruptions prevailed over Cœlebes and the Moluccas, during which twenty thousand lives were said to have been lost. I do not observe that any signs of this manifested themselves in any part of India—From the 6th to 9th of April last, a constant series of slight shocks were experienced all over the Punjaub.

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The Monthly Meeting of the Bombay Geographical Society was held in its Rooms, on Thursday the 19th February 1857, at half past four P. M.

Present.—Rear Admiral Sir Henry Leeke, Commander-in-Chief of the Indian Navy, Prdsident in the Chair, W. E. Frere Esq., C. S.; E. Leggatt Esq., Lieut. D. J. Kennelly; H. Liardet Esq., (visitor); and R. S. Sinclair Esq., Acting Secretary.

The minutes of the last Meeting were read and confirmed.

Letters read.—No. 5803 of 1856, from H. L. Anderson, Esq, Secretary to Government, Political Department: No. 11 of 1857, from John Mawson, Esq., Acting Secretary to the Bombay Chamber of Commerce: No. 8 of 1857 from E. H. Furgusson, Esq., Lieut. I. N., superintendent of Government Observatory; No. 221 of 1857, from Colonel Melvill, Secretary to Government, Military Department; letter from C. S. Sinclair, Esq., letters from C. Weedmann, Librarian, and from Dr. Martinez, Secretary, Royal Bavarian Academy, Munich.

Presents to the Library.—1. Naturiorssenschaftliche Abhandlungen Gesammelt von *Wilhelm Haidinger*.

2. Abhandlungen der Kaiserlich—Koeniglichen Geologischen Reichsamstalt.

3. Jahrbuch der Kaiserlich Koeniglichen Geologischen Reichsamstalt (Parts 5, 6, 7.).

4. Journal Asiatique (Parts 6, 7.)

5. Report of the Bombay Chamber of Commerce for 1855-56.

6. Journal of the Indian Archipelago and Eastern Asia.

7. Contributions to the Meteorology and Hydrology of the Indian Ocean.

8. Colonel Alexander Walker's Reports on the Province of Kattywar and the Ceded Districts in Guzerat.

9. Magnetical and Meteorological Observations made at the Hon'ble East India Company's Observatory, Bombay, in the year 1854-55 under the superintendence of Lieut. E. F. T. Furgusson, I. N. F. R. A. S.

The best thanks of the Society were voted to the donors for these presents to the library.

In reference to the following extract from the letter of Dr. Charles V. Martinez, Secretary Royal Bavarian Academy Munich: "I should be very thankful if you give me some accounnt of a Botanist to whom I could apply for a mutual correspondence and exchange of dried plants (or books) I am particularly interested in knowing the Palmæ in the Flora of Bombay amongst which the *Borassusdichdtoma*) (*Kulpavroochum*, Sanscrete) is totally unknown to me," the Acting Secretary was directed to communicate with Dr. Gibson, Conservator of Forests.

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Also it was agreed, that the Society would be happy to become the means of communication between Dr. Martinez and any person interested in the subject of Botany. Should a more direct correspondence, however, be considered desirable, the Society wish it to be known that "Willams and Norgate, London" was suggested to themselves by Dr. Martinez, as being one of the least expensive channels of intercourse.

In reference to the letter from C. Weedmann, Librarian to the Royal Bavarian Academy of Sciences, thanking the Society for vol. xii. of its Transactions, and desiring a copy of vols. i—viii. and xi., it was stated that the first impression of the earlier volumes of the Society's Transactions having been exhausted, another impression was in progress. It was then resolved that, as soon as reprinted, a copy of the above mentioned volumes be forwarded.

At this meeting of the Society no regular paper was read. But the President and other members present, dwelt with much interest on the desirableness of trying M. Foucault's pendulum experiment for exhibiting the rotation of the earth, in Bombay with the necessary degree of accuracy. It was stated that under much more unfavorable geographical circumstances, the experiment had been made in Ceylon (Lat. 6 56) by Lamprey and Schaw with very creditable experimental results; the hourly motion of the place of the pendulum's oscillation being 1.870 according to experiment, whereas the amount, as deducible from theory, should have been 1.815°. The geometrical considerations involved in the problem were briefly stated, which lead to the following formula that the motion for Mean Solar Hour of the plane of vibration of a pendulum at any place on the earth's surface is equal to 15.0411 multiplied by the *sine* of the Geographical latitude of the place.

M. Foucault's own experiments were conducted on a very grand scale, in a good latitude (48° 50), and with excellent appliances. The upper end of a steel wire, of about 64 mètres in length, was encased in a metallic plate fixed to the centre of the cupola of the Pantheon, while the lower extremity supported a heavy ball of copper. The pendulum thus formed effected its oscillations very slowly; the duration of each of them occupying about 8 seconds of time. The result of the series of experiments gave 11.500° as the hourly motion, theoretic computation assigning 11.323°. In some other places of the earth, experimental results have approximated still more closely than M. Foucault's to those of calculation, sometimes erring in defect, sometimes in excess. Not having at hand a larger number of experiments, the following carefully determined figures may be cited as affording matter of interest. The Latitudes have been determined by independent means; the hourly motion of the plane of the pendulum has been observed by the annexed names; and the assigned times of rotation of the earth have been several-

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ly computed from the motions by aid of the formula already stated.

Place.	Lat.	Observed Hourly Motion.	Observer.	Time of Rotation H.	M.	S.
Ceylon	6o 56'	1o.870	Lamprey & Schaw.	23	14	20
New York	40 44	9·733	Loomis.	24	8	9
Providence R.I.	40 49½	9·955	Carswell & Norton.	23	38	29
New Haven C.T.	41 18⅔	9·970		23	50	7
Geneva	46 12	10·522	Dufour & Wartman	24	41	39
Paris.	48 50	11·500	Foucault	23	33	57
Bristol.	51 27	11·788	Bunt.	23	53	2
Dublin.	53 20	11·915	Galbraith & Haughton.	24	14	7
Aberdeen.	57 9	12·700	Gerard.	23	48	49

It is curious to observe that the mean of the above times of rotation is 23*h*. 53*m*. 37*s*. differing by less than 2½ minutes from the true amount for a period of nearly 24 hours. Considering the experimental difficulties to be encountered, these figures are very close.

It was stated by one of the members, that not being acquainted with any results by the pendulum for latitudes near that of Bombay, as well as for its local interest, he had begun to make some observations in the Central room of the Government Industrial Museum ; the ceiling of which room however was much too low. This fact independently of drafts of air, would render the observations less useful. The cupola of the Town Hall was mentioned as being apparently the most suitable place for suspension in Bombay. The President, Mr. Frere, Lieutenant Kennelly and other members contributed suggestions as to meeting the practical difficulties ; but the official occupations of the members seemed to tender it impossible for them to devote to the matter at present the necessary time.

The Monthly Meeting of the Bombay Geographical Society, was held in its Rooms, Town Hall, on Thurusday the 23rd April at ½ past 4 P. M.

Present,—Rear Admiral Sir Henry Leeke, Commander-in-Chief of the Navy, *President*, in the Chair.

The minutes of the last Meeting were read and confirmed.

Letters Read.—From W. H. Carry Esq., Thomason College, Roorkee. From Messrs. Smith, Elder & Co., Cornhill, London. From Mooltan, April 4 From Captain R. McLagon, Officiating Principal, Thomason College 28th March. From Thomas Oldham Esq., Superintendent of the Geological Survey of India, and of the Geological Museum Calcutta. January. From W. C. Coles Esq., Secretary to the Medical and Physical Society of Bombay. 2nd March, No. 1572 of 1857 from Colonel Melvill, Secretary to

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Government, Military Department. No. 1603 of 1857 from H. L. Anderson, Esq., Secretary to Govenment Political Department. From Dr. Downes forwarding at the request of Captain Furshard, I. N., a record of observations made from Zanzibar to Aden, also extracts from the log of the Brig Helena from Zanzibar to Seeshikles and back. From Dr. Gibson, Conservator of Forests, stating he would take an early opportunity of communicating with Dr. Martinez, and expressing the hope that he would be able to send him a supply of the fruit of the Borassus Dichotoma during the present year.

PRESENTS TO THE SOCIETY.

1. Memoirs of the Geological Survey of India.

2. Miscellaneous information connected with the lapsed Sattara Territory, and the districts belonging to the Sattara Jageerdars.

3. Transactions of the Medical and Physical Society of Bombay for the year 1855-56.

4. Reports on the proceedings of the officers engaged in the magnetic survey of India.

5. Correspoodence relating to the Tenure of the possessions in the Deccan held by His Highness Jyajee Rao Sindia under the treaty of Surje Anjungaum.

6. Report on Vaccination throughout the Bombay Presidency and Sind, for the year 1855.

7. Papers regarding the Revenue Settlement effected in the Districts of Omerkote and Thurr; and on the condition and system of management of the Tharr and Parkur districts.

8. Annual Directory and Calendar for the N. W. Provinces, Punjaub and Oude for the year 1857.

9. The Almanac and Companion for the North-west Provinces and the Punjaub for the year 1857.

10. Proceedings of the Royal Geographical Society of London.

11. A Memoir on the Ancient Reservoirs lately discovered, and now in course of restoration at Aden.

12. Russia at the close of the sixteenth century, comprising the Treatise "of the Russian Commonwealth," by Dr. Giles Fletcher, on the Travels of Sir Jerome Horsey, Knight, now for the first time printed entire from his own manuscript.

13. Proceedings of the Society of Antiquities of Scotland. Vol. 2 part. 1.

The thanks of the Society were voted to the donors for these contributions to the library.

The President then called on Mr. Leggatt, who spoke much to the following effect in illustration of a vast variety of excellent specimens of ferns which

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were exhibited at the meeting. The principal were the followiug, gathered on the Neilgherries in the year 1854.

1. Adiantum Capillus Veneris.
2. Asplenium Strigollossum.
3. Asplenium Planicaule.
4. Asplenium Raaberhizon.
5. Asplenium Bulbiferum.
6. Asplenium Appendiculatum.
7. Asplenium Felix Femina.
8. Nothochlœne Squamosa.
9. Nothochlœna Rufa.
10. Nothochlœna Agentia.
11. Nothochlœna Nicea.
12. Niphobolus Lingua.
13. Niphobolus Pertusus.
14. Niphobolus Rupes-tris.
15. Polypodium Longipes.
16. Polypodium Longipes Femina.

The Fern is a weed, in Botany of the Cryptogamia class, very common in dry and barren places, and is very injurious to the land in which it has once taken root. Between the tropics several species like the Asplenium Bulbiferum. form small trees, having something of the aspect of palms, and are considered one of the greatest ornaments of those regions. In the Phillipine Islands, particularly in Mindora, they grow luxuriantly and their branches shoot almost to the water's edge which forms a pretty contrast with the white sandy beach it overlaps. Ferns have different degrees of organisation some have stems, and leaves, and a sort of wood, others again consist of simple threads or look as a collection of little grains. Between these two extremes, there are various conditions of stem and leaf; the two often growing into each other and forming only a thin expansion. Ferns have no flowers or seeds and therefore their manner of fructification is remarkable; they are generated by little embryo plants called spores, being a number of contained cells in little clusters of capsules from which new plants are produced. In most ferns little brown spots may be seen on the under sides of the leaves, as for instance, like the Niphobolus Rupes-tris. Each of these brown spots is composed of a quantity of very minute membranous capsules which contain the reproductive germ furnished by nature with a sort of elasticity to assist in its dispersion.—In speaking of natural Elasticity, it must be remembered that one of the peculiar phenomena of vegetation is the irritability of some plants, that they possess a sort of nervous system, dependent on atmospheric influence and various other causes. We have only to refer to various flowers in this country, like the sun and moon flower, to remark the direct influence those celestial bodies have on them. In England the evening primrose will not open its yellow flowers till the sun has fully set, and the cereus only expands into blossom at midnight; again the irritability produced by external touch to some plants is familiar to most persons, even so, there is a peculiar irritability about ferns, little understood, which propagates these little embryo plants,—in most species these brown spots called *sori* are protuberating, which on the sligtest breeze is ruptured and its contents discharged. As on order, ferns are very widely distributed, there are upwards of two thousand species now known and very many of them are grown in Great Britain. Ferns, owing to their beauty, variety, and singularity of reproductive organs, may well rank with the best of cultivated plants.

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They are found in different parts of the world in all shapes, sizes, and colours, some species grow to the height of 20, 30, and 40 feet, others a foot high, and some bear the resemblance of creepers. They are seen growing on the Neilgherries, in Mysore, in Burmah, in the Mauritius, and China, as well as growing wild in some of the Islands of the Pacific. The specimen I have chosen for this evening is the Adiantum Capillus Veneris or Dry Venus Hair Fern, gathered on the Neilgherries in. 1845, it is very commonly known too by the name "of Maiden Hair Fern," it is so perfect, and every portion of it entire, that it is a source of gratification to me to be able to produce it in that state before the Society this evening,—for Professor Lowe in writing of the specimen in his valuable work on Ferns lately published, styles it "the only British representative of this delicately beautiful family." It is grown in England principally under pot culture, sometimes in a hot-house, as a warm temperature is said to be essential to its wellbeing. Professor Lowe and Dr. Hooker both in writing on this Fern, state that frost is injurious to it, and the former writes, "the great cold of 1853 destroyed all the plants in the Fernery at Highfield house." This seems very strange, for I know it as a fact from where this specimen was gathered that no care was bestowed on its growth, for it was found wild among the rocks on the Hills and persons who have been resident there, will be ready to certify to the truth that frost and cold are both felt severely in their season on the Neilgherries. Moore who has very lately written an excellent work with very elegant painted prints of Ferns grown in Great Britain (a copy of which through the kind permission of Mr. Taylor of Messrs. Smith Taylor and Co.'s Firm, I am able to lay before the meeting this evening and to whom my thanks are due for the privilege) states of the Adiantum Capillus Veneris "that it is a delicate plant, will not even stand the cold inside of a warm house, and is by no means a hardy fern." Yet in remarking of its geographic range, both Lowe and Moore as well as Dr. Hooker describe the following Indian localities where it is to be found :—Malabar, Simla, Scinde, Affghanistan, Beloochistan, &c. Now Simla, in consequence of its low temperature is considered highly salubrious, the winter there is described as sometimes very severe and in 1836 snow is said to have laid on the ground in the month of January and February to the depth of six feet and appears not to have melted away for some time—the height of the encampment is stated to be nearly 8,000 feet above the level of the sea, and the highest point of the Neilgherries where this fern may be found, is nearly 9,000 feet. Scinde, we all know at certain seasons of the year, is very cold and as for Affghanistan and Beloochistan they are known to have winters which at times are any thing but mild. My object in remarking on the temperature of these localities is, that I wish to show that whatever cold may do in England to prevent the full development of this Fern, in India and other places to the eastward of it, cold is conducive to its well being, and tends to harden, and strengthen its growth. On the Neilgherries, it is found to grow to the height of 18 inches

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to 2 feet, in Burmah up the Arracan River about Chyndook it is seen as a wild creeper, in China it grows in a woody manner 3 or 4 feet high, while in England it rarely grows as high as sixteen inches. According to the strength of the tree or plant, the leaves are found more membranous and are in all places a beautiful evergreen. In some parts the little brown spots are plainly visible on the fronds, as in the specimen before you, in others just like delicate moss on the stem, and in some there is nothing visible to the naked eye, but with a microscope may be discerned small hairs growing on the tips of the leaves. In conclusion, the medicinal properties are very peculiar and wonderful in this fern, the leaves contain an astringent mucilage, which the Burmese and natives of India use as a tincture for cough, and cold, the root when boiled is a purgative and regarded among the Chinese in the same light as we do Rhubarb and the same root, if burnt, yields a considerable quantity of Alkali.

During the conversation which followed Mr. Leggatt's communication, Mr. H. B. E. Frere remarked that this beautiful species of fern was found at Hinglaj, a remote place of pilgrimage in Mekran, and that native visitors, thinking it the only place in the world where it is found, are in the habit of taking pieces of it away. However the late Dr. Stocks, very much to their mortification, undeceived them by exhibiting dried specimens from the Himalayah and from England.

Dr. Bhawoo Dajee exhibited a specimen of the Adiantum Lunulatum.

The President then called on Dr. Bhawoo Dajee, who gave a very interesting description of a variety of Palbrow found in the Presidency, including the Borassus Dichotoma, amply illustrated by specimens. It is to be regretted that the author has not yet found time to furnish an abstract of his instructive discourse.

The best thanks of the Society were voted to Messrs. Leggatt and Bhawoo Dajee for their communications.

The Annual General Meeting of the Bombay Geographical Society was held in its Rooms, Town Hall, on Thursday, the 21st May 1857, at 4½ P. M.

The Minutes of the last Meeting were read and confirmed. The following report gives the state of accounts of the Society for the year, May 1st 1855 to April 30th 1857, and the changes which have taken place in the list of our members.

1856	*Receipts.*	Rs.	A.	P.	
1st May.					
To Balance in the hands of Treasurers.....		1032	8	2	
Ditto Secretary		46	4	9	
					1078 12 11

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To Annual Subscriptions of Members, together with Rs. 100 commupication.	986	0	0
„ Philosophical Instruments sold.	123	0	0
„ Society's Transactions sold	17	8	0
„ Interest on Treasurer's account up to 31st July 1856	40	2	3
Rs.	2,845	7	3

1856 *Disbursements.*

May 1st.	Rs.	A.	P.
By Office Establishment for the year	600	0	0
By Cash paid for contingences additional to Government allowance	140	6	3
By Bill of Exchange remmitted to Messrs. Smith Elder & Co., London	79	11	3
By printing and advertising from June 1856 to February 1857.	1322	6	0
By Commission to 31st July 1856	12	1	8

1857

April 30th

By Balance in Tresurer's hand at this date	Rs.	643	3	7	
By ditto in Secretary's hand		47	10	6	
					690 14 1
Rs.					2,845 7 3

Assets.—Instruments on hand on the 30th April 1857.

4	Sympesometers at Rs. 55 each	220	0	0
3	Adie's Thermometers at Rs. 13 each	39	0	0
2	Large Compasses at Rs. 3 each	6	0	0
11	Small ditto at Rs. 2½ each	27	8	0
31	Triple Lenses at Rs. 2½ each	77	8	0
35	Double ditto at Rs. 1½ each	52	8	0
33	Single ditto at 1 Rs. each	33	0	0
5	Barometer Tubes at Rs. 12	60	0	0
	Rs.	515	8	0

Net Balance in the hands of the Society	690	14	1
	515	8	0
Rs.	1206	6	1

[The Acting Secretary overlooked four Large Barometers one with Captain Burton, one with Major Barr, one with Lieut. Twyford, one with Principal Harkness, three of which have since been returned.—G. B. *Secretary.*]

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Members.—We have to deplore the loss by death of two of our oldest Members, Colonel Neil Campbell, Quater Master General, Bombay Army, and Commodore R. Ethersey, I. N.

The following Members are at present in Europe:—W. P. Adams, Esq., Henry Young, Esq., C. S.; Richard Willis, Esq.; A. Robertson, Esq., C.S.; J. M. Erskine, Esq., C. S.; C. Kingcome, Esq.; Nowrojee Furdoonjee, Esq.

Returned from Europe.—The Hon'ble J. G. Lumsden; Captain G. Jenkins, I. N.; Commander W. C. Barker, I. N.

The following Members have retired from India:—Colonel J. Holland N. I., and William Howard, Esq.

The following Office-bearers were elected for the ensuing year.

Vice-Presidents.—The Honorable Arthur Malet; W. E. Frere, Esq., C. S.; C. J. Erskine, Esq., C. S.

GENERAL COMMITTEE OF MANAGEMENT.

Resident Members of Committee.

H. L. Anderson, Esq., C. S.	Lieutenant Furgusson.
Dr. E. Impey.	Lieutenant Constable.
J. J. Berkeley, Esq.	Cursetjee Jemsetjee, Esq.
W. F. Hunter, Esq.	Narrayen Dinnanathjee, Esq.
Major Phayre.	Bhaoo Dajee, Esq.
Captain Jenkins.	R. S. Sinclair, Esq., L.L.D.

Non-Resident Members of Committee.

P. W. LeGeyt, Esq., C. S.	Commander Jones.
General J. Jacob.	Captain A. B. Kemball.
Lieut. Colonel LeGrand Jacob.	Lieutenant Grieve, I. N.
Dr. Winchester.	Lieutenant A. D. Taylor.

Letters Read.—Letter from Mr. De Souza, Printer, accompanied by a copy of the forthcoming Transactions, as far as printed. Letter No 1061 of 1857, General Department, from W. Blowers, Esq., Deputy Post Master General. Letters from George Simson, Esq., of the Stuart Wortley, dated May 11th and 21st. Letter from Dr. Carter, Editor of Geological Papers on Western India, May 21st. Letter from J. W. Hurst, Esq., Secretary to the Bombay Mechanics' Institution.

Presents to the Library.—1. 2.—Jahbruch der Kaiserlich Koninglichen Geologischen Reichsaustalt, 1856 vii. Jahrgang, No. 2 and No. 3.

3.—Reports of the Juries of the Madras Exhibition of 1855.

4.—Address delivered at the Annual Meeting of the Bombay Mechanics' Institution, April 11th 1857, by the President James J. Berkely, Esq.

5.—Geological Papers of Western India, &c, Edited for Government. By H. J. Carter, Esq. Assistant Surgeon, H. Co.'s Service, Bombay.

6. Atlas to ditto. By H. J. Carter, Esq., Assistant Surgeon, H. Co.'s Service, Bombay.

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The thanks of the Society were voted to the donors for their contributions to the Library.

The Weather book of George Simson, Esq., "on the Phenomena observed from the Equator up to Bombay at the commencement of the Monsoon" was, by the courtesy of that gentleman, laid on the table for the inspection of the Members of the Society.

The Ordinary Monthly Meeting of the Bombay Geographical Society, was held in its Rooms, Town Hall, on Thursday the 16th July at 4½ P. M. Colonel LeGrand Jacob in the Chair.

The Acting Secretary stated that he had received a note from Rear Admiral Sir Henry Leeke, the *President*, expressing his regret that he had not known that a meeting of the Society would be held on the 16th, sufficiently early to have altered his arrangements about setting out for Poona.

The minutes of the last meeting were read and confirmed.

Letters Read.—1. Letter from Captain Jenkins I. N., dated May 28th 1857.

2. Letter from Dr. Alexander Gibson, Conservator of Forests, dated May 29th.

3. Letter No. 2382 of 1857, dated May 26th, from H. L. Anderson, Esq., Secretary to Government, Political Department.

4. Letter No. 4 of 1857, dated June 11th 1857, from W. Hart, Esq., Secretary to Government, Public Works' Department.

5. Letter No. 83 of 1857, dated 20th June 1857, from Dr. Giraud, Acting Principal of the Grant Medical College.

6. Letter No. 3163 of 1857, dated June 6th 1857, from Colonel P. M. Melvill, Secretary to Government, Military Department.

Presents to the Library.—1. Memoirs, By Commander James Felix Jones, I. N. connected with Bagdad; Nahrwan Canal, Frontier of Turkey and Persia; Median wall of Xenophon and discovery of the Ancient Opis; Topography of Nineveh &c.

2. Report of Captain W. S. Merewether, Acting Political Superintendent, Frontier of Upper Sind, with other papers relating to the enlargement of the Begaree Canal, in upper Sind.

3. Journal of the Royal Geographical Society. Volume the twenty-sixth.

4. Annual Report of the Grant Medical College, Bombay. Eleventh year session 1856-57.

5. Reports on the proceedings of the officers engaged in the Magnetic Survey of India.

6. History of the new world, by Girolamo Benzoni.

7. Results of the Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich 1855.

In accordance with Rule IX., the Society proceeded to elect from the Resident Members of the General Committee, the following Chairman and Members of the Sub-Committee of Accounts and Sub-Committee of correspondence.

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Sub-Committee of Accounts.

W. F. Hunter, Esq. Chairman. Major R. Phayre ; Lieutenant Fergusson ; Lieutenant Constable ; Cursetjee Jamsetjee, Esq. and Narrayen Dinanathjee, Esq., Members.

Sub-Committee of Correspondence.

H. L. Anderson, Esq ; Chairman; Dr. Impey ; Captain Jenkins ; J. J. Berkeley, Esq. ; Bhawoo Dajee, Esq. ; R. S. Sinclair, Esq.—Members.

The Chairman having stated that he had taken some notes of a journey through the Thur Desert some years ago, in the course of conversation thereupon it was proposed by Jagonnath Sunkersett, Esq. and seconded by W. T. Roper, Esq. and concurred in by the other Members present, that Colonel LeGrand Jacob be invited to prepare a Memoir of his journey through the Thur Desert for insertion in the volume of the Transactions which will appear after the next, namely for that of 1858. Colonel LeGrand Jacob stated he had much pleasure in complying with the wishes of the Society.

The Ordinary Monthly Meeting of the Bombay Geographical Society, was held in its rooms, Town Hall, on Thursday the 24th September 1857, at 4½ P. M.

Letters read.—1. From the American Geographical and Statistical Society, New York, 22nd May 1855.

2. From the Smithsonian Institution at Washington, of February 13th 1854, and July 10th, 1855.

3. From H. L. Anderson, Esq., Secretary to Government, No. 1713 of 1857, dated 7th September 1857, enclosing an extract from a letter from Captain R. F. Burton, commanding expedition into Equatorial Africa, dated Zanzibar 23rd April.

4. From J. H. Hofmery, Esq., District Rivendate, Cape of Good Hope, dated 20th May, enclosing a bottle log.

5. From Rear Admiral Sir Henry Leeke, dated 13th September.

6. No. 70 of 1857, dated 23rd September, from Lieutenant E. F. J. Fergusson, I. N., Superintendent Government Observatory.

Presents to the Library :—1 Document relating to the Colonial History of the state of New York, vols. 3 and 4.

1. Reports of the Legislature of the State of New York.
2. Rail Road Statistics, 1854 and 1855.
3. On the Canals, 1854 and 1855.
4. Of the Superintendent of the Banking Department, 1855.
5. Of the Commissioners of Emigration.
6. Of the Governor of the Alms House.
7. Bulletin of the American Geographical and Statistical Society.
8. Smithsonian Contributions to Knowledge, vol 7.

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9. Ninth Annual Report of the Board of Regents, of the Smithsonian Institution.

10. English Annual Report of the Board of Regents, of the Smithsonian Institution.

11. Report and Charts of the Cruise of the W. S. brig *Dolphin* with a map.

12. Bulletin De la Societi De Geographic. Paris.

13. The Journal of the Bombay Branch of the Royal Asiatic Society for 1857.

14. Report of the Juvenile Improvement Library, read at the fifth annual meeting, held August 8th 1857.

15. Magnetical and Meteorological Observations made at the Honorable East India Company's Observatory, Bombay, for 1856.

16. Mittheilungen Der Kaiserlich—Koniglechens Geographischen Gesellschaft Jahrgang 1857. Wien.

The bottle log, referred to in letter 4 above, bears the following account:—"No. 73. This bottle, with its enclosure, was thrown from on board the ship *Malta* on her way from Bombay to London, at noon on the 8th day of April 1857. Observations:—Lat. 35 28' Long. 21° 9' E. Picked up at Steinkool Fontein, twenty miles E. of Port Beaufort, Cape of Good Hope, 12th May 1857."

Mr. Hofmery, who forwarded the above, states the bottle "was found on the beach entangled in sea weed," and adds—"As the part of the coast is but thinly inhabited, I cannot with certainty state how long the bottle might have been there before I found it."

After the reading of Sir Henry Leeke's letter, resigning the office of President, which he held for upwards of five years, it was unanimously resolved:

I. That Rear Admiral Sir Henry Leeke be elected an honorary member of the Society.

II. That the members now present form themselves into a Sub-Committee to acknowledge the receipt of the late President's resignation, and to return him the thanks of the Society for his exertions in its behalf, to be forwarded by the next mail.

Member Proposed.—Commodore George Wellesley, Commander-in-Chief of the Indian Navy; proposed by W. E. Frere, Esq. *Vice President;* seconded by Venayeckrow Jugonathjee, Esq.

A Meeting of the Bombay Geographical Society took place in its rooms on 15th October, W. E. Frere, Esq., in the Chair. The attendance was less numerous than it probably otherwise would have been, in part from the absence of members from the Presidency for the holidays, in part from the exciting scene at that hour passing on the Esplanade. (The execution of the Mutineers.)

Commodore Wellesley having been elected member of the Society was,

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on the motion of W. E. Frere, Esq., seconded by Juggonath Sunkersett, Esq. unanimously elected President, in room of Sir Henry Leeke, returned to Europe.

In reference to the correspondence with the Post Master General, regarding the books received by Trieste through the Post Office at Alexandria, it was agreed that the Society had no remedy but pay the postage, making their German correspondents aware, that the simplest channel of intercourse was through the Royal Geographical Society of London.

In reference to the communication from the Smithsonian Instutionation at Washington, it was agreed that to meet the wishes and emulate the munificent liberality of the United States Government and the American Societies, the Bombay Geographical Society should not only transmit its own transactions, but use its utmost efforts to collect all local publications for their use. It should moreover apply to Government to meet the liberality of our Transatlantic brethren, by forwarding all sets of the publications issued by them since 1850, especially including the Custom-House returns and the volumes on local topography and statistics, now of themselves constituting a library—the Society to tender their services as a medium of communication, or if deemed more agreeable, to accept for themselves, with a view to transmission, a set of the publications referred to, in addition to that they have been in the habit of receiving for their own use.

The table was entirely covered with trays of specimens, with books, sketches, drawings, and curiosities of various kinds. The walls were decorated wish sets of drawings of the cliffs and headlands along the Portuguese and Sapanish coasts, of the rock of Gibraltar in various aspects, the headlands and ridges by the Wadi Moosa, near Suez, the mountains on the African Coast, and peninsula of Sinai, as seen from the Gulf of Suez, with a whole series of representations of the volcanic islands in the Red Sea, and the Aden and Little Aden volcanoes.

The Secretary said—"The Society will not have forgotten the somewhat stringent resolution of September 1854, which makes it imperative on the Secretary to see that there is at least one paper essay, or discourse of some length before each meeting of the Society. When papers fail to make their appearance from without, and members show no disposition of being communicative, there remains no alternative but for the Secretary to step into the gap, or incur the severest of official punishments—the displeasure of his constituents. I have not been able since my return, to find time to prepare what was required, or more properly speaking to provide adequate illustrations for a discourse, in the preparation of which there need be no great difficulty. I have therefore thought that it may not be uninteresting to members to take a rapid excursion with me over the grounds I have lately travelled, and to inspect some of the curiosities I have collected, little connected as many of them are with the strict concerns of geography. Out of the brief outline I am about to give, I hope to be able, for the current session, to provide papers on the following subjects :—

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1. On the Physical Geography of the Arabian Sea, Gulf of Suez, and Red Sea,—that is of the ocean sweep from Bombay to Suez, betwixt the 10th and 32nd parallels and the 32nd and 72nd Meridians.

II. The Geology of the three Aden Volcanoes.

III. The Geology of the Desert, especially of the portion near the upper part of the Gulf of Suez.

IV. Note on the Geology of Malta, supplementary to Captain Pratt's paper.

V. The Geology of Gibraltar.

These papers of course are in reserve merely, ready to give place to any others any member may provide.

The large tray of specimens from Aden forms but a very imperfect series,—the principal part of those requisite to illustrate the paper in view, collected for me by Lieutenant Wilkins, of the Engineers, having been left behind, may be looked for by next steamer. I have not been able to obtain specimens either of the fibrous Gibson or fibrous satin spar, or of the beautiful crystals of fluor spar discovered in 1845 by the late Dr. Malcolmson, and analysed by Dr. Giraud. In 1840, I published, in the Transanctions of the Asiatic Society, a notice of the sea shells scattered over many of the spurs of the mountain to the height of 500 feet, and which I then assumed to have risen with the volcano.* The assumption has now been fully verified. Dr. Steinhaeuser, three weeks since, pointed out to me large beds of shells, which I examined, on the ridge betwixt the main pass and the gate leading to Turkish wall, the same in character as those prevalent in the seas adjoining. I have little doubt that similar beds will be found all round the mountain, at nearly the same elevation—that is, about 250 feet above the sea. I need not trouble you with the details of the Red Sea volcanoes—the field appears to me very much larger than it did when I published a notice of them in your Transactions in 1852 and I have no doubt that it extends from Ormuz in the Persian Gulf, to near the junction of the Gulfs of Suez and Akaba, and probably comprises an area of 30,000 square miles, in place of the 10,600 then assigned to it. I was happy to see that in the new edition of Mrs. Somerville's work, now passing through the press, this magnificent volcanic group, hitherto ignored in physical geography, takes, through the exertions of the Society, the place to which it is entitled.

The drawings and specimens connected with Suez, furnish material or illustrations for a separate lecture. It had for seventeen years been a dream with me, to examine the magnificent range of rocks which terminates at Ras Ataka, or the Cape of Deliverance—the point supposed, and not unreasonably so, to be that from which the Israelites crossed the Red Sea. I had believed it to consist either of alternate beds of limestone and lava, or of limestone and the ligniferous conglomerate of the desert, but found it in reality composed entirely of alternate beds of soft and hard nummulite, differing only in consistency—the same fossils prevailing throughout. There are numberless

* Journal of the Bombay Branch of the Royal Asiatic Society vol. I. p. 344-45.

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peculiarities connected with the rock, which will form the subject of a future discourse. I need only point now to the breccias, obviously formed from the debris of the mountain while it was ascending, cemented by some mysterious means through the agency of sea water, and the numberless forms of gypsum, found in every variety of circumstances, obviously the result of subsequent decompositions. I unwisely made this excursion on foot, before breakfasting, without commissariat supplies; and though the distance out and in was only about sixteen miles, I got knocked over with the sun, and so missed my passage. I believe that not the less, I was amply requited.

We spent, coming out, two days at Malta, and on these I was able to make two excursions across the Island—one to St. Paul's Bay, to which I sailed by St. Paul's Valley, Torre Rosso, and so round—the other across from Valetta, by Citta Vecchia to the sea. I had the benefit here of Captain Pratt's excellent paper, with the account published by Mr. Muir, of what are called the Phœnician remains, both now in my hand. To the geology of Captain Pratt, some few additions may be made, and I was fortunate enough to pick up many beautiful specimens, one of a shark's tooth three inches long, which I now hold in my hand, of almost unequalled beauty. I was able to walk round the base and across the top of Gibraltar in going home, and as my impression was that there must be a good geological account of it somewhere or other, I did not examine it so minutely as I otherwise should have done. I found that, with the exception of a very short notice by Mr Smith, of Jordan Hill, there was no account of it anywhere. During the four hours allowed us ashore on my return, I walked up about 800 feet, and then down to the cliffs on the Mediterranean side, round by Europa point, and so returning, rounded the rock by the neutral ground, and then back again, to within about half a mile of where I had been before—a distance in all probably about ten miles. Amongst the many things strange and new, the most marvellous was the discovery of the fact, that the huge apron of sand, about 3,000 feet in base, and 1,000 feet in height, had been lifted with the rock and not drifted up, as at first sight it appears to have been. The mass must have been soft and slightly cohering when it rose—subsequently slipping down and becoming corrugated, like wet paper, presenting in the drawing exactly the appearance Professor James Forbes assigns to advancing glaciers.

[Drawings were then exhibited of Tarifa, Lisbon Head, Torres Vedras, Cape St. Vincent, the Berlings,—very closely resembling the rocks off Vingorla—the Devonshire chalk cliffs, the Needles and Alum Bay, of which short notices were given. Specimens were then shewn and explained, of maps reduced by photography, of electro-type plates of the great ordnance survey maps, of a large folio atlas, reduced to 32mo., sold for six-pence. There were sets of Belmont candles from palm, oil, glycerine soap, candles from petroleum, a large parcel of specimens of cotton, of the cheaper kinds, commonly used in Lancashire, with the prices and peculiarities of each. These were meant for distribution, with a vast number of other curiosities, meant to form subjects for discussion afterwards]

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The Ordinary Monthly Meeting of the Bombay Geographical Society, took place in its Rooms in the Town Hall, on Thursday the 19th November, at half-past four o'clock in the afternoon,—Commodore Wellesley, President, in the Chair.

The Commodore, on taking his place as President, an office to which he had just been elected, expressed his acknowledgments to the Society, and stated that it would be his anxious wish at all times to promote their interests; and to endeavour, as far as in his power, to enable it to maintain the distinguished name it had earned for itself.

The minutes of last Meeting having been read, the following letters were laid on the table:—

Bombay, 22nd October, 1857.

Sir,—In acknowledging the receipt of your letter of the 19th instant, I beg you will have the goodness to convey to the Members of the Bombay Geographical Society, my best thanks for having elected me a Member and President of that body; and to inform them, that I willingly accept the appointment they have so kindly conferred on me.—I have the honor, &c.,

GEORGE G. WELLESLEY, *Commander-in-Chief I.N.*

To G. BUIST, Esq., L. L. D.
Secretary to the Bombay Geographical Society.

To the Secretary Bombay Geographical Society.

Sir.—I am directed to acknowledge the receipt of your letter dated the 3rd November 1857, and to acquaint you, for the information of the Society, that the Right Hon'ble the Governor in Council has much pleasure in acceding to the application therein preferred.*

2. A copy of each of the publications printed at the charge of Government since the year 1850, will accordingly be forwarded to you from the proper departments, for transmission to the Society in America,—I have the honor to be, &c.

Bombay Castle, 19th Nov. 1857. W. HART, *Secy. to Govt.*

The following having been circulated amongst the members of committee were laid on the table consideration.

To the Committee of the Geographical Society.

Gentlemen.—I have the honor to submit, for your consideration, memoranda which, if approved of, may be placed in the hands of the Marine authorities.

It is not flattering to our pride, that when we want information about the Seas which wash the shores of the British Empire in the East, and which are daily traversed by men of war or firts-class merchantmen, we should require to resort to the United States, France, Germany or Russia—although such is unhappily the fact.—I have the honor to be, &c.,

4th November 1857. G. BUIST.

* See minutes of last meeting in reference to the transmission of books to America.

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Information that might be collected in connection with the soundings in contemplation, in anticipation of laying down a Telegraphic wire from Suez to Bombay.

The United States' Government have set an example which all the great powers of the world are following—on the subject of the deep sea soundings, sub-surface currents, and other hydrographic enquiries, not only appertaining to navigation, but as bearing on great questions of physical science.

The operations connected with the soundings likely to be immediately required, in contemplation of telegraphic communication betwixt Suez and India, promise to afford opportunities for the prosecution of other enquiries of the deepest interest to the philosopher.

The first of these is, the examination into the speed and direction of the sub-surface currents, a succession of which will most likely be found to prevail at different depths in the sea.

In 1850, the Bombay Government authorized me to get an instrument constructed at the steam factory for the purpose :—the first plan did not succeed : I subsequently constructed, at my own charge, a second instrument, which, after the introducton of several alterations suggested by the late Admiral Beechy, Captain Washington and Captain Beecher, was pronounced entirely satisfactory. It is now in the possession of the Hydrographer to H. M.'s Lords of the Admiralty. The original of this is in my possession, and may be completed, if desired, at the charge of about Rs. 50; or the enquiry might be pursued on the old system, as described by Mr. Maury in his reports. It would be of the utmost interest to have this matter enquired into in the Gulf of Aden. One of the two cruisers commonly lying idle there might push out into mid-channel, and accomplish all that is required—while the boats or vessels now constantly at Perim, might examine the surface and sub-surface currents of the Strait.

I have two instruments at disposal,—nearly identical, as they turned out to be, with Dr. Marcet's bottle,—for drawing water from any depth under the surface ; and as we have now a valuable series of observations on the saltness of the sea at the surface, from Suez to Bombay, it would be important if this could be compared with its saltness at great depths.

In moderate depths, it would be eminently desirable to obtain specimens from the bottom by the use of armed leads ; and as at each sounding, the survey vessel will be from 10 to 20 hours nearly at rest, valuable opportunities will occur for enquiries into marine zoology—such as are there daily presenting themselves. The Surgeon of the ship on whom this division of research devolves, should be provided with a microscope, and the means of preserving soft specimens.

We are, up to the present time, in a great measure in the dark as to the Hygrometry of the atmosphere at considerable distances from the shore :—evaporating dishes may easily be employed in still weather with the ship at rest, and Hygrometers of all sorts at all times.

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MINUTE BY MEMBERS.

Minute by Commodore Wellesley.—Any information or suggestion that any member could give upon the subject of deep sea soundings would be very desirable, as preparations are making for trying the depth across to the Kooria Mooria Islands by Aden.

MEMORANDUM ON THE INFORMATION DESIRABLE FROM THE PERSIAN GULF.

Captain Jenkins, just appointed Commodore in the Persian Gulf, was the first of our members who communicated to the Society information regarding its islands.

Ormuz,—of the sulphur of which an account by him was published in an early number of our Transactions,—is said to be a volcano. We want drawings and specimens of the rocks to verify the fact; and wish to know how far the volcanic field extends around.

At the last Meeting of the Society, beautiful specimens of sulphur from Ormus were exhibited by Dr. Burn: these were stated to have been found crystallized, on the surface of masses of rocksalt, and in this case seem more likely to be the result of decomposition, than of sublimation or of fusion. Careful examination, and a profusion of large specimens, would throw light on one of the most curious questions in physics.

Some very excellent papers by Dr. Winchester have been published on Karrack and the adjoining countries. Specimens for the illustration of these are desired.

The manufacture of candles from petroleum, of which vast supplies are said to exist near Bussora and Bushire, makes information on this subject desirable in an economic, as well as in a scientific point of view: and a good account of the petroleum wells in Arabia or Persia, might be the foundation of a reputation, and something more substantial.

The same information in reference to subsurface currents, and other matters derivable from the deep sounding survey, would be important from the Persian Gulf. G. BUIST.

MINUTES BY MEMBERS.

The information sought on the subjects mentioned in both memos. is of a very valuable character to science. It can only be acquired in vessels employed in similar capacity to that described in Dr. Buist's 2nd and 3rd paras.

As it will rest with the President, in his official capacity of Commander-in-Chief of the Indian Navy, to instruct officers on the subjects of research brought forward, I would suggest that he be solicited that he should permit them to be undertaken and give them his support, and that Dr. Buist be requested to draw up definite instructions as to the information required, providing instruments at the Society's expense.

E. IMPEY.

As the opportunity which will occur, when sounding the sea for the electric wire, will be one that will not again perhaps offer itself, I think all prac-

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ticable methods should be tried to ascertain the speed and direction of sub-surface oceanic currents, as well as the temperature and saltness of these at different depths from its surface to the bottom. Not only this, but specimens of the bottom should, if possible, be got at every cast of the lead, their character carefully noted ; and when those specimens are of an extraordinary nature, they should be carefully preserved in glass stoppered phials, and made over to the Government Museum or some scientific society's museum. It is my opinion, that the obtaining the data above desired, should not be left to change, but be required as a portion of the duty of the officer entrusted to take the soundings, and Government be requested to furnish such instruments as may be required.

The Secretary might draw up a memo. of (and the expense of) such instruments, rules of using, form of journal to be kept &c. &c. &c., and submit the same for the sanction of Government in the name of the Society.

E. P. FERGUSON.

The Secretary stated that he entirely concurred in the excellent observations of Dr. Impey and Mr. Ferguson, and should feel much gratification in undertaking any task entrusted to him by the Society. Two of the instruments referred to were on the table—that called Dr. Marcet's bottle had been constructed without his knowing of the existence of the contrivance originally bearing the name, and on comparing the two, they were found pretty nearly identical. Those now on the table had been made at the School of Industry, and cost some fifteen or twenty Rupees a-piece. The sub-surface current measuring machine is nearly the same as that deposited with the Hydographer to the Lords of the Amiralty, which had been tried and found perfectly efficient. There were a number of improvements which subsequent experience suggested, but the whole might readily be constructed for fifty Rupees. At the same time, it would be well to have as a substitute, in a service where instruments are so apt to be lost, a good supply of the old contrivances specially described by Maury. He says :—

" The next subject to which I would refer, is our investigation of the *under-currents* of the ocean. I regret we had so few opportunities for these very interesting experiments ; but enough has been done to seem to warrant the conclusion, that these undercurrents are *generally* stronger, setting in various different directions, than those of the surface. I am well aware that there is no mode of testing their *exact* velocity ; but that practised by myself, which I will describe, was certainly all sufficient to show their relative velocity. There may be none so rapid as that mighty oceanic river, the *Gulf Stream* : unfortunately, the weather prevented our making these investigations in that interesting region ; but in the various parts of the Atlantic in which we succeeded in these experiments, on only two occasions did we find the undercurrent of less velocity than that running in a different direction above it. The following is the mode practised in testing them.

The surface current was first tried by the usual mode (a heavy iron kettle

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being lowered from a boat to the depth of 80 fathoms) ; then, for the trial of the undercurrent, a large *chip-log*, of the usual quadrantal form, the arc of it measuring full four feet, and heavily loaded with lead to make it sink and keep upright, was lowered by a light but strong cod-line to the depth of 126 fathoms, (the length of the line :) a barrega was attached as a float, a long-line fastened to this barrega, and the rate of motion of this float, as measured by this long-line and the glass, as well as the direction as shown by a compass, were assumed as the velocity and set of the undercurrent. No allowance was made for the drag of the barrega, which was always in a different direction from the surface current. It was wonderful, indeed, to see this barrega move off against wind, and sea and surface current, at the rate of over one knot an hour, as was generally the case, and on one occasion as much as 1¾ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had hold of the weight below and was walking off with it."

I have no doubt that in the Arabian Sea, more especially in the Gulf of Aden, a vast complication, or what at first sight may seem a complication, but it is readily a beautifully harmonious system of currents, will be discovered, and that the officers in charge of the deep sea sounding telegraphic survey, have within their reach a series of discoveries, of the greatest value and importance. To achieve these, they ought not only to be provided beforehand with instruments, but they ought to be carefully trained in their use ; exercised for weeks off the shores of Bombay, while the other preparations for the expedition are in progress. Besides those just adverted to, there are two points demanding especial attention. I shall presently have occasion to lay before you, a large collection of tables of the temperature of the Arabian and Red Sea, taken ten or twelve feet under the surface, with which I have been supplied by Mr. Ritchie, and of its specific gravity and saltness, from some excellent experiments by Dr. Giraud. It will be seen from these, that the Red Sea is saltest in the Gulf of Suez, that it gradually becomes less and less salt, till just east of the meridian of Socotra, when its saltness once more increases on to Bombay. Again, its heat is greatest in the active volcanic region betwixt Jebel Teer and the Straits, where for three or four hundred miles, it is generally above 90° twelve feet under the surface, occasionally rising to the enormous elevation of 95°, sinking again immediately, by nearly ten degrees, when the Strait is passed. The mean temperature of Aden is a little above 80°, its maximum about 96°, but then, some of the deep wells there, rise, doubtless from volcanic causes, to a heat of 92°. As 95° greatly surpasses the mean temperature even of the desert of Sahara, it looks as if this was connected with the volcanic action beneath, a fact to be determined by taking temperatures at great depths. We have no thermometers suitable for this in Bombay—supplies from home, such as those that have been employed in the Atlantic, will be required. If the heat comes from below, we shall then find a highly concentrated brine, or probably masses of solid salt near the bottom. The temperature, as just stated, sinks down almost immediately on

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passing the Straits. It rises again at Aden, a circumstance which is probably due to the shallowness of the sea in the vicenage of the shore. When descending as the Gulf opens up, it once more rises in the open sea under the meridian of Socotra, where the gravity is least, descending again as we near Bombay. The region in the Arabian Sea where the heat is greatest, and the gravity least, is the squally space south of Kooria Mooria bay, where we are most accustomed to meet in with those discolored and luminous tracts of ocean, which have lately received so much notice. I state these things, it must be remembered, as conclusions from a very limited number of facts,—rather as probabilities to be enquired into, than things well established. The actual analysis of sea water is a very troublesome operation, and might, I think, be obviated by the use of the hydrometer,—that now employed on board the steamers being, in my opinion, faulty. Hydrometric experiments are always referred to a temperature of 60°—a very convenient one for Northern Europe, but requiring in these latitudes a tabular correction, which it would be convenient to avoid. I would have all hydrometers meant for sea service cut for a temperature of 96°, a degree higher than the extreme heat of the ocean, the blood heat of the human body. It is very troublesome to cool down water to 60°, and unless this is done, we must make the correction on board ship, and especially on board a steamer. it can be raised to any thing that is desired. On the one side of the scale, the specific gravity should be given—on the other the quantity of salt is indicated, and the observer will thus be able to give all the facts we require at once. A very simple set of tables would reduce the gravity from 95° to 60° when we come to edit for publication. On the table is a collection of hydrometers, and other intruments prepared for these ends many years ago, but which leisure has never permitted me to employ beyound the field of house experiments. The best form of hydrometer, for very refined investigations, is the one I hold in my hand with glass bulbs and a metallic stem. I find glass when drawn out to the fineness required, is so liable to accident, as to need a nicety of packing and delicacy of handing scarcely to be looked for at sea, otherwise a homogeneous material would be preferred.

This having closed the business part of the proceedings, a paper was then read by Dr. Buist on the "Physical Geography of the Red Sea." See *Papers*.

At the conclusion, a very interesting discussion, in which Captain Barker and Mr. Kennelly chiefly shared, took place.

Dr. Buist said that what he had read was merely a compilation, and that with the exception of the geology and meteorology, and some theoretical views of his own, he was entirely indebted to Captain Barker and the other distinguished men, who had conducted the Red Sea survey; and whose only fault had been, that they had not given to the world more of the important information that they had collected. The discussions in reference to the Red Sea took their origin from a communication of Captain Barker, on an eruption amongst the Zebayer islands, he had witnessed in August 1846;

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and as he was now amongst them, it was hoped that the Society would be favoured with the results of his investigations at greater length than they had hitherto been given.

The discussion promised to be productive, and of so much interest, that it was resolved to adjourn it till next meeting, when a paper on the geology of the country round Suez, and of the desert generally, with some references to the topography of the Exodus, would be read. In all likelihood the Red Sea discussion would occupy the entire time of the meeting, when the other paper might be postponed.

The meeting was then adjourned.

At the Ordinary Monthly Meeting of the Geographical Society held on Thursday, the 23rd instant, W.E. Frere, Esq. Vice-President, in the Chair, the following gentlemen were proposed and elected Members :—Lieutenant Montmorency 27th N. I.; and Mr. Bentley, Mint. The following letter from Captain Burton was laid before the meeting. The various references contained in it were made at the suggestion of the Committee of the Society in the correspondence with Captain Burton, and with Government in December 1856 :—

SIR,—I have the honor to acknowledge receipt of your official letter dated the 8th December 1856, conveying to me, by order of the Geographical Society of Bombay, certain suggestions regarding the expedition into Eastern intertropical Africa, which I have been appointed to lead, and to express my gratitude for their valuable instructions and recommendations.

During my last preparatory journey from Mambator, on the Panjan river and thence by land to Fuga, the capital of an interesting mountain district —Usambara—I left at Zanzibar for comparison a barometer in charge of Mr. Frost, Medical Officer to the Consulate, the instrument (by Adie) obligingly lent to me by the Secretary of the Bombay Geographical Society. It would have done scant service during a coasting voyage, and on a rough mountain tour, so delicate an instrument would certainly have come to grief. I took with me four thermometers by Newman, of which one, Boiling Point Thermometer, was rendered useless by the mercury getting in to the upper bulb, consequent upon expansion of air carelessly left in it by the manufacturer. I have now in all four strong Nutt's Thermometers, in good condition, and two Boiling Point ditto, one used by Captain William Smyth, R. N., in crossing the borders, and kindly given to us by Colonel Hammerton. These, even should the "Adie" be broken, and the instrument recommended by the Medical Board Bombay not arive in time, will suffice to determine with tolerable accuracy the altitude of the Unyamisi Lakes. As regards sympisometers, they are found by the long experience of Naval officers, and the accurate hourly observations of a staff of recorders, to be use less by reason of their extreme sensitiveness on this coast within 6° or 8° N. and S. of the Line. This however might not be the case on land.

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For a reference point of known pressure, I am happy to say we can now confidently apply to Zanzibar. Mr. Apothecary Frost, an able and accurate observer, has during the last ten months filled up Meteorological tables with the Barometer,—probably the same instrument sent by the Bombay Geographical Society in 1847,—with Thermometer attached and unattached, wet and dry bulb, evaporating dish, and with the rain gauge. As the Society seems to take an interest in these observations, I have the honor to transmit copies with which Mr. Frost has obliged me.*

I now proceed to answer your letter paragraph by paragraph. (*vide ant.* p.p. xxxi xxxii)

For enquiries into the hydrology of the region which we purpose exploring, I shall be careful to provide myself with a dish and a gauge. The professionally learned however must not be exacting in their demands for observation. These African explorations present peculiar difficulties. An expedition into the Eastern Interior is a small campaign, in which the traveller is beset by all the troubles, hardships, and perils of savage warfare. He must despair of studying "infusoria," unless at least he has nothing else to do.

The Missionaries and all acquainted with the country have wondered at our using instruments at Usambara:—the dazzle of a sextant makes every man thirst for your blood. The climate also is hostile to the traveller in more ways than one. Captain Spike, my well tried and energetic companion, has twice suffered severely from sickness—jungle fever and catarrh,—in consequence of exposure to heat whilst taking observations. The simplest geographical operations become at times impossible. During our two days and two nights at Fuja, a dense pall of clouds overhung the sky, the rains had set in though the half of February had not elapsed; we never saw the sun, and we could not find even a star till we had descended the hills. In these regions the traveller's chief study must be to make things easy, to take all easy, and do only what is easy. I doubt the route crossing any great mountain ridge as you suppose: it leads, say the Arabs, with a steady rise and an occasional ascent, between the coast and lake. As regards our altitudes on the way, we can boil Thermometers and register the Barometer;—for objects on the line of march we must depend upon compass bearings, a Pedometer horse-line and vertical angles observed with a large or small sextant. I have the honor to forward a few specimens of the coast formation: but for the sickness which cut short our journey our collection would have been less meagre. The mountain zone, like Zanzibar and its adjacent Islands, is a mass of corallines, often shelley and coated with red, yellow and black argillaceous soils, rendered fertile by decayed animal and vegetable matter. In some places there are distinct sea-beaches rising 100 to 150 feet above the alluvial plain. In others I could find none.

From Mombas to the Panjany river (the tract called in Sawahil "Mri-

* The copies were received but so far from being of the importance assumed they were transparently so inaccurate as to be set aside as of no value whatever.—G. B. *Sec.*

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ma" or the Mountain Region) stretches a broken line of sandstone at some distance from the coast, and varying from 700 to 1200 feet above the sea level. The interior is gneiss, quartz and sandstone, with detached hills of tufas and grey granite : the latter is so micaceous that the Belooch garrison cannot banish their belief that it contains gold. As at Madagascar no limestone appeared, and the result of enquiry is a doubt of its existence. I inspected many wells and excavations upon the coast, and rarely saw either blue clay or tree roots underlying the gravel. The habitat of the Cocoanut is chiefly the Coralline coast, but it extends along the Panjany river, and bears fruit at least 30 miles from the sea ; wherever it is found at any distance from the main stream the natives judge water to be near.

The ripe Copal (called Gum Animi in the London market) is the most interesting production of Eastern Africa. This semi-fossil is not generally "washed out of streams and torrents," but dug up especially during the rains by the Sawahili of the coast and the savages of the interior. There is, however, a kind of gum called by the natives—who deeming it the Egesta of whales, know no use for it—"Damar." Found upon the sea, especially about Cape Delgado, it floats, whereas copal sinks in water : it may be unripe gum washed from the shore during the S.W. monsoon. The whole of this coast produces the real copal of commerce in different degrees of excellence. Specimens have been brought to Zanzibar from Brava and Magdishu (Magadoxo). Small quantities are found in the Rabai hills behind Mombas, and the tree grows in the Jungle-patches which stud the range. From Panjany southwards for 80 miles it is plentiful, at distances varying from three hours' march to two days' journey from the coast. It would be impossible for us "to trace the position and circumstances of the extinct forest, of which it now constitutes the principal remains." Such an investigation would require at least two months' voyaging along and dwelling upon the fatal sea board. In most places, I am told, there is now no sign of a tree.

Of Gum Copal these regions supply two great varieties :

1. Raw, popularly called "Jackass Copal," is, I venture to opine, the gum which, exuding from the trunk or branches of the tree when injured by elephant or man, fall to the ground, and either infiltrated, or was covered by successive layers of soil. Like a common resin it is softened by spirit, and becomes viscid in the solution used for washing ripe copal. This variety is exported in considerable quantities from Zanzibar to China, where, it is said, the people have discovered and retained to themselves the secret of working it. At Bombay and Surat, it is made into an inferior varnish for carriages and palanquins.

2. The ripe or true copal—a semi-fossil, doubtless the product of forests overthrown by gradual decay, by the upheaval of the coast, or by some violent agency of the elements. This is proved by the fact, that pieces of the gum are met with embedded in wood, which crumbles to dust under the touch, and by its "goon-skin," which is the impress of sand or gravel.

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There are many varieties of colour, caused probably by the embedding strata, the clearest and most transparent fetches the highest price; then follow the numerous and almost imperceptible gradations of light amber, lemon and dark yellow, red and tufas. I have seen a specimen of tender green. Sometimes the gum, like Sicilian amber, contains drops of water, bees, tics, flies and other insects, delicately and completely preserved, and disproving a remote antiquity.

Without entering further into theory, I will simply describe two visits which I made to the Copal-diggings. On the 10th May, I rode out from the Town of Zanzibar upon the Mony road. One mile east of the town lies a low sandy plain covered with sedgy grass, and pitted with holes two or three feet deep, from which copal had been dug. The place is about a mile from the shore, apparently but a few feet above high-watermark, and bounded landwards by a sandy nullah. Passing the palace of Mtony, some one hundred yards, I was shewn a torrent bed, where during the rains copal is said to be brought down and picked up by slaves. Thence turning towards the interior we rode up the rising ground, to judge by the eye, about one hundred feet above the level of the sea, for a mile and a half into an estate, belonging to the prince, and called Ranzah. Here were many traces of copal diggings. The soil is a dark vegetable mould varying from a foot to a foot and a half in depth, passed upon blue clay, the raised sea beach. This clay becomes exceedingly fat and adhesive, clogging the bar the deeper it is excavated; it is mixed throughout with fibres, said by the negroes to be roots of the Cocoanut tree half decayed and of bright red: blood colored bits of earth also variegated the faint blue color, and at a depth of about two feet and a half, water began to exude from the greasy walls of the hole. The copal is here found in the vegetable soil overlaying the blue clay.

On the 13th May I started from Saadan, a haven on the mainland, opposite Zanzibar, in company with the Akida-ao, or Mucuddum of the copal diggers. Passing over an alluvial plain, covered with rank vegetations, Acacias, thorns and spear grass, after walking three miles I was shown the copal tree. It is growing in a thicket upon a flat covered with toddy and fan palms, but no cocos; it stands about thirty feet high, and measures in girth three feet. Gum exuded from the bark, and in securing the specimen of the wood herewith forwarded, we were pitilessly assailed by a large ginger-colored and semi-transparent ant whose every bite drew blood. The copal tree is rare on this part of the coast: within the space of several hundred yards I saw two only.

Another mile brought us to a distinctly defined sea beach rising about 150 feet in a swell from the plain, marked by a regular line of quartz and quartzose pebbles and crowned with luxuriant thickets. The soil is sandy, and here as on the flat below are frequent traces of the copal digger. Our guide was induced to cut a stick to sharpen it, and to scrape out the earth which produced several bits of gum. One of the slaves dug a sit about three feet

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deep; the color of the band became redder as he went lower, crimson fibrous matter appeared, and presently the ground seemed to be half copal, half sand. He assured me that there is no subsoil but this red sand, and that his people never dig deeper than a man's waist.

The whole of this land from Panjany to Mboamaji may be called the copal coast: it affords an apparently endless supply of the gum. Copal is obtained by scraping the sand, even in places washed over by high tides and often when digging holes, to fix the poles of houses, the people come upon it. That of Saadan is poor compared with the produce of Wande and the Southern harbour. On the mainland it costs half price of what is paid upon this Island, and the lazy inhabitants of the villages can never be induced to dig whilst they have handful of food remaining.

The copal tree (Valeria Indica? or Hymenœa Vermicosa?) is still found in the Island and on the mainland of Zanzibar. It is not as was supposed a small and shrubby thorn nine feet high: from its towering stem canoes sixty feet long have been made, and a single trunk has sufficed for the kelson of a brig. The green wood is gummy; whole flakes at times adhering to the saw. When dried it is well veined of a light tint, and has been used for the pannels of doors: when oiled and polished it darkens to a yellowish-brown. Its small branches freshly cut make good and pliant sticks for chastisement.

I have the honor to forward the best specimens procurable of the superficial soils, in which the gum is chiefly found, the underlying blue clay, the reddy earth that is found mixed with the latter, a piece of copal, branch and leaves, and a bit of the gum here called "Damar." Unfortunately the copal tree was not in flower or fruit: the people assured me that it bears a berry not unlike a grain of Indian Corn.

The merchants of Zanzibar (mostly Germans and Americans) are not likely to throw away an ounce of serviceable copal, and they have consulted the ablest European Technologists upon the subject of preparing it to the best advantage. Supply certainly no longer meets demand, but that golden rule of political economy, full of exceptions in civilised regions, in these latitudes becomes a sad fallacy. There is an inexhaustable supply upon the coast of East Africa, but "hands" are wanted. When there is little rain and the ground is hard, the lazy savage will not dig. Moreover "Kizkazy copal"—that excavated in the N. E. or dry monsoon—annoys merchants by the difficulty of washing off the hard sand which adheres to its surface. Whenever upon the coast there is either a blood feud—and these are a legionary host—or a drought, or a famine, or a pestilence, the people strike work and dollars are offered in vain.

I must leave, Sir, to your ingenuity the task of remedying these evils. European labourers cannot be employed, the climate of East Africa, as has been abundantly proved is not less injurious to our constitutions than the worst parts of the Western Coast. Indian coolies, the only procurable hands, would fear to face the wild men, some of whom I believe to be

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inveterate canibals. If they did summon courage they would lose their lives, and justly enough, for trespassing upon other people's property. A large gang (say 500) of good fierce negroes from Kilva (Quiboa) and the southern parts, might be taught to use a proper mattock instead of the child's plaything now employed, and each man would doubtless procure twelve or fifteen lbs. per diem; but the Imaum's Government would probably object, as a late treaty enables it to do. The Lawahili Mtua Mkuba or muccadum of the copal diggers would require propitiation, and to prevent the labourers running away, it would be necessary to enter into arrangements with all the chiefs of tribes, villages, and harbours. It is to be feared that such an operation commercially speaking would not pay. Willingly therefore as I would wish that highest of meed, the gratitude of my fellow countrymen, by reducing the price of carriage-varnish, I must fairly confess it to be beyond my powers. The sole remedy for the manifold diseases of this Bona Terra with its Malaguns is time:—perhaps an occasional East African expedition might be administered to advantage.

We have, I am happy to say, shaken off the miasmatic fever of the coast, and are ready to set out again when the rains shew any signs of abating. Dr. Steinhauser has not yet joined us, but we are in hourly hopes of the welcome event: his presence will be no small comfort in a sickly climate, and where we must expect to suffer from the hardships, exposure, and various incidents of African exploration.*

RICHARD F. BURTON, Bombay Army,
Commander E. A. Expedition.

Dr. BUIST then proceeded to give some addition to his previous paper on Geography of the Red Sea. This was followed by some admirable remarks

* The following extract from a letter from Major Rigby, since September last resident at Zanzibar, contains much that is interesting bearing on the points on which Capt. Burton touches. It is added as a contribution, short though it be, of very great value on the statistics of the Commerce and Commercial Capabilities of Zanzibar. It is most singular certainly that England should only possess one-seventh the Commerce of France, one-fifth that of America, one-fourth that of Hamburg, with a port within a week of us, none of the countries just named having a possession in the eastern seas at all.

ZANZIBAR, 25*th August* 1858.—"We left Bombay on the 20th June and had for the first 8 or 9 days rough weather with frequent squalls, but we ran out of the S.W. monsoon in about 4° north, and then had lovely, cool, steady weather all the way to the Seychelles. We got to Mahi in 18 days, passing to the north of the Chagos Archipelago. Three or 4 years ago the *Clive* went to the Seychelles in the same month and was 30 days, because she went down as far as 10° south, 5° more than we did. There is an idea amongst naval men in Bombay that you must go down 10° south to make the passage to Zanzibar or the Seychelles at this season, and it is a great mistake. There is also another idea, that it is impossible to make the passage from Aden to Zanzibar during the S.W. Monsoon. Whenever I enquired whether I could come here *via* Aden I was told it was impossi-

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by Captain Baker, when a discussion of some length arose, in which various members shared.

Dr. Buist on exhibiting the mass of Iron formerly supposed a meteor,

ble; that a vessel would have to cross almost to Bombay before she could *make* any southing. Now I find that American ships come here regularly every month during the South-West Monsoon, and one arrived lately which made the passage in 24 days. The Captain tells me he ran down to the Equator in 9 days and had fine calm weather; he only went as far as 1° South and 63 E. L and before steering for this. It is a pity that so little is known about the navigation to this place, because the French, Americans and Germans are monopolizing the valuable and fast increasing trade here to the total exclusion of the English, as you will perceive from the following statements of arrivals of ships here:—

1852	74	Vessels arrived here	1855	66	(Trade affected by the Russian war)
1853	76				
1854	81		1856	89	

And in this last year they belonged to the following States:—

3	English	1517	Tons	2	Spanish	460 Tons.
20	Hamburg	5438	do.	1	Prussian	600 do.
24	American	7215	do.	1	Danish	450 do.
23	French	10979	do.			
12	Arab	3938	do.	89	Ships	31,127 Tons.
3	Portuguese	930	do.			

And so little is thought about this place in Bombay that the Marine Office had no charts of the Channel, although every foreign vessel coming here has excellent charts of it; and it seemed somewhat humiliating to find that the Commander of one of the Hon'ble Company's ships of war was obliged to borrow charts from merchant ships here, because his vessel had been sent to sea without them: and now, look at the result. We made the southern point of the island of Zanzibar in 7 days after leaving Mahi. We came up the channel with a fair wind and were within 15 miles of the harbour; but it was near sunset, we could not distinguish the coral reefs, not a soul on board knew the place, the vessel had no chart of the channel, so we stood out to the south for the night. At daylight, we found the current had set us out to leeward of the island. We beat against the current for two days, but in vain. We got set to the north close to the island of Pemba. Had the Captain had any directions for making this harbour, we might easily have come in to the north end of the island, but having no proper charts, he thought it was a great risk to try it; so we stood out to sea to the east, and did not get in for six more days, before which the crew were on half allowance of water; and had we missed the point again must have run back to Bombay, for the last flour had been issued, and there was very little biscuit or fuel left. The night before we got in we were set 54 miles to the north by the current. In these parts the currents are very extraordinary. You remember the 'St. Abbs' was wrecked about two years ago on the island of Juan de Nova to the east of Madagascar. Well, part of her cargo and part of the wreck have been washed up at Brava on the east coast of Africa, in about 1° North. Many articles, musical instruments, surveying instruments, billiard balls, &c., have been sold here, which were recovered there, and I understand a great many articles were sold to buggalows. I remember the 'St. Abbs' had 3 or 4 billiard tables on board. This place has never been surveyed since Captain Owen was here, in 1824 and 25, and it is now known his survey is very incorrect, and Horsburgh is very indistinct. It is a pity it is not resurveyed, for there

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stated that on analysation by Dr. Giraud, none of the meteoric metals save the iron was found contained in it. The idea of its extra-telluric origin must, therefore, be abandoned. It contained a large quantity of arsenic and some antimony, and was pronounced by all the chemists and metallur-

are many shoals in the south part of the channel not laid down in the charts. This is a lovely island, of unbounded fertility; the mango and other trees grow to an enormous size, oranges grow in profusion everywhere, and pine-apples of large size and good flavour grow wild all over the island. The Arabs find the clove plantations so profitable, that they are now growing cloves to the neglect of all other produce. There is not much field for a Geologist here, for there is scarcely a pebble to be found anywhere. The soil is a rich vegetable mould formed by decayed plants on a bed of coral; but for a Botanist this would be a paradise, many rare and valuable plants grow here wild: the Sarsaparilla, the Copal tree, spices of all sorts, sugar-cane of immense size, and rice, the finest I have ever seen. The common Indian Dholl plant is here a good-sized tree. The climate at present is delightful, much cooler than it ever is at Bombay, and I believe it is never very hot here, and some of the merchants who have been here some years tell me, the climate is healthy if people are moderately careful. It is dangerous for Europeans to sleep in the interior, or in any of the garden houses because the vegetation is so exceedingly rich; but the town is healthy. I find in the Meteorological Tables for Zanzibar, published in 1850 by the Observatory at Bombay it is stated, "it is evident that but few European constitutions could exist in the climate of Zanzibar." Now, when one sees Europeans and Americans who have lived here for years and tell you they never had a day's sickness, it is evident that these remarks are quite erroneous, and they do harm by frightening English merchants from coming here. I heard all sorts of absurd stories about this place in Bombay; one said, oh! it is so frightfully hot that no European could sleep a single night on shore without danger; another three generations of European settlers had died during the last thirty years. Now, what do I find; the Thermometer never rises above 87° ; the nights are always quite cool, I always put on flannel if I go on the roof of my house after sunset; I find the merchants living in comfort if not luxury. English and French ships of war are constantly coming here for supplies and Zanzibar is rapidly becoming the emporium of all the trade of Eastern Africa, and old John Bull is so gulled with accounts of the bad climate, &c., that he won't cut in for a slice of it. Another gross error in the climatology published is, that there is no dew here, whereas one of the prettiest features in a morning's walk through the woods is, to see the heavy dewdrops on every branch.

News arrived a few days ago from the East African Expedition—not from Burton or Speke, but an Arabian letter from the chief Arab with them; it was dated "Bunder Ujij" 26th March, and stated that they arrived there on the 14th February, and had been detained there up to the date of writing for want of the means of crossing the inland sea or Lake; that they had a pleasant and safe journey up, and the gentlemen were quite well. Bunder Ujij is known to be a town on the great Lake, and in the map compiled from native descriptions by the German Missionaries it is called Ujigo. Mr. Rebbman, who has lived 14 years on the coast near Mombass, says, the people are quite inoffensive, and that the road Burton has gone is so safe that a lady might travel it without risk. They have a guard of the Sultan's soldiers from here, and a large amount of baggage. The French are carrying on an immense slave trade all along the East Coast of Africa; large vessels are being sent out from France to engage in it: they call it the Engagé trade. One man at Marseilles has contracted to convey 2,500 ne-

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gists of the presidency the most extraordinary specimen of cast Iron ever seen by them.

Zanzibar, May 25th, 1857.

The Ordinary Monthly Meeting of the Geographical Society took place on Thursday, the 18th instant, Captain Wellesley, Commander-in-Chief of the Indian Navy, the President, in the chair.

Mr. Bently and Lieutenant Montmorency were proposed for election. This was the only business before the meeting.

Dr. Buist then proceeded to give an account of the Geology of the Rock of Gibraltar. See paper p. 46. A suite of eight drawings, taken from on board ship, in various voyages round the Rock, from the anchorage or from the shore with numerous sections, charts, and diagrams representing

groes to Bourbon in two years. There are two French ships of war here now, *L' Eglie* and *Genie* which have come to induce the Sultan to give his consent to the export of negroes from his dominions to Bourbon, but he has given a positive refusal. There is a large French ship here now full of slaves, they all have a board round the neck with a number on it. The French settlements Mayotta and Noss Bey, are mere slave depots. The slaves are taken there in native boats from all parts of the Mosambique, and then shipped to Bourbon as engaged labourers. The Portuguese Gov. General lately caught a French ship taking slaves from the Portuguese territory in the Mosambique, and condemned the ship, and the Captain has been sentenced to 10 years' imprisonment. The French are very wroth, and a ship of war was sent there from Bourbon to demand his release, but the Portuguese refused to give him up. The present Sultan here, Said Majid, is a most amiable, liberal-minded man, and is most highly spoken of by all the Europeans and natives."

28*th Agust.*—I have opened my letter again to tell you of a splendid meteor which was seen here yesterday evening. At 7 P. M. about N. E. and 40 degrees above the horizon, there was a very brilliant light, and a meteor shot from it and disappeared below the horizon: but the light remained a clear bright streak to the naked eye, appearing about 2 feet in length for about 20 minutes, when it gradually paled. The stars were shining, and whilst it was visible it was as brilliant as the large stars. I have told you of it as it may have been seen in other parts. I am told that meteors are sometimes very beautiful here; that a while ago one shaped like tulip, and which stretched across several degrees, was visible for some time. I am told by the merchants, during the N. E. monsoon a great deal of fine regularly cut teak timber is washed ashore on the African Coast near Brava: it is much prized, and some of the merchants have sent to their agents at Brava to buy as much as they can of it next season. Where can this come from? They say here it is drifted across from the coast of India. Can it be washed out of any of the rivers in Burmah or Siam? I don't think there is any teak in Madagascar, or any place to the south of this. It is a very curious circumstance, and I'll make more enquiries about it. I have sent some specimens of a very curious vegetable growing in the Governor's Garden at Mosambique. It is a sort of potatoe growing on a tree, they are of every variety of shape, a dark green colour, inside very like the common potatoe. The tree grows in the interior of Africa, and is thought a curiosity at the Mosambique.

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Gibraltar in all its aspects were exhibited ; while a large and varied collection of specimens completed the illustrations.

The Annual Meeting of the Geographical Society for 1858 was held in the Rooms of the Society 20th May.

Present.—Commodore G. G. Wellesley, *President,* in the chair. W. E. Frere, Esq. T. H. Bent'y, Esq., Ali Mahomed Khan, Esq. and Dr. Geo. Buist, Secretary.

The minutes of last annual meeting having been read and confirmed Capt. Ahmed bin Ali Khan was elected a member of the Society.

Presents to the Library.—Selections from the Records of the Bengal Government, No. XXVII.

Dodabetta Meteorological Observations from 1851 to 1855.

The Secretary stated, that during the past year five new members had been added to the roll viz :—Commodore Wellesley, Dr. Leith, Lieut. Montmorency, Mr. T. H. Bently, Capt. Ahmed bin Ali Khan.

The following Members had returned from Europe since last Anniversary Meeting :—Henry Young, Esq. C. S., A. Robestson, Esq. C. S., R. Willis, Esq., J. M. Erskine, Esq. C. S., and Dr. Morehead.

The following have retired from India :—Admiral Sir H. Leeke.

On the retirement of Sir Henry Leeke in September, Commodore Wellesley was elected President of the Society.

In the course of the year papers had been read on the following subjects:—

On the Physical Geography of the Red Sea, by Dr Buist ; with a supplementary paper by Captain Barker :—On the Geology of Lower Egypt, especially of that portion surrounding the Gulf of Suez, Dr Buist :—On the Geology of the Rock of Gibraltar, Dr Buist.

The state of the Society's Instruments and other apparatus remained nearly as at last annual meeting.

The following office bearers were elected for the year 1858-59 :—

Vice Presidents :—The Hon'ble A. Malet, W. E. Frere, Esq., H. L. Anderson, Esq.

General Committee of Management.

Resident Members of Committee:—Dr Bawoo Dajee; R. S. Sinclair L.L.D. J. J. Berkley, Esq. ; W. F. Hunter, Esq., Cursetjee Jamsetjee, Esq ; Dr. J. W. Winchester ; Narrayen Dinnanathjee Esq. ; John Ritchie, Esq ; Dr. E. Impey ; Capt. Barker ; T. H. Bently, Esq., Dr. R. Haines.

Non-Resident Members of *Committee* :—Col. LeGrand Jacob ; Com-

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man der A. F. Jones; Dr C. Morehead; P. W. LeGeyt, Esq.; Colonel J. Jacob; Lieut. A. D. Taylor, I. N.; Captain A. B. Kemball.

RECEIPTS.

1857.					
May 1.	To balance in the hand of the Treasurer Rs. 643 3 7				
	To Secretary ..... „ 47 10 6		690	14	1
	To Government Subscription through the year @ Rs.50 per mensem.		600	0	0
	To Annual Subscriptions of Members..... ...		480	0	0
	To Philosophical Instruments sold		22	0	0
	To Society's Transactions sold..... :		2	8	0
	To Interest on Treasurer's Account up to 31st July 1857.		27	0	0
		Rs.	1,822	6	3

DISBURSEMENTS.

1857.					
May 1.	By Cash &c. to Office Establishment.....		600	0	0
	By Cash paid for contingencies		181	5	4
	By Cash paid to Deputy Post Master for Postage by Cheque.....		23	0	0
	By Cash paid for Printing and Advertising.....		223	0	0
1858	By Cash paid to Commission to 31st July 1857.		9	9	0
April 30	By balance in the Treasurer's hand at this date ....Rs. 765 9 10				
	By balance with the Secretary 19 13 2		785	7	0
		Rs.	1,822	6	3

ASSETS.

Instruments in hand on the 30th April 1858.

4 Sympiesometers @ Rs. 55 each	Rs.	220	0	0
3 Adie's Double Thermometers @ Rs. 13 each.....	„	39	0	0
Mountain Barometer one large.....	„	120	0	0
Three Ordinary and 70.....	„	210	0	0
	Rs.	589	0	0

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TRANSACTIONS

OF THE

BOMBAY GEOGRAPHICAL SOCIETY.

ART. I.—*Physical Geography of the Red Sea.* By DR. GEORGE BUIST, L.L.D. F.R.S. L. and E. &c.

Boundaries.—The Red Sea is one of the most remarkable estuaries on the surface of the globe; separating the N. E. portion of Africa from Arabia for the space of above 1280 miles, it seems at no very remote period to have been connected with the Mediterranean. Opening into the Indian Ocean through the Gulf of Aden, it commences at the Straits of Babelmandeb, lat. 12° 30' N., long 43° 40' E., extending in a north-westerly direction till it terminates in the two Gulfs of Akabá and Suez, the upper extremity of the former being in lat. 29° 36' N., long. 35° 2' E., that of the latter in lat. 30° 2' N., long. 32° 38' E. From the Strait to Suez in a direct line is 1230 miles; the greater strait itself measures in breadth 13 miles, the lesser 1¾ miles; the two together, which constitute the entrance to the sea, 14¾ miles, or including the island of Perim, which separates them, 16¼ miles. Its entire circuit measured round both gulfs is 4020 miles, its area 108,154 miles, and its cubic content probably about 800,000 miles.* Its greatest breadth under the parallel 17° N., that is one-third up the sea, is 192 miles and it narrows pretty uniformly towards both extremities, being 72 miles across at Ras-Mahommed, where the peninsula of Mount Sinai splits its upper extremity into two, and nearly a similar breadth at Gibbel Zugar, under the 14th parallel.

Gulf of Suez.—The Gulf of Suez from its upper extremity to its entrance is 167 miles in length; its greatest width is under 30°; at its mouth it is about 17 miles from shore to shore. Its area in all is about 2000 square miles. Its greatest depth is about 50 fathoms, its average about 22; excluding the shallows at Suez, which occupy from 8 to 10 miles at its upper extremity.

Gulf of Akabá.—The Gulf of Akabá is about one-third the area of that

* The figures representing area, circumference, and content are to be received as approximations merely—especially the circumference; the area will probably be found not very far from truth.

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of Suez, or 800 miles; it is 100 miles in length, 16 across at the widest, and 7 at the strait. It is more than double the depth of its sister gulf, being about 120 fathoms for two-thirds of its length, reaching at one point the depth of 200 fathoms without bottom. Its mean depth altogether is probably not less than 70.

Depth of the Red Sea.—Two-thirds of the area of the Red Sea have never been sounded, and although no sufficient data exist from which to form a judgment of its depth, there is reason to believe it in some parts very great. There are soundings all around its shores from 10 to 20 miles out from Judda, in lat. 21° 30', to the approach of the volcanic region in lat. 17°, and frequent cross soundings have been obtained from this southward to the strait. From 21° to 27° 30', or for nearly 400 miles in length, there is a space from 50 to 70 miles in breadth, or an area of about 20,000 miles, that seems never to have been sounded; and this part has not been examined since the original survey was made 20 years ago. Being free from islands, reefs, and shoals, it occasioned no alarm to the navigators, and the surveyor had no time to devote to mere questions of physical geography. The greatest depth that seems ever to have been tried is 400 fathoms, lat. 25° 20', at which no bottom could be found; and there appears to be a chasm from 5 to 10 miles wide down the centre of the sea, varying from 150 to 250 fathoms with abrupt and precipitous sides. The average depth of the central region of the sea to an extent of about 40 miles or so may probably be about 300 fathoms; the average depth of the whole sea probably falls short of 70. A reef or shallow runs across from Mocha, lat. 13° 30, to the African shore; it has been very carefully sounded all along; it affords an average depth of from 25 to 30 fathoms; its greatest depth being 40, near mid-channel. From this the sea deepens again to 125 fathoms* as it approaches the strait. The great strait, as already mentioned, is 16 miles across; its average depth is about 80 fathoms, its greatest 125; and for a breadth of nearly 6 miles in mid-channel the depth exceeds 100 fathoms. The narrow channel being that which vessels from Aden almost always prefer in ascending the Red Sea, varies from 12 to 17 fathoms in depth, but there is 30 feet of water up to both shores with a fine sandy bottom, so that navigators feel no apprehension in traversing it at any hour. The Gulf of Aden, which continues the communication from the Straits to the Arabian Sea, is a funnel shaped estuary above 900 miles in length and nearly 200 across from the N. W. point of Africa to the Arabian shore. Its general characteristics are similar to those of the lower part of the Red Sea—it is remarkable for the violence of its currents, which will be noticed afterwards, and for the depth of its central channel and shallowness of its shores.

The Tides at Suez are about 5 feet at neap and 7 at spring. The rise and fall at Ras-Mahommed is about 5 feet—high water spring tides at 6 o'clock. The direction of the wind makes a difference of about 4 feet in the depth of

* The depths are taken from the chart, but the greater part of the soundings are marked as having "no bottom," so the actual depths are certainly beyond this—how much we know not.

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the water near Suez: the banks which are left dry by the N. wind are well covered with a breeze from the S. We know little of the tides over the rest of the sea. At Aden, 80 miles without the strait, where continuous observations have been taken by gauge for three years, the tides rise 4 feet at neaps, and nearly 8 at springs; high-water occurring at 1·30; the sweep of the tides, as well as the hour of high-water, being remarkably irregular. The Red Sea probably derives its name from large portions of it, as well as of the Arabian Sea, being covered with patches, from a few yards to some miles square, of a blood-red colour, derived from a species of vegetable or animalcule particularly abundant in the spring months, and which dyes the upper waters of the most intensely blood-red hue that can be conceived.* There is nothing else about the sea that is red, and a considerable expanse of this, encountered by an early navigator who had not met with any similar phenomenon elsewhere, would seem warrant enough for its name.

Islands.—Though islands are numerous along both shores of the Red Sea, they are for the most part of inconsiderable size, and they have been included in the measurement of the area: their structure will come to be spoken of along with that of the rocks on the opposite shores.

Appearance and Saltness of its Waters.—As the Red Sea is entirely surrounded by a hard, sandy, or rocky shore, without a rivulet, and scarcely a drop of rain falling into it from year to year, its waters are remarkable for their transparency and purity, even over a long expanse of shallows. Where the sea is deep and distant from the land, its colour is of the most intense blue, changing from greenish-blue to bluish-green, green, and light green, as the coral reefs approach the surface—the dead corals themselves being mostly white, the live ones greenish. It was long supposed to be considerably salter than the general ocean, a supposition now proved to be partially unsound. In 1837 Dr. Malcolmson found the water off Cossir of specific gravity 1·035, indicating a degree of saltness greater than that at Suez but not so great as that of many parts of the Atlantic. The water at Mocha and Camran hardly at all differs from that of the outer sea. In 1848 Mr. Morris, engineer, obtained for me specimens of the water from seven different stations, nearly equidistant from each other all the way down: they were examined by Dr. Giraud, Professor of Chemistry at Bombay, and the following were the results:—

	Lat.	Long.	Sp. gr.	Saline Contents in 1000 parts.
	° '	° '		
No. 1 Sea at Suez	29 40	35 2	1·027	41·0
2. Gulf of Suez	27 49	33 44	1·026	40 0
3 Off Cosseir	24 29	36 0	1·024	39·2
4. Off Jedda.... ...	20 55	38 18	1·026	40·5
5. Off Hali	18 43	40 3	1·024	39·8
6. Off Hodida	14 34	42 43	1·024	39·9
7. Below the Strait ..	12 39	44 45	1·023	39·2

* See Transactions of Bombay Geographical Society, previous number; also Dr. Carter's paper on the Colouring Matter of the Sea, Transactions of the Bombay Branch of the Royal Asiatic Society 1858.

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Dr. Giraud gives the following note of the saltness of the sea from a variety of other localities. From this it will be seen that the Mediterranean at Marseilles is of the same saltness as the Red Sea at Suez, while the Atlantic in the latitude of Canaries is $\frac{1}{100}$ more salt.

	Grs.	
Baltic	20.0	in 1000
Frith of Forth	30.0	,,
Boulogne	32.0	,,
Havre	36.0	,,
Bayonne	38.0	,,
Marseilles	41.0	,,
Atlantic, Canaries	44.0*	,,

The following is from Dr. Lyon Playfair and Liebig's Report 1852 Sea Water.

					Sp. Gr.	Grs. 1.000
Port of Callao	A	12° 5 S	77 14W.	March		32.752
Algodon Bar	B	22 6 S	70 16W.		1.0278	36.773
Dead Sea	C	25 11 S	93 24W.	March	1.0284	35.233
Cape Horn. same Spot	D				1.0260	34.708
Near Cape Horn	E	56 32 S	68 47W.	April		34.763
Atlantic	F	20 45 S	29 27W.	May	1.0244	32.583
Same	G	00 47	30 20	22	1.0275	35.695
Same	H	20 54 N.	40 44W.	June 4		24.746
Same	I	41 19W.	36 28W		1.0287	38.422
North Sea	K	51 9 N.	3 34W.	July	1.0264	34.083

The following are from specimens of Water taken by Lieut. Adams of the H. C. S. Victoria betwixt Suez and Bombay, October 1854. They were very carefully analized by Dr. Giraud.

140 Miles from anchorage		Lat. N.	Long. E.	Sp. Gr.	gives in 1000	Date.
Gulf of Suez near bottom	1	28 25 N.	38 15	1·0803	42.6	
Red Sea	2	25 28	35 44	1·0304	42.9	
Yemboo	3	22 25	37 24	1·0297	41.5	
Jedda	4	19 14	39 14	1·0288	40 7	
Hodida	5	16 14	41 25	1·0288	40.0	
Mocha	6	16 00	43 20	1·0280	39.2	
Gulf of Aden	7	12 57	46 59	1·0270	89.2	
	8	13 29	47 44	1·0270	37.6	
Open Sea N. off Socotra	9	14 18	52 30	1·0269	35.8	
	10	15 35	55 50	1·0267	36 8	
Opposite entrance P. Gulf	11	16 40	59 33	1·0265	37.5	
East of Persian Gulf	12	17 30	63 11	1·0270	37.4	
Meridian of Kurrachee	13	18 04	66 49	1·0279	37.4	
100 Miles off Bombay	14	18 37	70 24	1 0270	37.8	

These experiments were made on water taken from 10 feet below the surface of the sea. We are ignorant of the character of the water in its depth, but have no reason to suppose it to differ materially from that at the surface.

From the specimens collected by Captain Adams, like those formerly taken by Mr. Morris and carefully analysed by Dr. Giraud, we have the following results. The water of the Gulf of Suez contains from 2 to 3 grains per

* Most likely where the Salt under Current of the Mediterranean rises to the surface.

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1,000 more than that of the Sea of Mocha—and this again is salter by 2 or 3 in the 1,000 than that of the outer ocean. Passing the Straits, we find the same saltness to a certain extent to continue till we reach Aden. It has been 42 grains in the thousand in the Gulf of Suez, 40 in the upper and 39 in the lower part of the Sea, but this last continues for a hundred miles below the Strait. As the Gulf opens out, and the waters of the Arabian Sea enter freely, it suddenly falls to 37 off Socotra, and further out in Latitude 14-18 and longitude 52-30 it descends to 35 8. As the shores of India are approached, the quantity of salt again increases, for one reason perhaps more rapidly than it otherwise would, in being mingled with the saline contents of the Persian Gulf, which like the Red Sea, throws off much more water in vapour than it receives from the rain or the streams entering it, and which may therefore be assumed considerably salter than the outer ocean. When the temperature of the Sea comes to be examined, it will be seen that the water is much warmer compared with the air along shore, than far out and here also the air is drier and the evaporation greater. Though the currents in the Sea, which these things themselves help to produce, tend to commingle the waters together, it takes some time to restore the equilibrium at first disturbed; observation bringing to light the very facts theory led us to look for. Unless where great rivers discharge themselves nearest the land, narrow seas are more salt than the open ocean. Wherever water of extraordinary density makes its appearance,—as for example off the Canaries in the Atlantic, some separate disturbing cause is sure to be discovered close by,—in this case the outward flowing over salt current of the Mediterranean.

Climate and Winds—From the general conformation of its shores, the winds in the Red Sea for the most part blow in the direction of its axis, being for eight months in the year from the N. W., for the remainder from the S. E. The characteristics of the climate of the upper and lower portions of the sea differ, as may be expected, materially from each other, that of the middle portion partaking occasionally of both. The N. E. monsoon, which commences in October and continues till May or June, blows with considerable freshness in February, but is as summer sets in occasionally interrupted almost altogether. On entering the Red Sea it is deflected, and pursues a path almost at right angles to that which it had previously pursued, becoming a south-easterly wind as it rushes up the axis of the sea. Confined in a comparatively narrow compass, it blows with considerable violence, and is stronger towards the Arabian than the Abyssinian shore in the lower part of the sea. It is freshest in the end of October and beginning of February, and is sometimes felt as far up as Suez, so that generally by the time that it gets as high as Judda, lat. 21° 30, it becomes for the most part light and variable. It slackens as it passes the Harnish and Zugar islands under the 14th parallel, where the sea begins to extend in breadth. Further to the northward it softens still more, till it is lost in the languid winds on the coral reefs of the Arabian Coast, or turning to the westward, wanders away out towards the islands of the African shore, until changing

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its course, it returns again into itself. In October and January the weather in the lower part of the sea is thick and hazy, obscuring objects until they are close at hand, and squalls and rain are frequent and heavy. Captain Ellowan states, that in December land and sea breezes were prevalent on the Arabian shore, half way up the Red Sea, with occasional southerly winds; in January it was frequently squally, with thunder, lightning, and some rain in the southward, occasional squalls being experienced in February. On the African coast, in lat. 15°, the prevailing winds in March are westerly, drawing off from the land towards night, from the sea during the day. In April regular land and sea-breezes prevailed, the winds generally from the N., though twice or thrice from the S., and the weather often hazy. In May the wind mostly comes from the land, the sea-breezes becoming light, sand squalls being experienced towards the beginning of June.

When the south-easterly monsoon begins to blow in the north-westerly part of the Indian Ocean, north-westerly winds prevail in the lower half of the Red Sea, where they blow with considerable violence in June and July becoming light and variable in August and September. As the time of their extinction approaches, there are sometimes calms of several days' duration experienced, when the sea-breezes become excessive. On the African shore, sea and land breezes are experienced towards the strait, with northerly winds nearly all the year round. The fine season prevails from August to October, showers, such as they are, are chiefly experienced from November to March. The winds from Suez to Judda are mostly notherly throughout the year, and occasionally blow with considerable violence. From December to April southerly winds are occasionally experienced in the Gulf of Suez, at times freshening into a gale, and blow for several days. Captain Carless tells us, that it is almost always stormy in the Guif of Akabà, the squalls being dangerous and violent where the two gulfs unite. Captain Cruttenden states, that when he visited Senna in July 1836, no rain had fallen, either there or at Mocha, for four years, but that during his stay heavy rains fell for nearly a month. These remarks are all taken from the writings of the officers on the survey, some of which still remain unpublished, and are mostly from the sailing directions of Captain Moresby. We have no regular meteorological observations from any part of the Red Sea higher up than Aden, where the evaporation amounts to about 7 feet annually. Off the peninsula of Sinai, according to the experiments of Captain Carless, it amounts to between 8 and 9 feet, and when the dryness of the desert winds is taken into account, the evaporation over its whole surface will probably be found to fall little short of 8 feet annually and certainly not more than an inch of rain or rain-water is added in the course of the year; the showers, heavy as they are, which occasionally fall on its shores being drunk up by the thirsty sands which cover them all around.

Hail storms of great violence occasionally occur both in the Gulf of Aden and in the Red Sea.

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Capt. Haines in 1836 experienced a hail storm of much force lat. 22 long. 60 off the Persian Gulf.

The following is given from the Log of the Clive Lat. 19.18 Long. 40.03 December 22nd 1842. This was followed a few days afterwards by a violent fall of rain at Aden.

"Tuesday, Dec. 26, 1842,—3 P. M. Dark squally appearances to the eastward with lightning. At daylight still a dark threatening appearance to the N. E., loud peals of thunder with vivid forked lightning, and the wind veering from S. S. E. to N. E. At 10 hard squalls, with heavy rain accompanied by hail, Lat. 18. 19 N. Long. 40.03 E."

There was a violent fall of rain at Aden more than six inches which nearly deluged the Cantonments on the 28th, 29th, 30th. Decr. 1842. It is now said to have been the first heavy fall experienced for fourteen years, none whatever had fallen from our occupation in 1838. On the 11th November 1854, a violent hail storm occurred at Suez simultaneously with the earthquake felt all over the Levant. The following is a list of well ascertained falls of recent occurrence at Aden.

1848, 28th January,—Light rain.
Feb. 27th.—Do. do.
March 20th.—Do. do.
July 15th P. M.—Heavy dust storm with lightning and showers of rain.
Do. 16th—Heavy rain at 1 o'clock. One inch fell in twenty minutes.
August 28th 4 P. M.—Heavy rain with thunder and lightning.
September 4th 2 A. M.—A smart shower of rain.
Do. 5th.—Rain with thunder and lightning.
Do. 19th.—A quarter of an inch of rain fell.
November 21st —Light showers over the twenty-four hours.
Dec. 30th.—Do. do.
1849 April 19th.—Showers of rain with thunder and lightning.
Do. 21st.—A heavy storm of wind and rain; above three inches fell.
July 31st.—Violent thunder storm with one inch and a half of rain.
Dec. 22nd and 24th.—Smart showers of rain.
1850, May 6th and 7th.—Rain with lightning and a heavy gale of wind.
1851, Dec. 12th.—One and a half inch fell.
1852, Jan. 3rd.—Half an inch.
Do. 22nd.—A quarter of an inch.
Do. 28th.—Five inches and a half.
Sept.—A heavy fall occurred; the amount not given.
1853, Dec. 6th.—A quarter of an inch.
11th—half an inch.
1854 Jan. 11th.—A quarter of an inch.
Do. 12th.—Four inches.
Do. 13th.—Light showers.
March.—About five inches; amount uncertain.
May 6th.—Quarter of an inch.
Oct. 25.—Two tenths.

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Oct. 26.—Three inches.

Dec. 5, 7, and 28th, Heavy showers.

1855, Jan. 2nd, 9th, 10th, 11th, 12th. Heavy showers, two inches and a quarter in all.

Aug. 21st.—Half an inch.

1856, Jan. 11th 22nd and 23rd. Heavy showers, one inch and a quarter.

It will thus be seen that for the past ten years, rain has fallen at Aden on six eight days annually,—the total yearly fall being somewhere about five or inches.

On the temperature of the Red Sea I have bestowed a special article at the conclusion.

It frequently happens at the same time that several years on end without so much as a shower, and this furnishes a fair type of the rain of the Red Sea. On the 28th of July 1854, I experienced a heavy fall of rain in the lower part of the Red Sea, which lasted a couple of days. Again, on the 10th of Feb. 1857, we had a heavy squall of rain in passing the Straits of Babel Mandeb.

Currents.—From the general character of the sea as just described, a very singular series of occurrences may be expected to make their appearance near the strait, to compensate an evaporation of nearly a quarter of an inch daily, or nearly 8 feet annually, over an area of 108,154 miles, or in all 165 cubic miles, of water raised in vapour in excess of the little rain that falls. Were the geological theory true, that the water, concentrated at the surface, occasioned a deposit of salt at bottom, the Red Sea must long ago have been transformed into a solid mass, and if the assumptions as to the capacity of the Red Sea be correct, the waters would be dried up in the course of a hundred years, were no water to enter from without. In the course of three thousand years (and for this time it has been known to us) it must have been converted into a solid mass of salt, had the whole saline matter, carried in from without by the current required to feed evaporation, remained within the strait. Yet we know that, in point of fact, it is, at the surface at all events, not one whit more saline than the outer ocean; and we have no reason to believe that its lower waters differ materially from those which float at the surface. The various officers of the survey were, from the commencement of their labours, struck with the extraordinary diversity of the currents within the Gulf of Aden. "My endeavours," says Capt. Haines in a paper prepared in 1849, "to reduce them to principles which might guide others have hitherto entirely failed, but I am at this moment not satisfied how the currents themselves are set in motion, whether by submarine impulse, by a change in the component parts of the water occasioned by different degrees of evaporation, or by the pressure of prevailing winds. At sea I have experienced a current running in circles, or in bands, 60 miles in extent, and have not unfrequently borne up, and set topmast studding-sails with a favourable wind, in order to escape the counter current, when, by observation, I have found

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the vessel in another stream out of the former current, and have hauled to windward again, and beaten fast sailers, which were working in-shore.' This corresponds almost word for word with the account given by Dr. Scoresby of the bewildering currents produced by the tepid waters of the Gulf-stream running N., and meeting the cold and heavy polar currents moving southward: the cause of both being the encounter of streams of water of different weight; the specific gravity of the two depending in the one case on the diversites of temperature, in the other on differences of saltness. The error into which those who assume the salting up of the sea, seem to have fallen, is that of supposing the water concentrated by evaporation to remain at the surface till close on the point of saturation, and then sinking only when ready to deposit its salt, whereas, in point of fact, the instant the upper waters become one atom heavier than those beneath them, they will sink down either till they reach the bottom, or meet with others of the same gravity as themselves. A mass of brine, by ever so little salter than the surrounding waters, may thus accumulate in the recesses of the sea, until it rises to the level of the Mocha barrier, when, by its own gravity, it will at once flow over, and produce an outward under-current, by which the whole mass of the sea will come to be discharged as it is concentrated. Between this and the upper inward-flowing current, required not only to supply the whole 165 cubic miles vaporized, but the vitiated water discharged, there will in all likelihood be a mass of stagnant water brought to rest by its upper and lower surfaces being acted upon in opposite ways by the conflicting currents. These things are matters of physical necessity, dependent on the first principles of hydrostatics, and not requiring experiment for their establishment. It seems more than probable that the Red Sea changes the whole of its waters at least once a year; and we may yet be able to determine the fact by observation. As it is, we know that a strong current sets along the coast of Arabia, towards Meckran and Scinde, the sweeping southward by the shores of Hindostan, where it is diluted by the enormous falls of rain, of which probably not less than 10 feet are discharged into the ocean annually from an area of 24,000 miles, or 40 cubic miles of water, it next crosses the Arabian Sea towards Zanzibar, and gives off its surplus vapour as it returns along the shores of Africa northward to the Red Sea, again to perform the task it originally accomplished. The whole amount of water, evaporated from the nearly rainless shores to the N. W. of the Arabian Sea, probably exceeds 400 cubic miles, the further deficiency being supplied by currents from the southward.

The Shores of the Red Sea.—Around the whole of the shores of the Red Sea is a belt of sand and gravel, sloping inward from high-water mark to a distance varying from some hundred yards to that of many miles. It abounds with shells and corals, identical with those in the sea itself, and is obviously an upheaved beach of comparatively modern date. It is not very easy to determine either the extent or the elevation of its landward margin, as a long series of upheavals appear in these parts to have follow-

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ed each other, so that a much more minute survey than has hitherto been bestowed upon it, would be required before what belongs to each could be determined. I have found Red Sea shells scattered in profusion all over the Desert, between Cairo and Suez, at an altitude of 800 feet, and they are mentioned as existing at an elevation of at least 2000. Dr. Carter describes a cavern near Ras-Morbat, in southern Arabia, the floor of which is a few feet above high-water mark, the roof being 30 feet high, obviously excavated by the waves. The face of the cliff on a level with the roof is full of borings of lithodomi, and Dr. Carter supposes that it was formed whilst slowly emerging from the sea.*

There are many similar caverns in the interior; the roofs and floors of all are incrusted with sulphate of lime, as stalagmites and stalactites. The cliffs along the shore of Africa, towards the mouth of the Gulf of Aden, are found all pierced with similar caves, as I have no doubt those around the Red Sea would be found to be, were they examined; and I have come to the conclusion that the altitude of the most recent of these upheavals varies from 5 to 30 feet, being different at different points.

During his investigations with a view to the construction of a canal between the Mediterranean and the Red Sea, Mr. Cubitt found the level of the two seas the same; and there can be little doubt that the bitter lakes in the isthmus at one time formed the head of the Red Sea. Mr. Stephenson has ascertained that the sea-shells in this district, as well as those on both the raised beaches in that neighbourhood, are the same as those now prevailing in the Gulf of Suez; so that, at a period comparatively recent all the tertiary beds forming the bottom of the sea and the contiguous land must have been elevated from 12 to 18 feet. Historical events afford us a date within which this must have occurred. Six centuries before the Christian era, Darius Hystaspes completed a canal from the Nile, a little above Bubastes, to the Red Sea near Patamos; it was in some places 150 feet wide and 30 feet deep, and was navigable for vessels of considerable burden; while the Nile which supplied it was high, the waters serving for irrigation. The vicinity of several important cities, the ruins of which are still scattered around, indicates that the district at this period was possessed of great fertility and a large population. Within three thousand years, then, the alteration of level must have occurred which rendered it impossible longer to supply the canal from the waters of the Nile. In this view I have adopted both the facts and the inferences of Mr. Cubitt, Mr. Stephenson, Capt. Newbold, Miss Corbaux, and Mr. Glynn, not having crossed it myself;† but I had come to exactly the same conclusions, and published an account of these four years before the earliest of the writings referred to appeared.

* Geography of S. E. Coast of Arabia: Trans. Bomb. Asiat. Soc., 1851, p. 252.

† Capt. Newbold's Visit to the Bitter Lakes, Isthmus of Suez. Trans. Roy. Asiat. Soc. 1845, vol. viii. p. 355; Mr. Glynn on the Isthmus of Suez, on Ancient Canals of Egypt, Institution of Civil Engineers, 1852; Miss Fanny Corbaux's Letters in the "Athenæum," 1852.

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It is singular that we should know so little that is authentic or accurate of the Wadi Arabá, or the region which intervenes between the Gulf of Akabà, the other terminal point of the Red Sea, and the great depression of Palestine, considering its perfect accessibility and the frequency with which it has been traversed. Even the little knowledge we flattered ourselves that we possessed, has now vanished. A writer in the 18th volume of this Society's Journal, basing, as I had supposed, his conclusions on well-established facts, had placed its length at 105 miles, and its summit level at 495 feet; but Capt. Allen, R.N., has since shown * that we are altogether ignorant both of the altitude and position of its water-shed. We do not profess to know anything of its geology, or the age of its upheaval. The islands in the Red Sea doubtless afford abundant evidence of these various changes of level: but, with the exception of the volcano of Gibel-Teer, and of those described by Ehrenberg, in the neighbourhood of Ras-Mahommed, scarcely one of them has been examined or described in modern times. The "Two Brothers, in lat. 26° 20' N., long. 34° 45' E., are set down in the chart as coral islands, about 60 feet above the level of the sea. The sea immediately around them sinks at once to 50 fathoms. The Red Sea, around its whole circuit, is walled in by vast masses of mountain, which, down to Judda, in 21° 30' latitude, approach close to the shores. On the African side, down to the 16th parallel, isolated hills alone skirt its boarders; the higher ranges 40 or 50 miles off are seldom seen at sea; and on the opposite shore, between the same parallels, the land slopes gently in towards the interior of Arabia. The rocks chiefly consist of nummulite limestone—a portion of the vast band so admirably described by Sir Roderick Murchison, as stretching all the way, in one unbroken line, from the Bay of Biscay to the shores of Aracan, for nearly one-third of the circuit of the globe. From the parallel 16 to 12 the mountains on both skores and the islands in the middle of the Red Sea are volcanic. Gibel-Teer. in lat. 15° 30', is still smoking, as it has been since 1774, when visited by Bruce, by whom it is set down as 500 feet in elevation. Dr. Kirk makes it 300 feet; the surveyors place it at 900: so little do we know of a volcano passed by our steamers at least four times every month. A violent eruption, of short continuance, took place in one of the Zugar islands, lat. 15°, in 1846, which was fortunately seen from different points of view by steamers passing in opposite directions but it has never since been visited. A range of hills, above 14 miles from the shore, to which it is nearly parallel, is laid down in the chart as volcanic on the African side, with a similar range of greater magnitude and of the same character, extending from lat. 12° to lat. 15° 30' on the Arabian coast. Dr. Kirk describes these as extending for about 300 miles to the westward, so that this vast volcanic field, which has carcely been so much as noticed by geologists occupies probably an area of above 10,000 square miles, with-

* Trans. of the Royal Geographical Society, 1853, vol. 23, p. 166.

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out interruption; and is perhaps the third or fourth in point of extent on the surface of the globe. The only one of all its volcanoes with which we are somewhat acquainted is that of Aden, in the crater of which our troops are quartered. It has been so often described that it is necessary here to refer to it, further than to state that it has clearly been submerged and elevated again from the waters, since the latest period of its activity. Up to the altitude of 500 feet it is thickly strewed with sea-shells mixed with scoriæ and volcanic ashes; and in the bottom of the crater and all around the margins of the peninsula are masses of shells and gravel, the same as now prevail in the sea around, and exactly similar to those on the raised beaches of India and of Suez. In September 1857 I was shewn a large bed of as perfectly well preserved shells of the same description as those on the shores of the sea at an altitude of 300 feet, on the ridge between the main pass and the New Works near the Turkish Wall (see Paper on the Geology of Aden).

Note by Captain Haines.—The latitude of the Straits of Babelmandeb I do not think correct. I found soundings all the way across just outside the Red Sea; greatest depth 198 fathoms.

There are, no doubt, many reefs in existence not yet discovered: I reported one in April last, upon which an Arab ship struck.

The height of the water within the Red Sea depends upon the seasons; and after strong N.N.W. winds the shoals in the north part are dry in many places: even the shoals in the centre are influenced in the same way. The Dedelus Shoal can be landed on *at times*.

In January and February it more frequently blows strong from S.S.E. up the sea in the lower part, and the contrary from N.N.W in June, July, and August —*S. B. H.*

DISCUSSION.—*At the meeting following that at which the preceding paper was read the following remarks were made* by CAPT. BARKER.

At our last meeting we were favored by the learned Secretary rendering a very interesting paper on the Physical Geography of the Red Sea. It being late, discussion on the subject was postponed to a future meeting.

It is generally supposed that there exists a perpetual surface current flowing into the Red Sea from the Indian Ocean; such however is not the case. To counteract the effects of this supposed current an undue amount of evaporation, and a sub-surface current has been resorted to, to restore the equilibrum of the waters of this Sea. It has also been asserted that the water at the Isthmus of Suez is lower than at the Straits of Bab El-Mandeb (vide Maury's sailing directions sixth Edition page 113.)

I do not deny the existence of sub-surface currents, but I am of opinion that sufficient attention has not been paid to the prevailing Winds of the

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Red Sea, I beg therefore to lay before the meeting the accompanying Abstract Log kept by me between the years 1831 and 1834, (while engaged in the arduous duties of the survey,) which will tend to elucidate the subject, and show that as the waters flowing into the Red Sea are governed by the prevailing winds, that a corresponding influence exists to cause the waters to flow out *at the surface* in a similar proportion.

It will be observed that during the year 1832, we were principally engaged on the survey of the Coast of Arabia and Islands of the Phassan group; and that during the year 1833, we were principally engaged on the opposite Coast and Islands, and that while on the former Coast the winds tend generally from the Southward and Eastward, on the latter their general tendency in corresponding months is from the Northward and Westward. I have placed the months of the two years opposite each other, that this may be seen at a glance.

I think it much more rational to account for the waters retaining their level by the action of surface currents, governed as we know they are by the prevailing winds, than to resort to an undue amount of evaporation, and sub-surface current.*

During the N.E. Monsoon, that is from October till May, a strong current sets into the Red Sea through the Straits of Bab-El-Mandeb, decreasing in velocity as it advances northward till it is altogether lost. The fact is that the waters thus forced into the Red Sea along the Eastern shore are forced out on the Western shore although this is not so perceptible as the current at the surface does not attain the same velocity on account of the greater width of the channel through which it flows.

During the S.W. Monsoon it is the reverse of this, the waters are forced out on the Eastern, and in, on the Western shore.

I am of opinion that there is no difference between the level of the water at the Isthmus of Suez and the Straits of Bab-El-Mandeb. Early in June northerly winds commence to extend their influence throughout the entire length of the Sea, and by thus giving an onward unchecked motion to the water at the surface, forces a considerable body of water out of the Sea, so that Reefs which are usually covered at low water spring Tides, become dry, thereby causing much sickness (Fevers principally) by the decomposition of vegetable and animal matter, thus exposed to the scorching rays of a Tropical and almost Vertical sun. This decrease or depression of the water is only temporary, lasting but a few days, when a re-action takes place and the waters resume their ordinary level.

* I have taken the evaporation as ascertained at Aden and at Rass Mahommed the lower and upper extremities of the Sea: but it is quite sufficient for my theory that more water is carried off by evaporation than is supplied by rain. There MUST in this case be an outward sub-surface or undercurrent, dependent on evaporation alone. There *may* be abundance of other currents caused by the wind—GEO. BUIST.

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I would next call your attention to the Log for the months of August and September 1833, particularly to the high range of the Thermometer. It will be observed that the hotwinds are confined to a very small extent of coast line, and generally do not extend any very great distance from the shore although they have been known to extend even to the opposite coast, and I have known ships in Juddah Harbour have their sails and rigging covered with a thick layer of sand, carried across by these winds.

The hotwinds commence about the same period as our S. W. monsoon setting in from the southward gradually hauling to the westward as the season advances but here all comparison ceases, for they bring with them no refreshing showers.

What distance do these winds traverse before they reach the coast? The sand which is borne before them in such dense clouds as to confine the limits of vision to a few hundred yards of what is it composed? Is it mere sand, or does it bear any affinity to the rain dust of Maury? (page 134-6th Edition). It is a subject worthy of consideration and investigation.

In alluding to Dr. Buist's remarks on the volcanic region of the Red Sea, I would observe that the whole of this Sea has evidently been subjected to violent volcanic agency. This is more apparent in the lower portion thereof where volcanoes appear to have existed at a much more recent period than in the northern portion. Extinct or exhausted craters abound, as at Jibble Teer, The Zebayers, Harish and Zoogur Islands and also along the shores of the Western Coast.

The most remarkable of these is perhaps Jibble Teer—called also by the Arabs Jibble Dookhan and Jibble Nahr. (The Hill or Mountain of Birds —smoke—Fire.) This is the northernmost of the central group of Islands situated nearly in mid channel, attaining an elevation of about 900 feet above the level of the Sea with *no bottom* close to it. Smoke has been observed to issue from its summit at various times during late years, particularly during the year 1832 when visited by the officers of the "Benares," when dense clouds of smoke issued from its summit.

During the year 1846 as recorded in the Transactions of this Society one of the Zebayers-group called Saddle Island, was observed to vomit forth "a dense cloud of sulphurous looking smoke." This occurred in the forenoon during a very heavy squall from the southward attended with vivid lightning.

The small Island of Kotumble one of the Pharsan group is evidently an extinct volcanoe still retaining its conical and croter like form.

In the northern part of the Red Sea opposite to Cosire are two small coral Islands called the Brothers (by the Arabs El-Fanadeeah) doubtless they are upheavals from the vast deep; Rising as they do, wall sided and flat topped attaining an elevation of about sixty feet having no bottom at 100 fathoms close to, they form a striking feature even in this remarkable Sea.

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But there is a still more remarkable spot viz. the small central Reef called the Dedalus or Abdool Keessan ; at times, when the Tide is very low forming a small Islet, but at others under water, thus rendering it very dangerous to navigation, particularly at night time or in calm weather ; the lead is no guide to the approach to this Reef there being 300 fathoms no bottom close to. It is situated nearly in mid-channel being 45 miles from the nearest Reef off the Western shore and 50 miles from the Reef off the Eastern shore. The channels on either side are said to be unfathomable.

The correct deep Sea sounding of the Indian Ocean and the central portion of the Red Sea has become a matter of deep importance in connection with the laying down the Electric cable to unite India with Great Britain.

The late startling events in Bengal and the N. W. provinces have rendered this imperatively necessary, and no time should be lost in carefully and correctly sounding, the entire distance between Bombay and Suez. Science demands, that our charts be no longer disfigured with 45° 80° and 90° the underlined cipher above the numeral denoting no bottom at that depth, as shown throughout the Sea, particularly in the chart of the Gulf of Akaba which is disfigured throughout its entire length by the perpetual recurrence of 140° which has such a poverty stricken appearance.

It has been ascertained that the Mediteranean has a depth of 2170 fathoms. I am of opinion judging from the natural formation of the shores of the Red Sea, whether viewed horizontally as to the Coast line, or vertically as to the height of the mountains on either side that this Sea will be found deeper than the Mediteranean and that the Bed of the Red Sea and Indian Ocean will be found to be about 3,000 fathoms from the surface, excepting the space comprized between a line from the Ras Ul Had (the Eastern extreme of the Peninsula of Arabia) to the Island of Socotra and the Island of Jibble Teer, the volcanic Island before alluded to. In this space I think that great irregularities will be found in the Bed of the Ocean.

One of the Royal Australian Mail Steamers, has recently arrived at this Port for the purpose of being Docked. This Vessel on her last voyage to Suez ; ran *into* (*not on*) one of the Sunken Coral Patches. Situated near the Nubian Coast below Jezeerat Maccowah.

It appears that the Vessel struck the Rock with her steam at full work with such force that she became quite wedged in, I have since heard they had 27 fathoms at the Cat Head, her keel never touched. There was but 18 inches water on the Reef while at the main chains or about two thirds of the length of the ship from the Stem, there was 67 fathoms ; and over the stern they lost the line in attempting to obtain soundings.

A wooden ship under such circumstances would inevitably have foundered and probably every soul on board would have perished. The fore

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compartment filled with water. The ship was extricated from her perilous position however by dint of great exertion and taken into one of the sherms or Harbours, on the Nubian Coast (Dub-a-Deeb.) grounded, the water pumped out and the damage sufficiently repaired, to allow the voyage to be prosecuted.

I merely allude to this to show the nature of the formation of the coral Reefs of this Sea.

I have already occupied too much of your valuable time, and cannot herefore trespass on your patience any longer by reading the accompanying paper on the Navigation of the Red Sea, in connection with the proposed "maritime canal of Monsieur Ferdinand de Lesseps," but beg to be allowed to lay it on the Table, for the perusal of members at their leasure, should the same be approved of.

This scheme would have been far advanced ere this, but for the opposition on *Political grounds* solely of our present Prime Minister and the present Ambasador at Constantinople, but we have lately seen great changes in the opinions of men long wedded to certain *fixed Political ideas*. It is to be hoped that a measure fraught with such universal benefit as the connecting the Red Sea with the Mediteranean by means of a navigable ship canal and thereby accelerating the means of transit between Great Britain and her Indian Empire, as well as the Colonies of South Australia and China, will not be retarded, the cause of civilization and Free Trade checked in their onward progress, merely on account of an imaginary political expediency.

For my part I am confident that this great undertaking will soon be commenced, and that ere long Red Sea will become truly the high-way of nations.

In conclusion I would observe that in the Paper now laid before you, the interval allowed for the transit between Bombay and England has been quoted at its *extreme figure*, and I feel confident that the Voyages to and fro will more often be performed under, than over, the time allowed.

I have spent the greater portion of my life afloat in the Red Sea extending over a period of *Active service* of 25 years, and cannot but take a deep interest in every thing pertaining thereto, which must be my apology for thus long trespassing on your time and patience.

W. C. BARKER,
Commander, I. N.

Bombay, December 17th 1857.

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Temperature of the Air and Sea between Bombay and Aden during the month of January 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Jan. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	72.30	18.44	79	82
4	68.41	18.01	78	78
5	65.34	17.20	78	80
6	60.22	16.21	80	78
7	56.35	15.21	82	78
8	52.37	14.33	81	78
9	48.30	13.13	83	78
10	Aden.		82	80
From Bombay to Aden.				
17	72.32	18.45	74	78
18	68.32	17.55	78	78
19	64.19	17.13	74	76
20	60.20	16.12	75	76
21	56 22	15.19	80	78
22	52.15	14.27	79	78
23	48.18	13.06	78	78
24	Aden.		78	78
From Aden to Bombay.				
1	55.06	15.40	78	78
2	58.30	16.46	77	75
3	62.17	17.42	80	76
4	66.01	18.29	80	77
5	69.47	18.56	80	79
6	Bombay.		80	79
	BombayHarbour			

Jan. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.56	18.39	85	82
4	68.11	17.58	82	83
5	64.27	17.14	84	80
6	60.34	16.15	84	80
7	57.15	15.23	85	78
8	53.39	14.20	79	78
9	50.03	12.50	82	78
10	48.51	12.26	80	78
11	Aden.			
From Bombay to Aden				
17	22.07	18.42	82	82
18	68.36	18.03	84	82
19	64.52	17.20	82	84
20	61.07	16.37	84	80
21	57.08	15.40	82	78
22	53.18	14.33	80	78
23	49.23	13.27	80	78
24	45.32	13.03	83	77
25	Aden		77	
From Aden to Bombay.				
1	48.38	13.10	83	78
2	51.22	13.29	83	80
3	54.28	14.28	79	80
4	57.25	15.05	83	79
5	60.25	16.00	87	80
6	63.54	16.39	85	80
7	67.48	17.21	86	80
8	70.09	18.24	88	80
9	Bombay.		88	82

Jan. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.53	18.39	81	79
4	67.40	17.55	76	78
5	63.20	16.59	79	77
6	59.19	16.07	76	76
7	55 23	15.02	81	77
8	51.37	14.24	80	77
9	47.57	13.21	81	76
10	Aden.			
From Bombay to Aden.				
17	71.30	18.20	80	80
18	66.20	17.10	81	80
19	61.34	15.55	80	74
20	56.55	14.46	81	74
21	52.02	13.56	81	78
22	47.23	13.19	81	77
23	Aden.			
From Aden to Bombay.				
1	54.17	14.47	78	77
2	58.03	15.30	80	77
3	62.18	16.16	80	77
4	66.10	16.57	80	77
5	69.49	18.03	78	79
6	Bombay.		79	

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Temperature of the Air and Sea between Bombay and Aden during the Month of January 1855-56-57, *taken from* 10 *feet under the surface.—Continued.—Noon.*

Jan. 1855.	Long.	Lat.	Air.	Sea.
From Aden to Bombay.				
13	47.44	13.03	81	80
14	50.45	13.45	86	78
15	54.18	14.19	81	80
16	57.20	15.16	78	78
17	60.42	15.55	78	76
18	63.53	16.29	75	76
19	67.06	17.17	79	76
20	70.34	16.15	84	78
21	Bombay.		85	80

Jan. 1856.	Long.	Lat.	Air.	Sea.
From Aden to Bombay.				
15	46.26	12.52	82	82
16	49.41	13.24	83	81
17	55.06	14.06	83	82
18	50.28	15.10	84	82
19	60.09	15.54	83	82
20	63.59	16.48	79	80
21	67.27	17.27	83	80
22	70.50	18.27	84	84
23	Bombay.			
From Aden to Suez.				
26	42.40	14.24	76	78
27	40.32	17.13	78	78
28	38.28	20.05	80	78
29	36.45	23.25	79	76
30	34.44	26.35	75	74
31	32.57	29.38	72	66
	Suez.			
From Suez to Aden.				
8	0	0	61	76
9	35.24	24.46	74	78
10	37.38	21.39	78	76
11	39.24	18.50	85	88
12	41.06	16.24	84	80
13	42.38	14.13	82	80
14	44.46	12.36	81	82
	Aden			

Jan. 1857.	Long.	Lat.	Air.	Sea.
From Aden to Bombay.				
15	49.47	13.56	82	81
16	53.26	14.41	81	81
17	56.80	15.17	78	81
18	59.35	16.05	80	80
19	63.00	17.00	79	81
20	66.44	17.48	80	80
21	70.51	18.44	85	81
22	Bombay.		85	80
From Aden to Suez.				
24	42.49	14.09	80	80
25	40.10	17.54	62	82
26	37.35	21.38	85	82
27	35.23	25.33	81	80
28	32.54	29.02	70	72
	Suez.			
From Suez to Aden.				
8	34.28	26.52	72	77
9	36.36	23.28	31	79
10	38.36	20.20	86	80
11	40.40	17.04	85	81
12	42.40	14.21	81	81
13	44.44	12.36	81	81
14	46.24	13.05	82	84
	Aden.			

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Temperature of the Air and Sea, between Bombay and Aden during the Month of February 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Feb. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
17	72.07	18.48	83	80
18	68.41	18.15	79	81
19	65.15	15.24	80	78
20	61.43	16.36	80	79
21	58.13	15.45	80	79
22	54.29	15.40	80	78
23	50.33	13.44	82	78
24	46.29	12.42	83	79
25	Aden.			
From Aden to Bombay.				
1	45.46	13.02	81	76
2	48.26	13.26	81	76
3	51.22	14.14	83	77
4	54.24	15.52	80	80
5	58.12	17.00	78	79
6	61.57	18.14	78	77
7	65.35	18.50	78	78
8	69.41	18.50	79	77
9	at Bombay.		82	78
From Aden to Bombay.				
15	72.52	17.28	82	82
16	73.22	15.19	85	82
17	74.30	13.14	85	82
18	74.13	12.57	86	82
19	72.12	13.15	82	81
20	69.36	13.22	81	80
21	66.38	13.33	81	80
22	63.45	13.41	79	80
23	60.38	13.51	79	80
	Aden.			

Feb. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
17	72.00	18.44	80	80
18	68.23	18.11	80	80
19	64.33	17.29	80	80
20	60.46	16.35	82	80
21	57.04	15.42	80	78
22	53.11	14.43	83	80
23	49.46	13.47	84	78
24	45.42	12.44	81	80
	Aden.			
From Aden to Bombay				
7	45.12	12.43	81	78
8	48.01	13.12	81	79
9	51.17	13.56	84	78
10	54.15	14.56	81	78
11	57.44	15.59	81	78
12	61.27	16.37	80	78
13	65.12	17.20	80	80
14	68.38	17.59	79	79
15	72.19	18.50	78	82
16	at Bombay.			
From Aden to Bombay				
15	46.30	12.41	74	80
16	49.38	13.07	82	78
17	53.00	13.53	88	76
18	56.25	14.47	84	80
19	60.05	15.50	83	78
20	63.52	17.02	84	79
21	69.36	17.52	84	79
22	71.39	18.28	84	79

Feb. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
17	71.45	16.28	81	86
18	67.51	17.27	81	86
19	63.54	16.34	77	83
20	59 56	15.36	77	82
21	56.00	14.47	75	82
22	51.30	13.39	78	83
23	47.28	12.59	81	82
24	Aden.		77	0
From Aden to Bombay				
1	54.17	14.47	78	77
2	58.08	15.30	80	77
3	62.18	16.16	80	77
4	56.10	16 57	80	76
5	69.49	18.03	78	77
6	Bombay.		79	0
From Aden to Bombay.				
14	46.49	13.06	84	79
15	50.31	14.35	84	78
16	54.27	16 10	83	76
17	58.05	17.56	79	76
18	61.55	19.38	79	76
19	66.42	19.49	78	78
20	71.17	18.53	83	81
21	to Bombay.		83	81

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Temperature of the Air and Sea between Bombay and Aden during the Month of March 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Mar. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
6	72.12	18.44	84	85
7	68.19	18.12	85	83
8	64.30	19.16	75	83
9	60.29	16 21	75	84
10	56.40	15.26	81	84
11	52.42	14.15	83	84
12	48.42	13.03	85	84
13	Aden.		83	84
From Bombay to Aden.				
20	71.54	18.49	82	80
21	68.00	17.40	81	84
22	63.56	16.36	82	82
23	60.04	15.35	83	80
24	55.46	14.35	83	82
25	57.45	13.46	85	82
26	47.27	13.46	83	78
27	Aden.		84	80
From Aden to Bombay.				
2	47.17	13.02	82	0
3	50.02	14.08	82	76
4	53.19	15.24	82	78
5	56.53	16.31	82	78
6	60.26	17.22	80	78
7	64.17	13.05	78	77
8	68.18	18.47	78	78
9	72.05	18.47	76	82
10	Aden.		79	78

Mar. 1856.	Long	Lat.	Air.	Sea.
From Bombay to Aden.				
6	71.42	18.44	81	79
7	69.59	18.08	82	79
8	63.50	17.13	83	84
9	59.51	16.02	80	82
10	55.49	15.10	85	85
11	51.36	14.08	85	80
12	47.28	12.47	85	80
13	Aden.		83	79
From Bombay to Aden.				
20	72.14	18.42	85	80
21	69.14	18.02	80	83
22	66.10	17.26	87	82
23	62.50	16.44	83	82
24	59.45	15.54	86	80
25	56.36	15.16	86	80
26	53.30	14.26	86	81
27	50.19	13.32	85	81
28	46.43	12.49	83	81
	Aden.			
From Aden to Bombay.				
1	45.32	12.53	83	82
2	48.36	13.19	84	84
3	51.54	13·52	85	82
4	54.58	14.30	84	82
5	58.06	15.15	84	82
6	61.32	16.12	84	82
7	65.02	16.58	82	82
8	68.25	17.39	83	83
9	71.56	18.36	86	82
	Aden.			

Mar. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
6	71.47	18.28	84	80
7	67.39	16.53	82	82
8	63.34	15.30	83	79
9	59.46	14.07	83	83
10	55.48	13.55	83	82
11	51.44	13.09	84	82
12	47.40	12.38	85	82
13	Aden.		83	81
From Bombay to Aden.				
20	71.55	18.44	85	81
21	67.56	18.04	84	80
22	63.56	17.12	85	80
23	59.31	16.15	84	80
24	56.31	15.13	82	80
25	52.41	14.06	81	79
26	48.37	13.03	81	79
27	Aden.		82	79
From Aden to Bombay.				
1	44.50	12.33	80	78
2	45.50	14.37	80	78
3	48.45	14.55	81	78
4	52.32	14.54	80	77
5	56.16	15.53	80	78
6	60.12	17.01	80	73
7	64.18	17.32	79	77
8	68.57	18.05	80	78
9	Aden.		83	

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Temperature of the Air at Noon and Sea, between Bombay and Aden during the Month of April 1855-56-57 *taken from* 10 *feet under the surface.*

Apr. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.51	18.36	81	83
4	68.06	17.36	81	83
5	64.11	16.47	84	85
6	60.15	15.49	84	86
7	56.26	15.15	84	86
8	52.39	14.36	84	86
9	48.58	13.37	85	87
10	Aden.		86	87
From Bombay to Aden.				
17	71.57	18.41	82	85
18	68.29	17.56	84	83
19	65.01	17.10	85	84
20	61.02	16.22	85	85
21	57.28	15.36	85	84
22	53.40	14.54	88	85
23	49.54	13.59	87	85
24	45.01	12.44	88	84
	Aden.			

Apr. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.58	18.44	85	85
4	67.46	18.01	86	85
5	63.47	16.47	86	85
6	59.35	15.53	86	86
7	55.42	15.09	88	86
8	51.45	14.22	87	86
9	47.38	13.20	87	85
10	Aden.		86	85
From Bombay to Aden.				
17	71.53	18.44	85	80
18	68.10	18.05	86	82
19	64.21	17.23	82	83
20	60.30	16.31	89	83
21	56.55	15.32	86	83
22	53.41	14.46	87	83
23	50.04	13.37	87	83
24	45.39	12.53	87	82
	Aden.			

Apr. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.50	18.33	86	80
4	68.13	17.37	87	82
5	64.30	16.48	86	83
6	60.40	15.47	86	82
7	56.42	15.04	87	83
8	52.43	14.13	87	83
9	48.42	13.32	87	84
10	Aden.		87	86
From Bombay to Aden.				
17	71.46	18.22	85	83
18	68.09	16.56	85	83
19	64.06	15.49	86	83
20	60.18	14.39	87	84
21	56.20	13.45	87	83
22	52.23	13.03	89	84
23	48.27	12 48	88	84
24	Aden.		87	84

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Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of April 1855-56-57, *taken from* 10 *feet under the surface.—Continued.*

Apr. 1855.	Long.	Lat.	Air.	Sea.
From Aden to Bombay.				
1	46.16	12.39	85	83
2	49.41	13.26	85	84
3	53.11	14.18	85	84
4	56.51	15.10	86	85
5	60.40	15.57	84	84
6	64.28	16.27	86	84
7	68.13	17.24	83	84
8	72.04	18.49	82	83
Bombay.				
From Aden to Bombay.				
15	43.22	13.08	85	82
16	48.22	13.16	86	82
17	51.46	14.29	85	82
18	55.29	15 50	82	80
19	59.22	17.04	85	80
20	63.36	18.05	83	80
21	68.01	18.35	82	80
22	72.36	18.54	84	80
23	Bombay.			

Apr. 1856.	Long.	Lat.	Air.	Sea.
From Aden to Bombay				
1	46.47	13.02	86	80
2	49.40	14.00	85	80
3	53.28	14.54	85	80
4	57.08	15.51	86	82
5	61.01	16.55	85	82
6	64.46	17.41	85	82
7	66.52	18.03	86	82
8	71.47	18.04	86	82
Bombay.				
From Aden to Bombay.				
16	47.15	12.49	88	86
17	50.21	13.21	91	84
18	53.44	14.12	87	84
19	55.20	14.42	82	84
20	58.32	15.45	88	85
21	61.54	16.40	87	85
22	65.16	17.40	89	87
23	68.45	17.42	87	87
24	72.36	18.34	88	
Bombay.				

Apr. 1857.	Long.	Lat.	Air.	Sea.
From Aden to Bombay.				
1	43.10	13.33	84	79
2	47.10	12.43	86	79
3	50.28	12.31	84	80
4	54.06	14.30	87	82
5	58.13	15.18	85	82
6	61.53	15.57	87	83
7	65.32	16.47	85	83
8	69.34	17.43	86	83
Bombay.				
From Aden to Bombay.				
13	42.56	12.40	84	78
14	44.50	13.38	87	80
15	48.40	13.26	89	82
16	51.42	14.52	87	81
17	55.36	16.59	87	82
18	59.20	16.49	83	81
19	63.33	17.19	84	80
20	67.15	18.04	81	79
21	71.38	18.36	81	80
Bombay.				

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Temperature of the Air at Noon and Sea between Bombay and Aden during the month of May 1855-56-57 *taken from* 10 *feet under the surface.*

May 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
2	71.54	18.39	85	80
3	68.33	17.41	85	81
4	65.03	16.42	85	81
5	60.59	15.56	85	82
6	57.09	14.50	87	81
7	53.12	13.45	88	84
8	49.34	13.15	86	84
9	45.29	12.50	90	86
10	Aden.		88	86
From Bombay to Aden.				
12	72.00	18.37	91	86
13	68.35	17.40	89	86
14	65.10	16.59	90	86
15	61.37	16.20	88	86
16	58.17	15.12	88	88
17	54.40	13.55	87	87
18	51.00	13.12	86	84
19	47.23	12.34	89	88
20	Aden.		89	
From Aden to Bombay.				
15	46.36	12.34	91	83
16	50.04	12.54	89	84
17	53.42	13.48	88	84
18	57.57	14.13	87	85
19	61.42	15.08	90	84
20	65.42	16.15	88	84
21	69.09	17.23	89	83
22	Bombay.		89	83

May 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
1	70.40	18.35	87	83
2	67.49	18.10	88	84
3	64.58	17.15	86	86
4	61.50	16.34	88	84
5	58.38	15.45	88	86
6	55.18	14.54	88	92
7	52.11	13.59	87	86
8	48.45	13.25	87	84
9	Aden.		87	86
From Bombay to Aden.				
13	70.40	18.17	87	88
14	67.19	17.13	87	89
15	64.01	15.55	85	87
16	60.49	14.52	87	89
17	57.28	14.08	86	88
18	53.44	13.44	88	90
19	50.28	13.43	88	90
20	47.07	13.00	89	89
21	Aden		89	88
From Aden to Bombay.				
15	45.56	13.06	91	83
16	49.34	13.51	91	83
17	53.25	14.57	89	83
18	57.28	16.17	87	83
19	61.38	16.38	87	83
20	65.27	17.38	89	82
21	69.28	81.31	86	82
22	Bombay.		89	83

May 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
2	73.33	18.46	87	79
3	68.57	18.07	86	80
4	65.18	17.09	86	79
5	62.46	15.45	81	78
6	60.30	15.14	87	82
7	57.14	14.10	88	83
8	53.33	13.04	87	81
9	49.46	12.36	90	83
10	45.40	12.38	90	83
	Aden.			
From Bombay to Aden.				
12	71.54	18.42	87	88
13	69.10	17.48	88	87
14		17.19	87	85
15		16.33	85	83
16		15.47	84	82
17		15.01	84	82
18		14.08	86	84
19		13.36	83	84
20		12.57	88	84
	Aden.			
From Aden to Bombay.				
15	46.50	12.54	90	86
16	50.20	12.15	88	87
17	54.00	14.02	87	84
18	57.38	14.44	86	84
19	61.25	15.10	87	84
20	65.20	16.04	89	84
21	69.00	16.52	88	83
22	72.38	18.27	88	83
	Bombay.			

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Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of June 1855-56-57 *taken from* 10 *feet under the surface.*

June 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11	72.01	18.47	88	87
12	68.57	18.17	88	87
13	66.02	17.45	91	90
14	63.50	17.28	90	89
15	61.45	17.05	89	84
16	59.42	16.50	87	82
17	57.23	16.29	87	82
18	55.00	15.36	87	82
19	53.00	15.00	87	81
20	50.57	14.28	88	84
21	48.06	13.08	82	84
22	Aden.		91	84
From Aden to Bombay.				
13	48.06	12.58	92	
14	51.44	13.55	91	
15	56.16	15.10	84	
16	60.48	16.12	85	
17	65.24	17.10	83	
18	69.23	18.05	85	
19			84	
20	Bombay.		82	

June 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11	71.56	18.40	89	86
12	69.21	17.57	92	86
13	68.25	15.03	92	85
14	67.47	11.27	93	84
15	66.29	8.32	92	86
16	63.48	8.03	88	86
17	61.23	8.44	82	85
18	58.49	10.40	85	84
19	55.44	12.46	85	84
20	52.16	13.30	87	86
21	48.13	13.15	90	86
22	45.03	12.45	96	86
	Aden.			
From Aden to Bombay.				
14	48.06	13.13	88	90
15	51.14	14.04	89	91
16	55.17	14.57	85	87
17	59.20	15.43	82	84
18	63.28	16.48	84	86
19	67.26	17.30	85	87
20	71.02	18.20	86	88
	Bombay.			

June 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
16	70.20	18.00	88	85
17	70.00	15.10	83	84
18	68.16	12.43	87	84
19	67.24	9.25	87	85
20	64.58	7.22	88	86
21	62.26	7.06	85	83
22	60.00	7.58	86	82
23	57.30	9.45	82	85
24	54.32	11.50	82	84
25	57.56	12.57	85	84
26	47.52	12.12	93	85
27	Aden.		91	84
From Aden to Bombay.				
12	45.44	12.55	90	86
13	49.01	13.47	88	86
14	52.22	14.25	87	85
15	55.53	15.06	83	81
16	59.20	15.29	84	81
17	63.29	16.24	83	81
18	67.38	16.55	81	79
19	71.00	18.05	84	79
	Bombay.			

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Temperature of the Air at Noon and Sea, between Bombay and Aden during the Month of July 1855-56-57 taken from 10 feet under the surface.

July 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11	72.16	18 30	89	85
12	69.43	17.25	87	84
13	66.58	18.52	87	83
14	64.02	20.48	83	80
15	60.52	21.13	84	80
16	60.14	19.30	86	80
17	59.07	18.39	88	83
18	57.27	18.35	81	78
19	55.38	17.12	82	78
20	53.30	15.49	86	81
21	50.30	14.35	85	80
22	48.03	13.23	89	85
23	45.28	12.48	84	85
	Aden.*			
From Aden to Bombay.				
14			86	84
15	49.00	13.46	85	82
16	52.44	14.38	84	83
17	57.07	15.52	82	82
18			82	82
19	65.54	16.62	83	82
20	69.58	17.38	88	83
21	Bombay.		84	81

July 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11				
12	69.34	18.27	85	
13	67.48	16.08	85	86
14	66.38	13.21	84	86
15	65.43	10.29	86	86
16	64.30	08.01	85	85
17	62.09	08.13	84	84
18	59.34	10.05	82	84
19	56.45	12.03	79	82
20	54.08	13.04	83	83
21	50.54	13 03	86	83
22	48.19	12.38	90	90
23	Aden.			
From Aden to Bombay.				
14			92	90
15	49.21	13.19	90	86
16	54.09	14.18	79	74
17	59.15	15.19	82	78
18	64.12	16.13	84	80
19	68.36	17.26	85	84
20	72.47	18.49	83	86
21	Bombay.		85	82

July 1857.	Long.	Lat.	Air	Sea.
From Bombay to Aden.				
15	71.09	18.18	88	82
16	69.12	17.47	87	82
17	68.08	15.10	85	82
18	66 50	12.28	84	82
19	65.45	09.34	84	82
20	63.36	10.51	83	81
21	61.09	11.33	82	80
22	58.58	12.13	83	81
23	56.47	12.49	82	80
24	54.13	13.21	82	78
25	05.53	13.40	81	80
26	49.00	13.08	89	86
27	46.57	12.46	89	86
	Aden.			
From Aden to Bombay.				
13			91	90
14	48.27	12.59	91	84
15	52.38	12 57	83	84
16	57.12	13.40	82	76
17	61.30	14.39	83	76
18	65.37	15.45	85	77
19	69.34	17.01	91	82
20	Bombay.		84	82

* This was a Monsoon passage, by the North West or Arabian route.

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Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of August 1855-56-57 *taken from* 10 *feet under the surface.*

Aug. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
14	70.42	18.10	85	87
15	67.44	17.23	86	88
16	64.59	17.04	83	85
7	62.15	16 33	80	82
18	59.48	15.47	80	82
19	57.24	15.16	80	81
20	54.47	14.28	78	80
21	51.50	14.02	84	87
22	49.13	12.45	90	91
23	46.20	12.58	88	89
Aden.				
From Aden to Bombay.				
13	46.43	12.33	89	87
14	49.32	13.14	90	89
15	53.09	14.00	80	74
16	56.36	14.41	77	76
17	60.09	15.36	80	88
18	63.50	16.12	82	79
19	67.25	17.18	83	82
20	70.47	18.10	84	84
Bombay.				

Aug. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
13	71.57	18.38	89	82
14	68.35	17.55	86	82
15	65.27	17.15	84	80
16	62.20	17.42	85	90
17	59.03	17.49	83	80
18	57.21	17.15	78	76
19	54.53	16.44	82	76
20	51.58	15.11	79	72
21	48 24	13.56	81	70
22	45.21	12.46	86	80
Aden.				
From Aden to Bombay.				
13	45.57	12.41	87	85
14	49.39	12.33	85	84
15	53.10	13.53	88	84
16	57.28	15.49	76	76
17	61.58	16.02	76	77
18	66.02	17.13	77	80
19	69.41	18.06	81	82
20	Bombay.		84	85

Aug. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
16	71.13	18.30	81	78
17	69.15	17.24	80	78
18	67.36	16.08	84	82
19	65.57	14.45	83	82
20	64.16	13.30	77	78
21	62.24	13.18	81	76
22	60 12	13 14	80	74
23	57.45	13.00	80	78
24	55.34	12.48	80	84
25	52.36	12.53	80	80
26	49.10	12.37	88	86
Aden.				
From Aden to Bombay.				
14	45.57	12.53	85	84
15	50.02	13.06	87	82
16	54.02	14.32	87	70
17	58.34	15.05	77	70
18	62.58	16.08	70	76
19	66.55	17.04	81	79
20	70.58	17.58	83	79
21	Bombay.		84	80

Digitized by Google

Temperature of the Air at Noon and Sea between Bombay and Aden during the month of September 1855-56-57 *taken from* 10 *feet under the surface.*

Sept. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
1	66.32	18.56	84	82
2	63.44	18.50	81	82
3	61.00	18.14	82	79
4	58.36	17.44	81	78
5	56.19	16.34	82	79
6	54.20	15.36	82	79
7	51.49	14.25	84	78
8	48.50	13 12	90	87
9	46.23	12.39	90	76
	Aden.			
From Bombay to Aden.				
13	72.03	18.51	83	82
14	68.54	18.42	86	82
15	66.02	18.26	84	80
16	63 17	18.04	82	80
17	60.23	17.51	80	76
18	57.14	17.16	79	74
19	54.39	16.00	83	79
20	51.34	14 36	80	76
21	48.02	13.12	89	88
22	Aden.		92	
From Aden to Bombay.				
16	48.56	13.27	87	88
17	51.47	14.14	83	84
18	55.47	15.10	82	84
19	59.29	15.58	80	82
20	63.42	16.47	81	83
21	67.28	17.35	84	86
22	71.01	18.27	84	86

Sept. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
1	68 33	16.56	82	62
2	66.35	16.53	82	79
3	63.55	15.01	80	78
4	61.45	14.38	79	80
5	59.32	14.01	79	76
6	57.10	13.38	80	77
7	55.22	13.11	76	75
8	53.40	12.50	80	76
9	51.04	13.12	80	84
10	48.14	12.45	83	86
	Aden.			
From Bombay to Aden.				
13	72.02	18.36	82	85
14	68.48	17.43	82	86
15	65.32	16.58	84	82
16	62.18	16.26	82	82
17	59.29	15.51	79	80
18	56.34	15.54	79	78
19	53.32	14.54	78	80
20	51.15	14.51	81	84
21	47.42	12.58	89	90
22	Aden.		92	90
From Aden to Bombay.				
12	43.05	12.45	91	90
13	49.15	13.16	91	88
14	53.38	14.17	78	84
15	58.22	15.15	83	80
16	62.43	16.14	80	78
17	67.02	17.06	85	81
18	71.22	18.26	82	82

Sept. 1857.	Long	Lat.	Air.	Sea.
From Bombay to Aden.				
1	17.19	18.40	86	78
2	68.46	18.27	85	82
3	66.12	18.17	84	80
4	63.56	18.08	83	22
5	61 49	18 04	82	82
6	59.17	17.45	80	78
7	56.38	17.10	78	76
8	54.23	16.12	80	80
9	51.22	14.47	83	78
10	47.34	13.33	89	90
	Aden.			
From Bombay to Aden				
16	71.13	18.30	81	78
17	69.15	17.24	80	78
18	67.36	16.08	84	82
19	65.57	14.45	83	82
20	64.16	13.30	77	78
21	62.24	13.18	81	76
22	60.12	13.14	80	74
23	57.45	13.00	80	78
24	55.34	12.48	80	84
25	52.36	12.55	80	80
	Aden.			
From Aden to Bombay.				
13	48.00	13.26	89	86
14	51.32	14.17	90	88
15	55.32	15.25	81	87
16	59.42	16.23	78	80
17	63.58	17.04	80	80
18	67.56	17.49	80	79
19	72.01	18.44	84	80

Digitized by Google

Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of October 1855-56-57, *taken from* 10 *feet under the surface.*

Oct. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	71.12	18.37	83	82
5	67.40	17.48	85	84
6	63.41	16.57	84	84
7	59.40	16.05	85	85
8	55.35	15.07	85	84
9	51.49	14.02	85	84
10	47.23	13.05	85	84
11	Aden.			
From Bombay to Aden.				
18	72.00	18.44	86	86
19	69.05	18.37	88	86
20	66.04	18.20	85	85
21	62.25	17 56	82	82
22	58.45	17.13	83	83
23	55.18	16.06	85	85
24	51.48	14.52	89	85
25	49.00	13.53	92	84
26	45.50	12.45	89	85
	Aden.			
From Aden to Bombay.				
16	49.03	13.04	86	86
17	52.18	14.04	84	82
18	56.21	14.26	86	84
19	59.45	15.14	84	85
20	63.28	16.04	84	83
21	67.09	17,02	84	83
22	70.12	17.58	84	83
	Bombay.			

Oct. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
4	72.02	18.36	85	85
5	68.11	17.51	85	84
6	64.45	17.00	85	85
7	61.34	15.12	81	84
8	58.02	15.36	83	84
9	55.07	14.36	81	84
10	51.54	14.17	82	82
11	48.07	13.38	85	85
	Aden.			
From Bombay to Aden.				
18	71.50	18.33	90	80
19	67.22	17.44	83	80
20	63.39	16.55	91	80
21	59.45	16.02	82	80
22	55.44	15.36	84	80
23	51.59	14.30	85	80
24	48.19	13.45	82	83
25	Aden.		87	82
From Aden to Bombay.				
15	47.10	12.42	86	86
16	50.22	13.10	86	84
17	53.24	13.56	83	83
18	56.46	14.18	84	82
19	60.00	15.16	81	83
20	63.17	16.05	81	83
21	66.43	17.10	86	84
22	70.06	18.13	84	84
	Bombay.			

Oct. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	72.09	18.40	83	83
5	68.39	17.57	85	84
6	65.0	17.13	86	84
7	61.28	16.28	86	85
8	58.03	15.41	81	79
9	54.34	14.52	79	79
10	51.07	14.05	80	79
11	47.42	13.23	82	80
	Aden.			
From Bombay to Aden.				
18	72.14	18.49	87	84
19	68.45	18.40	87	86
20	65.03	17.56	87	84
21	61.20	17.03	84	82
22	57.48	16.09	81	82
23	54.00	15.11	82	80
24	50.16	13.59	84	82
25	46.40	13.12	85	88
	Aden.			
From Aden to Bombay.				
15	48.15	12.58	86	84
16	52.20	13.24	84	78
17	56.12	14.19	82	77
18	59.22	15.43	84	80
19	62.28	16.34	84	80
20	66.16	17.38	89	80
21	70.27	18.20	89	80
	Bombay.			

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Temperature at Noon of the Air and Sea between Bombay and Aden during the month of November 1855-56-57 taken from 10 feet under the surface.

Nov. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.52	18.43	83	85
4	67.10	17.34	85	95
5	62.25	16.23	83	82
6	58.04	15.18	82	79
7	53.48	14.22	81	78
8	49.27	13.25	84	82
9	44.59	12.44	83	81
Aden.				
From Bombay to Aden.				
17	71.55	18.38	82	83
18	68.06	18.45	83	83
19	64.12	17.19	84	84
20	60.25	16.28	83	84
21	57.37	15.40	79	84
22	52.43	14.18	81	85
23	48.38	13.24	81	85
Aden.				
From Aden to Bombay.				
17	46.56	13.18	88	85
18	48.50	13.16	87	81
19	51.24	14.26	89	81
20	54 23	15.02	84	81
21	57.13	15.53	83	79
22	60.11	16.50	88	81
23	63.13	17.19	84	80
24	66.54	17.45	84	79
25	69.15	18.14	88	81
26	72.27	18.14	84	83
Bombay.				

Nov. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	70.07	18.13	86	84
5	66.14	17.17	85	84
6	62.27	16.20	86	84
7	58.31	15.28	85	83
8	54.39	14.49	83	82
9	51.06	13.56	83	83
10	47.02	13.22	84	78
Aden.				
From Bombay to Aden.				
18	70.32	18.19	82	81
19	66.37	17.24	80	80
20	62.48	16.16	81	78
21	58.43	15.23	80	78
22	54.34	14.37	78	77
23	50.34	13.35	80	76
24	46.14	12.51	80	78
Aden.				
From Aden to Bombay.				
15	45.24	12.44	81	80
16	48.30	13.29	87	80
17	52.03	14.41	82	79
18	55.35	15.30	81	80
19	58.50	16.52	82	84
20	62.38	17.36	82	79
21	66.26	17.59	80	80
22	70.21	18.40	80	80
Bombay.				

Nov. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	70.15	18.17	86	
5	66.24	17.17	86	
6	63.01	16.27	82	87
7	59.27	15.36	80	86
8	55.49	14.45	82	
9	52.19	13.46	81	
10	48.47	13.03	84	86
Aden.				
From Aden to Bombay.				
22	33.33	28.03	67	78
23	35.45	24.46	77	80
24	37.37	21.45	86	84
25	39.30	19.05	85	86
26	40 59	16 39	87	86
27	42.16	14.50	84	86
28	43.24	12.05	81	82
Aden.				
From Bombay to Aden				
14	46.59	12.58	84	80
15	45.50	13.26	87	80
16	52.33	13.52	81	82
17	55.15	14.42	81	79
18	57.55	15.38	84	83
19	60.42	16.42	83	83
20	64.00	17.20	84	83
21	67.05	17.51	84	83
22	78.10	18.23	84	85
Bombay.				

Digitized by Google

Temperature at Noon of the Air and Sea between Bombay and Aden during the Month of December 1855-56-57 *taken from* 10 *feet under the surface.*

Dec. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
4	71.56	18.45	81	83
5	68.52	18.07	82	82
6	65.25	17.14	82	82
7	61.43	16.15	80	82
8	57.48	15.18	78	81
9	54.02	14.40	79	80
10	50.34	13.32	80	80
11	46.18	13.14	82	81
Aden.				
From Bombay to Aden.				
18	72.12	18.42	81	84
19	68.36	18.05	81	84
20	65.04	17.19	80	86
21	61.24	16.34	81	86
22	57.50	15.38	79	80
23	54.04	14.39	77	80
24	50.17	13.40	79	76
25	46.28	13.13	81	76
Aden.				
From Aden to Bombay.				
15	47.04	12.41	83	84
16	50.19	13.44	81	80
17	53.45	14.17	79	81
18	67.08	15.27	79	82
19	60.31	16.49	80	83
20	64.02	17.56	81	84
21	67.51	18.29	82	81
22	71.51	18.50	88	80
23	00.00	00.00	79	81
Bombay.				

Dec. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	71.50	18.40	80	79
5	67.55	18 00	80	79
6	63.31	17.25	80	78
7	58.50	16.09	80	78
8	54.10	15.13	78	77
9	49.55	13.31	80	79
10	45.35	12.30	80	79
11	44.39	12.35	80	79
Aden.				
From Bombay to Aden.				
18	71.49	18.34	80	86
19	67.20	17.40	80	84
20	63.00	16.43	77	84
21	58.42	15.46	77	81
22	54.12	14.52	79	86
23	49.59	13.51	79	80
24	45.35	12.57	79	82
25	44.05	12.31	80	
Aden.				
From Aden to Bombay.				
15	73.41	8.43	83	83
16	73.53	5.23	83	82
17	74.14	1.57	81	80
18	74.33	1.25	83	80
19	73.56	4.12	83	80
20	74.26	6.57	84	82
21	75.10	10.02	85	83
22	74.30	13.24	83	81
23	73.19	16.01	85	83
Bombay.				

Dec. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
None.				

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of January 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Jan. 1855.	Long.	Lat.	Air.	Sea.

Jan. 1856.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
9	37.38	24.46	74	78
10	39.24	21.39	78	76
11	41.06	18.50	84	88
12	42 38	16.24	85	80
13	44.46	14.13	82	80
14	46.26	12.36	82	82
15	Aden.		8	82

Jan. 1857.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
8	34.28	24.52	72	77
9	36.36	23.28	81	79
10	38.36	20.:0	86	80
11	40.40	17.04	85	81
12	42.40	14.20	81	81
13	44.44	12.36	81	81
14	46.42	13.06	82	84
Aden.				
From Suez to Aden.				
17	71.30	18.20	80	81
18	66.20	17.10	81	80
19	61.34	15.55	80	74
20	56.55	14.46	81	74
21	52.02	13.56	81	78
22	47.23	13.19	81	77
Aden.				
From Suez to Aden.				
23	33.40	00.00	72	72
24	36.32	21.33	81	78
25	37.32	21.48	84	88
26	39.38	18.53	84	81
27	41.33	16.03	82	76
28	43.02	13.23	80	75
29	43.02	13.28	82	75
30	47.09	12.55	80	76
Aden.				
From Aden to Suez.				
9	47.57	13.21	81	76
10	47.57	13.21	81	77
11	42.55	13.59	79	76
12	40.40	17.11	80	77
13	38.36	20.38	80	82
14	36.22	23.41	80	88
15	34.34	26.36	77	75
16	32.37	29.49	73	66
Suez.				

Digitized by Google

Temperature at Noon of the Air and Sea between Aden and Suez during the month of February 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Feb. 1855.	Long.	Lat.	Air.	Sea.

Feb. 1856.	Long.	Lat.	Air.	Sea.
		From Suez to Aden.		
8	34.03	27.38	73	0
9	34.03	27.38	69	72
10	36.18	23.40	68	72
11	38.44	20.36	80	78
12	40.27	16.53	79	80
13	42.57	13.62	80	78
14	42.57	13.62	82	80
15	46.30	12.41	74	80
		Aden.		
		From Aden to Suez.		
24	45.42	12.44	81	80
25	44.34	12.36	80	78
26	41.18	15.24	80	78
27	39.44	18.31	85	82
28	38.03	20.53	82	80
29	36.16	23.40	80	76
		Suez.		

Feb. 1857.	Long.	Lat.	Air.	Sea.
		From Suez to Aden.		
8	34.32	26.43	75	74
9	37.06	23.00	78	80
10	39.21	19.12	81	81
11	41.25	16.14	84	80
12	42.32	14.26	79	77
13	44.46	12.37	80	75
14	46.49	13.06	84	79
		Aden.		
		From Aden to Suez.		
24	47.28	12.59	77	82
25	43.04	13.25	81	82
26	41.05	16.18	81	82
27	39.17	19.14	80	82
28	37.37	21.33	77	83
		Suez.		

Digitized by Google

Temperature at Noon of the Air and Sea between Aden and Suez during the month of March 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Mar. 1855.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
13	48.42	13.03	85	84
14	43.53	12.27	83	84
15	41.35	16.24	82	83
16	39.51	18.08	82	82
17	38.05	20.45	85	84
18	36.16	23.42	82	83
19	34.46	26.44	79	84
20	34.46	26.44	74	83
Suez.				
From Suez to Aden.				
23	34.24	27.10	71	84
24	36.21	23.37	78	85
25	38.50	20.19	82	84
26	41.09	16.54	85	84
27	42.22	14.49	85	84
28	43.18	13.12	84	82
29	43.18	13.12	82	84
Aden.				

Mar. 1856.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
11	34.15	27.27	70	74
12	35.55	23.54	75	76
13	38.22	20.44	80	84
14	40.31	17.29	82	84
15	42.37	14.09	82	80
16	42.37	14.09	87	80
17	46.31	13.01	87	80
Aden.				

Mar. 1857.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
1	36.07	24.05	77	76
2	34.11	24.05	77	76
3	34.11	27.11	77	
Suez.				
From Aden to Suez.				
13	47.40	12.38	85	82
14	43.02	13.31	82	82
15	40.40	17.03	85	82
16	38.44	20.35	85	82
17	37.12	22.28	78	82
18	35.33	24.23	78	79
19	34.00	27.30	74	74
20	34.00	27.30	70	75
Suez.				
From Suez to Aden.				
10	34.16	27.09	63	76
11	36.38	23.25	77	80
12	38.36	20.07	85	78
13	40.09	16.54	87	82
14	42.50	13.54	84	80
15	42.50	13.54	81	80
16	46.47	13.09	83	80
Aden.				
From Suez to Aden.				
23	34.00	27.33	77	78
24	35.55	23.58	81	78
25	38.30	20.40	87	80
26	40.42	17.40	87	80
27	41.57	15.29	86	78
28	43.10	15.33	85	79
29	43.10	13.33	86	81
30	47.10	12.43	81	96
Aden.				

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Temperature at Noon of the Air and Sea between Aden and Suez during the Month of April 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Apr. 1855.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
1	38.12	20.49	85	80
2	36.12	23.54	89	78
3	34.22	27.10	73	78
Suez.				
From Suez to Aden.				
9	34.02	27.00	80	76
10	36.46	26.33	81	78
11	38.56	20.00	84	82
12	41.00	16.13	88	82
13	43.22	13.00	88	82
14	43.22	13.00	90	82
Aden.				

Apr. 1856.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
1	39.25	16.40	82	87
2	38.11	21.16	84	82
3	36.16	23.57	75	74
Suez.				
From Aden to Suez.				
11	43 01	14 05	86	84
12	40.24	17.46	90	84
13	38.08	20.49	83	82
14	36.38	23.09	80	80
15	34.59	25.35	79	78
16	33.01	28.49	75	71
Suez.				
From Suez to Aden.				
8	34.02	27.37	74	70
9	34 02	27.37	75	70
10	35.46	24.19	80	76
11	38.01	21.41	82	81
12	39.56	18.50	90	84
13	41.08	16.19	90	84
14	42.59	13.54	89	83
15	42.59	13.54	92	84
Aden.				
From Suez to Aden.				
22	32.22	28.18	75	75
23	35.22	24.35	83	78
24	38.11	21.11	85	84
25	40.10	17.38	90	86
26	42.24	14.38	90	84
Aden.				
From Aden to Suez.				
24	45.39	12.53	87	82
25	44.10	12.29	86	82
26	41.58	15.19	89	82
27	39.50	18.23	85	84
28	37.50	21.25	85	83
29	35.56	24 39	82	79
30	30.06	27.33	77	78

Apr. 1857.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
11	43.05	13.22	84	86
12	41.18	16.12	86	86
13	39.16	18.53	84	82
14	37.16	22.05	86	84
15	35.16	25.42	87	84
16	35.16	25.42	87	85
Suez.				
From Suez to Aden.				
8	34.17	27.13	80	74
9	36.19	24.07	85	79
10	38.29	20.55	86	80
11	40 43	17.25	82	80
12	42.56	13.58	84	78
Aden.				
From Suez to Aden.				
22	31.04	27.26	74	83
23	36.02	23 54	80	81
24	38.33	20.34	82	82
25	40.59	17.05	88	83
Aden.				
From Aden to Suez.				
24	48.27	12.48	87	84
25	43.14	13.09	87	84
26	41.13	16.26	86	83
27	39.09	19.38	88	83
28	33.20	22.33	85	83
29	35.13	25.37	85	82
30	33.23	28.21	83	79
Suez.				

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Temperature of the Air at Noon and Sea between Aden and Suez during the month of May 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

May 1855.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
14	42.08	14.51	88	84
15	40.07	18.03	92	82
16	37.41	21.04	87	80
17	36.00	24.17	88	78
18	34.15	27.26	85	73
19	34.15	27.26	84	70
Suez.				
From Aden to Suez.				
24	45.01	12.44	83	84
25	44.39	12.36	90	82
26	42.39	14.22	87	85
27	40.45	17.14	88	85
28	38 51	20.26	88	85
29	36.34	23.17	84	84
30	34.51	26.17	79	83
Suez.				
From Suez to Aden.				
9	34.09	27.24	81	83
10	36.05	24.02	87	84
11	38.30	20.55	89	85
12	40.57	17.38	90	86
13	42.49	14.10	89	85
14	42.49	14.10	85	84
15	46.36	12.34	89	84
Aden.				
From Suez to Aden.				
22	36.30	23.46	81	72
23	38.48	20.22	87	78
24	40.59	16.44	92	83
25	45.07	12.58	88	82
26	45.07	12 58	89	84
27	46.33	12.35	92	84
Aden.				

May 1856.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
12	38.43	21.23	88	86
13	36.00	24.19	83	84
14	34.08	27.19	82	84
Suez.				
From Aden to Suez.				
22	43.18	13.01	87	89
23	41.52	15.33	89	90
24	40.03	15.57	87	88
25	38.03	20.10	88	90
26	37.09	22.17	87	88
27	35.35	25.03	85	86
28	34.01	27.31	82	83
29	32.31	30.00	76	78
Suez.				
From Suez to Aden.				
9	34.20	27.09	77	75
10	36.21	23.41	85	75
11	38.52	20.29	90	82
12	40.40	17.17	93	82
13	42.55	14.00	93	84
Aden.				
From Suez to Aden.				
23	34.23	26.15	76	82
24	36.25	23.25	82	82
25	38.33	20.12	86	86
26	41.01	16.36	83	86
27	43.06	13.26	88	86
28	43.06	13.26	92	88
Aden.				

May 1857.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
12	42.56	13.46	87	79
13	40.53	16.47	86	80
14	38.44	19.44	86	79
15	37.56	22.55	81	78
16	35.02	25.33	87	82
17	33.15	28.28	88	83
Suez.				
From Suez to Aden.				
9	33.55	27.38	76	78
10	33.55	24.33	83	83
11	37.45	21.33	86	84
12	40.03	18.16	89	86
13	42.06	15.04	89	86
Aden.				

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Temperature of the Air at Noon and Sea between Aden and Suez during the month of June 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Jun. 1855.	Long.	Lat.	Air.	Sea.	Jun. 1856.	Long.	Lat.	Air.	Sea.	Jun. 1857.	Long.	Lat.	Air.	Sea.
From Aden to Suez.														
12	43.09	13.13	93	90										
13	41.34	13.51	94	91										
14	39.54	18.01	92	89										
15	38.24	20.01	91	86										
16	37.11	22.07	87	85										
17	35.60	24.35	87	83										
18	34.05	27.04	89	81										
19	32.40	29.45	86	78										
Suez.														
From Suez to Aden.					From Suez to Aden.									
24	35.05	27.28	89	80										
25	35.58	24.12	90	83										
26	38.09	20.17	94	87										
27	40.43	17.53	94	89										
28	42.29	14.25	94	89	29	43.23	12.53	92	86					
29	43.07	14.25	91	89	30	41.20	16.18	92	88					
Aden.					Aden.									

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of July 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

July 1855.	Long.	Lat.	Air.	Sea.

July 1856.	Long.	Lat.	Air.	Sea.
	From Aden to Suez.			
1	39.01	19.39	92	90
2	36.52	23.02	90	86
3	35.00	25.54	89	84
4	33.15	28.20	82	78
	Suez.			
	From Suez to Aden.			
8	33.56	27.42	91	82
9	36.06	24.20	82	82
10	38.05	20.48	92	90
11	43.05	17.09	91	85
12	41.45	13.39	91	90
13	43.00	13.39	92	90
	Aden.			

July 1857.	Long.	Lat.	Air.	Sea.
	From Aden to Suez.			
15	43.08	13.25	89	84
16	41.11	16.24	89	92
17	39.40	19.08	88	83
18	37.51	21.37	91	87
19	36.62	24.36	89	80
20	34.08	27.24	83	84
	Suez.			
	From Aden to Suez.			
16	41.11	13.25	89	92
17	39.40	19.08	98	87
18	37.52	21.37	91	87
19	36.02	24.36	89	85
20	34.08	27.24	88	84
	Suez.			
	From Aden to Suez.			
29	43.28	12.42	90	85
30	41.57	15.21	94	88
31	39.56	17.56	94	88
	Suez.			

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of August 1855-56-57 *taken from* 10 *feet under the surface—Noon.*

Aug. 1855.	Long.	Lat.	Air.	Sea.

Aug. 1856.	Long.	Lat.	Air.	Sea.
		From Aden to Suez.		
22	45.01	12.46	86	80
23	44.09	12.47	84	80
24	41.56	15.26	96	90
25	39.38	18.35	93	90
26	37.34	22.01	94	90
27	35.52	24.51	91	88
28	34.17	27.04	87	86
29	32.56	28.56	86	80
		Suez.		

Aug. 1857.	Long.	Lat.	Air.	Sea.
		From Suez to Aden.		
8	34.08	27.30	85	83
9	35.49	24.22	85	86
10	37.46	21.22	88	87
11	39.54	18.24	91	87
12	41.52	15.25	91	88
13	41.52	15.25	90	89
		Aden.		
		From Suez to Aden.		
22	33.26	28.11	83	84
23	35.44	24.44	91	86
24	37.50	21.15	94	90
25	40.20	17.54	94	86
26	42.30	14.30	93	87
		Aden.		
		From Aden to Suez.		
27	45.57	12.50	87	85
28	45.57	12.47	87	81
29	42.50	14.09	88	88
30	40.42	16.53	91	90
31	38.37	19.56	91	90
		Suez.		

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of September 1855-56-57 taken from 10 feet under the surface.—Noon.

Sep. 1855.

From Aden to Suez.

Sep. 1855.	Long.	Lat.	Air.	Sea.
23	43.14	13.07	93	90
24	41.23	16.06	93	90
25	39.22	18.44	92	90
26	38.08	21.23	89	86
27	36.18	23.40	87	84
28	35.06	25.59	85	82
29	33.27	28.18	81	78
30	33.27	28.08	81	78

Suez.

Sep. 1856.

From Suez to Aden.

Sep. 1856.	Long.	Lat.	Air.	Sea.
7	34.22	27.08	84	86
8	36.27	23.23	90	88
9	39.00	19.47	93	90
10	41.15	16.14	94	92
11	43.28	12.41	93	92
12	49.15	12.45	91	90

Aden.

From Suez to Aden.

Sep. 1856.	Long.	Lat.	Air.	Sea.
23	34.04	27.33	77	83
24	35.34	24.31	85	84
25	37.40	21.44	87	85
26	39.38	19.05	90	85
27	41.25	16.16	91	86
28	43.00	13.31	92	86
29	43.00	13.31	92	86

Aden.

From Aden to Suez.

Sep. 1856.	Long.	Lat.	Air.	Sea.
23	43.10	12.59	90	92
24	41.50	15.58	96	94
25	39.40	18.48	97	92
26	38.02	21.42	90	96
27	36.14	23.57	87	88
28	34.34	26.43	86	84

Suez.

Sep. 1857

From Suez to Aden.

Sep. 1857	Long.	Lat.	Air.	Sea.
7	34.34	26.52	89	85
8	36.31	23.31	94	90
9	38.48	20.12	94	88
10	40.50	16.56	95	90
11	43.66	13.41	90	88
12	43.06	13.41	91	88

Aden.

From Suez to Aden.

Sep. 1857	Long.	Lat.	Air.	Sea.
22	34.03	27.28	79	85
23	36.13	23.44	83	90
24	38.30	20.26	86	90
25	41.00	17.04	90	92
26	42.59	13.14	92	92
27	42.59	13.14	90	90

Aden.

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Temperature at Noon of the Air and Sea between Aden and Suez during the Month of October 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Oct. 1855.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
9	34.11	27.26	79	84
10	38.17	24.06	84	85
11	38.17	20.59	88	88
12	40.14	17.51	94	92
13	42.05	15.01	94	92
14	45.54	15.01	94	92
Aden.				

Oct. 1856.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
8	35.05	27 25	81	86
9	36.07	24.10	86	88
10	38.14	21.18	89	90
11	40.04	18.15	91	92
12	41.58	15.17	91	92
13	43.13	13.17	83	86
Aden.				
From Suez to Aden.				
22	34.14	27.06	76	
23	36.05	23.46	81	
24	38.24	20.41	87	
25	40.12	17.54	89	
26	41.35	15.23	86	
27	43.12	13.10	85	
28	43.12	13.10	85	
Aden.				
From Aden to Suez.				
13	43.17	12.54	85	
14	41.15	16.11	90	
15	39.23	19.04	90	
16	37.29	22.00	90	
17	35.31	24.39	89	
18	34.01	27.27	86	
Suez.				

Oct. 1857.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
7	34.20	27.00	82	79
8	36.34	23.12	88	84
9	39.02	19.45	90	86
10	41.15	16.35	94	85
11	42.38	14.22	90	88
12	44.48	12.30	90	85
13	44.48	12.30	89	84
Aden.				
From Suez to Aden.				
22	33.42	27.56	80	76
23	35.48	24.29	84	80
24	37.49	21.26	84	79
25	39.56	18.32	87	83
26	41.42	15.47	87	83
27	43.24	12.52	85	80
Aden.				
From Aden to Suez.				
13	43.02	13.32	84	83
14	40.57	16.33	86	84
15	38.52	19.23	93	80
16	37.14	22.21	86	83
17	35.18	25.19	86	83
18	33.32	28.06	81	79
Suez.				

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of November 1855-56-57 taken from 10 feet under the surface.—Noon.

Nov. 1855.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
25	43.13	13.16	80	84
26	41.09	16.32	83	85
27	39.00	19.42	82	85
28	36.52	23.01	80	84
29	36.00	26.09	81	78
30	33.26	28.13	75	74
Suez.				

Nov. 1856.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
9	34.21	27.31	79	86
10	36.22	23.50	80	100
11	38.28	20.48	82	106
12	40.30	17.31	83	100
13	42.45	14.05	82	96
Aden.				
From Suez to Aden.				
22	33.36	28.04	77	80
23	35.41	24.53	84	84
24	37.55	21.59	88	86
25	39.41	19.06	88	86
26	41.13	16.13	85	83
27	42.56	13.56	85	83
28	43.03	12.45	85	83
Aden.				
From Aden to Suez.				
12	42.59	13.40	84	82
13	40.40	16.42	85	82
14	38.36	19.57	90	88
15	36.53	23.15	88	86
16	34.56	26.20	85	80
17	32.57	27.19	80	76
Suez.				
From Aden to Suez.				
25	46.14	12.39	83	98
26	42.20	14.51	82	78
27	40.18	17.43	84	84
28	38.22	20.43	82	82
29	36.18	23.38	79	78
30	34.39	26.31	78	76
Suez.				

Nov. 1857.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
7	34.12	27.12	77	84
8	36.31	23.57	78	80
9	38.34	20.47	86	88
10	40.16	17.57	89	88
11	42.43	17.23	88	85
12	43.20	13.41	87	83
13	43.20	13.41	85	83
Aden.				
From Suez to Aden.				
22	33.33	28.03	77	78
23	35.45	24.46	77	89
24	37.37	21.45	86	84
25	39.30	19.05	85	86
26	40.59	16.39	87	86
27	42.16	14.50	84	86
28	43.24	12.50	81	82
29	43.24	12.50	89	
Aden.				

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Having given these very valuable Tables at length, I shall now endeavour to make such an analysis of them as may afford at a glance the substance of the information they contain. Though not directly bearing on the physical condition of the Red Sea, I shall take up first the observations on the Arabian Sea, as this will dispose, though somewhat out of place, of a matter requiring to be taken up when the consideration of the vast expanse of water comes before us.

The tables first given are those obtained from the logs of vessels proceeding from Bombay to Aden, then of those returning. In the abstract we concern ourselves exclusively with the position of the ship, the direction in which she was moving is immaterial.

COLD SEASON.—Grouping November, December, Jan., Feb. and March together as constituting the Cold Season, we find a considerable uniformity in the laws of temperature and probably much as we should have expected.

During these four months the air betwixt the meridian of 55 and 72 E. and parallels of 12 and 20 N. seems always hotter than the surface of the Sea. The temperature of both sea and air are higher on the shores of India lat. 19—than of those of Arabia and Africa lat. 12,—a result not to have been looked for when it is remembered how the air with us is freshened by the most luxurious vegetation, and cooled by the majestic masses of the Ghauts and the deluges of rain of our S. W. Monsoon. On the shores of the Gulf of Aden we should have expected it to be heated to suffocation by the barren rocks and arid deserts on every side. The temperature proceeding from Bombay westward and southward, especially of the Sea, continues to decrease where it might be expected to increase, and reaches its minimum betwixt the 14th and 16th paralels and 55 and 61st meridians—in fact betwixt Socotra and to within seven degrees of Aden, where the water ranges from 76° to 80°, the air being warmer by from 2 to 3 degrees.

APRIL.—A series of new laws now comes to be described, and April must be taken by itself. The temperature of both sea and air have taken a sudden jump, neither ever getting lower than 79, rarely below82°, both occasionally reaching as high as 87. During the cold season, we have found the temperature higher on the shores of India, lat. 19, than on those of Arabia lat. 13. This state of matters is now reversed: and the air and water within 300 miles of Aden, are almost invariably warmer than within a similar distance of Bombay. The air continues in general hotter than the water, but less so than during the previous five months. The region of maximum heat of sea and air takes the place of the previous minimum about the entrance of the Gulf of Aden.

MAY.—The temperatures of May, are nearly the same as those of April, only that the sea and air are less in harmony than before. We have the latter frequently at 90° when the former does not get beyond 84° and the Aden is now very much warmer than the Bombay end of the line.

JUNE.—Both temperatures become irregular, jumping up and down most likely according to the earlier gusts of the monsoon. On the whole the air

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is about 3_0 higher than the water though the latter several times gets above 90° —the influence of the rains in lowering the temperature on the shores of India now becomes conspicuous.

JULY.—The Monsoon effects a large reduction in the temperature for July—the sea only twice reaching 90° in both cases just off Aden, never otherwise rising so high as 87° In an experimental Monsoon trip where the steamer stood westwards towards the Arabian shore in place of southwards, the temperature of the sea betwixt the 17th and 18th paralels and 55th and 57th meridians was 78° the air being 81°, five degrees lower, in both cases than the air and water at that date af either end of the line. The region of minimum temperature was once more westward of Socotra but the water had fallen here nearly five degrees below the averages of the previous three months, ranging from 76 to 78°.

AUGUST AND SEPTEMBER.—We are now presented with some singular anomalies, as the S. W. Monsoon begins to draw off. The temperature of the eastern portion of the Gulf of Aden, which in July had stood above 80. or 82 at an average, now sinks down to 78; sometimes to 72 or 70; the air being often ten degrees hotter than the water, the averages of both of those off Aden being nearly the same as before.

OCTOBER.—Differs from the preceding months in the general and somewhat rapid rise of the temperature especially of the water—which, though once reaching 77 and several times 79 rarely falls below 81°, rising occasionally as high as 85°. The temperature of the air and water during October approach more nearly to each other than during any other part of the year.

And this brings us round again to the cold season already examined. I have throughout discarded the heat in the harbours of Aden and of Bombay, these, especially the former, being so much modified by local causes as to permit of no general conclusion being drawn from them.

From the Tables it will be seen, that the temperature of the Arabian Sea betwixt the 12th and 19th parallels is throughout the year above 82° or nearly three degrees higher than what might have been expected, and that the coldest portion for ten months at least is what, judging by the latitude, ought to have been the hottest, the southwest opening of the Gulf of Aden betwixt the shores of Africa and Arabia.

We now come to the examination of the Tables, giving the temperature of the Red Sea betwixt Aden and Suez; this includes a space of 80 miles eastward of the Strait of Babelmandeb, where the Red Sea in reality opens.

The Temperature Tables betwixt Aden and Suez do not admit of the same minuteness of analysis as is permitted of those of the heat betwixt Bombay and Aden; and there is no occasion for classifying them into seasons. From Aden to the Straits of Babelmandeb, in lat. 12 30 N. and long. 43.40 E. the ship steers nearly on the parallel. After getting quit of the high temperature of the anchorage, the sea and air continue pretty much as they are further east the Gulf. Just within the Straits we get to a fearfully hot portion of the sea, the highest temperature prevailing betwixt 14 and 21

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N. the great volcanic region. There the sea rarely falls lower than 80 even in the cold weather months. In March and April it mounts to 84° : by May it occasionally reaches 90° often 86° the air being in general considerably hotter than the water. In June the air often reaches to 94° the Sea following at an interwal of two or three degrees, and this state of matters continues through July, and August. September gives us our greatest average heat, when both sea and air get occasionally above blood heat, with an amount of dampness that envelopes the body in one sheet of perspiration. Looking over the rails of the ship, with the sea in this state of heat, at a time when rain falls and cools the deck, the feeling conveyed is that of holding the head over a boiling cauldron. In November 1856 the temperature of the water betwixt 17 and 23 was for three days 100 or higher, being one day 106, that of the air never exceeding 82.—I know no paralel to this. By the time we reach latitude 21 off Jedda the sea has attained its greatest breadth of nearly 200 miles, and the volcanic islands with which from 12 to 15, it was crowded, have disappeared. The temperature now moderates suddenly, that of the sea decreasing faster than that of the air, and in the Gulf of Suez it is almost always moderate, unless when the Kam Sin or hot wind of the Desert blows ; but this again is so extremely dry as to carry off all superfluous moisture from the skin, and secure us drinking water at least 20 degrees below the temperature of the air.

Since the principal portion of this paper was in type the Red Sea has been thoroughly sounded from end to end for Telegraphic purposes, and Capt. Pullen has given a series of deep-Sea soundings and temperatures at great depths presenting so much additional information on these points that this section of my remarks would require to be re-written. Captain Pullen finds the following in reference to the Arabian Sea.

"The first cast of 1880 fathoms was in Lat. 10° 59 N., and Long. 64° 27. E., the bottom brown mud, with a minimum temperature of 44°, the surface at the same time 81° 5. The next was about half way between Socotra and the Coast of Arabia, 1500 fathoms, light colored sand very much less than I expected ; however, here is the fact. The min. temperature at this depth was 43° 5. The surface 82°. The next cast, and last, was 1200 fathoms, light colored mud with min. temp. of 45° surface 81° 5. Thus I think we see what an even bottom it is between these two ports after getting well off the bank. I did not reach Aden until the evening of the 26th April."

Captain Pullen had previously found that the temperatures of the sea lat. 7. 12 S. Long. 60.48 E. at the depth of 2400 feet was 38°, and this corresponds so very closely with the doctrine of a stratum of water of uniform temperature of 39, from pole to pole at certain depths of the ocean that the difference of one degree is probably the result of index error. At the Equator Mrs. Sommerville states, this to be at a depth of 7200 feet.* The elevation of temperature in the Gulf of Aden from 39 that due to 1200 fathoms (7200 feet) deep up to 45, is doubtless owing to the narrowing

* Vide ante p. xvii Proceedings.

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of the channel of the Gulf, and the outward subsurface current from the Red Sea. The temperatures of 35 found by him lat. 26.46 S. at a depth of 38,400 feet and of 5° 37 S. and 61,29 E. and depth of 27,036 I am unable to explain.

I conclude these remarks with a table of temperatures of the Wells of Aden as having at all events a possible bearing on the extraordinary heats of the volcanic region of the Red Sea.

FROM GENERAL REGISTER *of the Aden Sweet Water Wells.*

No.	Names.	Description of Water.	Dept feet.	Yield gale.	Temperature.	Where Situated.
1	Bir. Ed. Dowlah.	Best	187	630	90°	Kussaf Battery.
2	Do	do.	180	205	95	do.
3	Do	do.	132	182	95	do.
4	Do	do.	103	77	93	do.
5	Jottee Mucadum.	do.	155	2000	95	do.
6	Annanjee	do.	173	290	94	do.
7	Barah Bhai	do.	148	258	96	do.
8	Pardesie	do.	117	208	....	do.
9	Do	do.	130	226	92	do.
10	Do	do.	112	....	....	do.
11	Do	do.	190	....	....	do.
12	Merrie Coobie ..	do.	124	263	92	do.
13	Do	....	106	...	....	do.
14	Do	....	186½	....	....	do.
15	Do	....	120	....	....	do.
16	Do	Best	97	499	92	do.
17	Do	....	100	....	....	do.
18	Do	...	200	....	....	do.
19	Do	Best	205	625	100	in rear of Capt. Haines'
20	Do	do.	175	2876	101	do. [House.
21	Ali Boo Bekr...	do.	138	4060	98	do.
22	Jews	do.	128	....	....	do.
23	Jemidars.....	do.	124	1892	93½	in rear of ex-Engineer's
24	Borah	do.	177	1100	....	do. [Office.
25	Banian	do.	225	4400	102	near Banian Well.
26	Do	....	233	...	....	do.
27	Tookerams	do.	257	2158	104	do.
28	Punch	do.	209	120	95	do.
29	Punch	do.	195	126	96	do.
30	Do	do.	120	20	95	Engineer Compound.
31	Bir. El Moze....	Very Good	118	1146	96	
32	Taweela	do.	128	2250	95	Taweela Valley.
33	Bir. Khulad	Fair drinking	107		95	do.
	Bir. Shad	Good.	90		90	head of Hydroos valley
	Do	....	79		90	do.
	Jaffran	Brackish	40		94	Jaffron Well.
	Parsees	do.	50		94	Parsee Garden.
	Dhobies	do.	28		93	Near Civil Hospital.
	Do	do.	30		88	N. Infantry Hospital.
	Do	do.	22		97	near the Bridge.
	Jail	do.	50		90	this well has the greatest diameter (16') in Aden.

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The subjoined in reference to a rain fall on the 30th April though out of date, inasmuch as the information it contains is much more recent than any thing due to this number of the Transactions, ought to be added as so valuable a contribution to the Storms at Aden, that the Chronological irregularity must be overlooked.

"The cyclone that passed across the southern part of India about the 26th of last month seems to have flung its tail over Aden in the shape of a terrific rain storm, accompanied by thunder and lightning. We have the following from a correspondent :—

ADEN, 3*rd May* 1859.—On the night of the 30th of April we had a rain-storm in Aden, such as the oldest Arab inhabitant of the place had never witnessed. The preceding night there had been a copious fall, sufficient to fill nearly the whole of our splendid tanks ; but at about 10 P. M. of Saturday it began again, and one might have thought that the dreadful pudder o'er our heads was determined to swamp us. The rain fell in flakes, and lasted without intermission for nearly three hours. About midnight screams and cries resounded through the town and camp, but it was not till the following morning that the extent of the mischief done was fully known. Long before day-break several hundreds of the people were collected on the sea-beach, some looking for their lost property and others busily engaged in searching after their lost friends and relatives. Nine bodies were picked up during the day, but twenty more are still missing. So sudden was the rush of water from the hills, that these unfortunate creatures were either taken by surprise and carried away whilst sleeping, or in trying to escape from their houses they were met by the torrent and hurried onward by its impetuous velocity. A great number of the *cajan* dwellings were swept away bodily, and upwards of two hundred stone houses have suffered considerable damage. The tanks, which had been filled the night before, stood the renewed strain tolerably well ; but different parts of the new masonry were carried away, and immense quantities of *debris* from the hills have found a lodgement in their capacious basins. It is my opinion, indeed, that the tanks, by breaking the rush of water from the hills, served in a great measure to shield the houses in the plain immediately below ; for had it not been for the interruption which they afforded, the torrent would have been much stronger and much more destructive. The storm was accompanied with heavy thunder and lightning, the latter so vivid and so continuous that one might have thought that the moon was shining. The Arabs maintain that a bolt struck the range of houses in the bazaar occupied by the butchers, and several persons were conscious of several slight shocks as of an earthquake.

The roads in every direction have been cut up fearfully. In some parts all vestiges of a road have been obliterated, and in others immense masses of stones and earth have been deposited in hillocks across them. The Main Pass was quite blocked up with one of these masses from the overhanging hills, and it was only with the greatest difficulty that the *cafila* could enter."—*Bombay Gazette, 13th May.*

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II.—*On the Geology of the Rock of Gibraltar.* By DR. BUIST, F.R.S. L. and E. &c. *Sec. to the Soc.*

'isiting India in 1840, I came out through France, and on
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.ıs in March and again in August last year (1857)
portunities I have had for examining the Rock, and I
.s, to prevent more weight from being attached to what I am
.ı to state, than is its due. In March we reached the Rock at day break in rain and storm, but from the coal charger having drifted from her moorings, I had four hours left me for work. I was fortunate in meeting an accomplished young officer, who had shortly before been stationed there, and undertook to be my guide. We walked first round by the Inundation under St. George's Hall, across the Isthmus, and so by the back of the Rock to Catalan Bay, and beyond the village as far as the precipice permitted. We then returned through the town, and proceeded as far round as Europa Point, thence ascended to St. Michael's Cave, and then to the signal station, 1255 feet above the sea, the highest point of Middle Hill, the centre section of the Rock. The steamer had now come down to the grand harbour, permitting us to spend the last moment in our enquiries, and to embark with our specimens. The chief thing on this occasion that astonished me was, the mistake I had observed in all our highest geological authorities, in reference to the Bone Breccia, described as found in the caves alone, and produced from the cementation, by lime drippings, of the bones of animals lately dead. I found it on the other hand forming a great mantle along the back of the hill for a distance of nearly a mile, and at least a quarter of a mile up and down the slope. I was lucky in finding various specimens both with recent bones, and fragments of oyster shells imbedded. The great apron of sand at Catalan Bay did not appear to me drift, as described, but a concrete like that on the Bombay Esplanade—an opinion in which I was confirmed by the corrugations it presented, and the steepness of the angle at which it reposed. According to the large chart by Admiral Smythe, its base and altitude must be each above 1100 feet, and dry loose sand slides down, until the base becomes twice the altitude. I assumed that I should find abundance of information on these points at home, when to my astonishment, I

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ART. II.—*On the Geology of the Rock of Gibraltar.* By DR. BUIST, L.L.D. F.R.S. L. and E. &c. *Sec. to the Soc.*

On first visiting India in 1840, I came out through France, and on returning home in 1845, passengers were, by the quarantine regulations, precluded from landing any where within twenty days of leaving Alexandria. On coming back again, four months afterwards, my time at Gibraltar was occupied by investigations under Her Majesty's Lords of the Admiralty, with Admiral Sir John Sinclair and Colonel Harding, for the commencement of a set of Tidal and Meteorological Observations suggested to Government by the Bombay Geographical Society. In 1853 I went home by Trieste; and my time on returning to Gibraltar in July 1854 was occupied by accompanying a party of passengers through the galleries. Two short visits in March and again in August last year (1857) comprised the opportunities I have had for examining the Rock, and I mention this, to prevent more weight from being attached to what I am about to state, than is its due. In March we reached the Rock at day break in rain and storm, but from the coal charger having drifted from her moorings, I had four hours left me for work. I was fortunate in meeting an accomplished young officer, who had shortly before been stationed there, and undertook to be my guide. We walked first round by the Inundation under St. George's Hall, across the Isthmus, and so by the back of the Rock to Catalan Bay, and beyond the village as far as the precipice permitted. We then returned through the town, and proceeded as far round as Europa Point, thence ascended to St. Michael's Cave, and then to the signal station, 1255 feet above the sea, the highest point of Middle Hill, the centre section of the Rock. The steamer had now come down to the grand harbour, permitting us to spend the last moment in our enquiries, and to embark with our specimens. The chief thing on this occasion that astonished me was, the mistake I had observed in all our highest geological authorities, in reference to the Bone Breccia, described as found in the caves alone, and produced from the cementation, by lime drippings, of the bones of animals lately dead. I found it on the other hand forming a great mantle along the back of the hill for a distance of nearly a mile, and at least a quarter of a mile up and down the slope. I was lucky in finding various specimens both with recent bones, and fragments of oyster shells imbedded. The great apron of sand at Catalan Bay did not appear to me drift, as described, but a concrete like that on the Bombay Esplanade—an opinion in which I was confirmed by the corrugations it presented, and the steepness of the angle at which it reposed. According to the large chart by Admiral Smythe, its base and altitude must be each above 1100 feet, and dry loose sand slides down, until the base becomes twice the altitude. I assumed that I should find abundance of information on these points at home, when to my astonishment, I

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that could be discovered, was a notice in the Geological Transactions of 1846, by Mr. Smith of Jordanhill, hardly half a page in length. On my return in August last, I re-examined all the points previously traversed, with the exception of the upper part of the rock, for which time was not on this occassion permitted, directing particular attention to Europa Point and the chasm or rupture called "Hole in the Wall" near Windmill Hill Barracks, as well as the Sand apron at Catalan Bay; I now give the results.* Gibraltar forms a magnificent mass of mountain facing eastward, and presenting an almost mural precipice on the Mediterranean side of from 1250 to 1470 feet in elevation. Its axis is nearly due north and south; measured on the chart it is from Europa Point to the base of the cliff rising from the neutral ground 5120 yards, or above two miles and three quarters. From Catalan Bay to the harbour it is 1000 yards, or nearly three-quarters of a mile across. It is terminated on the north by a precipice 1350 feet in height, and here is planted the Rock gun, the highest on the peninsula. It is united to the mainland by a low isthmus from half to three-quarters of a mile across, and two and a half miles in length—a raised beach consisting of sand, shingle, and shells, such as now prevail in the sea around. The highest point is about two miles along the ridge, where the little turret called O'Hara's Tower is built, on a point 1408 feet above the sea. From this it descends by a steep rugged slope towards the table-land called Windmill Hill, a plateau about 350 feet in height. Another step or precipice descends to the flat at Europa Point, a lower plateau 150 feet above the sea, surrounded by a precipice deeply caverned by the breakers. An overhanging cliff for about half a mile along betwixt "Hole in the Wall" and Catalan Bay prevents the possibility of reaching the one from the other, expect by sea, or a circuit of nearly the whole rock,—a source of much disappointment to me, as I had pushed on much further than I should otherwise have done, hoping to reach the sand apron at the Bay by a short cut. I was compelled to retrace my steps and once more traverse the town, so that a walk of about ten miles performed during the three hours I was allowed ashore, left but little time for drawing or observations.

The prevailing rock on both sides of the Strait, is a siliceous sandstone of a yellowish brown colour, generally associated with limestone and shale in different states of induration, the subordinate beds of chert and coal probably belonging to the Jurassic group. The Gibraltar limestone contains casts of marine shells chiefly *Terebratulæ*.† It forms a long precipitous

* Since the meeting of the Society, I have fallen in with the extended paper of Mr. Smith of which that adverted to in the text is an outline merely. I have drawn from it freely. I was not aware until now that fossils were found in the central rock, and I am indebted for this to Mr. Smith's paper exclusively. I have quoted it only on those points where I had not the means of examining the facts for myself, or where he goes more minutely into particulars than I could venture to do. The only matter of novelty almost which remains for me, is that referring to the cemented sand which he regards as *drift*.

† Mr. Smith *verbatim* Lon. Geol. Trans. 1846. p. 41.

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ridge, the Mediteranean face of which has already been described, sloping gradually westwards to the town and harbour, which forms a beautiful horse shoe six miles across, directly opening out upon the Strait—here nine miles in breadth. The mass is divided into three sections, the northernmost called Walf's Crag, the central one Middle Hill or Signal Station, and the Southernmost and loftiest O'Hara's Tower or Sugar Loaf Hill. The great mass of the rock is a hard compact pale bluish or grey limestone, resembling in appearance similar masses which constitute the sea cliffs at Marseilles, and the mountain range over which the high road and railway ascend from Trieste towards Galatz. The strata of Middle Hill dip westerly at an angle of from 9 to 40, and have been much broken and shivered both in the strike and vertically; to such an extent indeed as to look saving in colour like Basalt, when seen at some distance from the sea. Some violent ruptures and dislocations have taken place at the western and southern base of Sugar Loaf Hill, where we have a vast line of covered ways and galleries, as if Nature meant to contrast the majesty and magnitude with which such things were constructed by her, with those around, the handiwork of man. Here are enormous fragments of rock lying loose on the surface, or cemented together by material corresponding with the littoral concrete of our shores.* A bed of "littoral concrete" extends along the base of the precipice towards the northwest, at an altitude of 60 feet above the sea, forming the site of the town and gardens. This is obviously an elevated beach, of which there seem to be three or four on the harbour side of the rock. The Bone breccia, if it may be so called, is very much older than this, though greatly newer than the rock itself. It is supposed by Mr. Smith, with all appearance of truth, to have come into existence when the limestone beds, now inclining at an angle of 30° were nearly horizontal and not very greatly above the level of the sea; and he assumes, with great probability, a succession of depressions and upheavals of magnitude and abruptness such as to account for the present fractures and derangements on the Rock. The Bone breccia consists of angular portions of the old grey limestone; with like portions of the beautiful Travertine generally known by the name of "Gibraltar Rock," cemented together by a brick coloured earthly material chiefly calcarous. In some places again, the Travertine itself, of much more recent age than that constituting the fragments, forms the commenting material, and it is quite clear that the existing Breccia is partly recent and partly formed from the fragments of an earlier Breccia, shivered to pieces by some convulsion, not suffiientlygreat to prevent the operations it disturbed, from proceeding to go on. The Travertines, both

* This term, which is of Bombay origin, indicates distinctly and intelligibly a particular variety of rock, formed by the cementation of sea-sand or shells, the same as those now prevalent along our shores. The term sandstone is associated in the mind with something arenaceous—Littoral Concrete being often highly crystalline, and without one atom of Silica and is apt to be confounded under this name with formations of divers characters and olde dates than the very latest.

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old and new, so exactly resemble that now being deposited from the drippings in St. Michael's Cave, that the one can scarcely be recognized from the other. The whole of the cementing matters abound in fragments of recent bones and sea shells, such as are usually described as alone prevailing in the Caves. These latter in part abound in Stalactite and Salagmite. They are occasionaly filled with an ochrey colored matereal beautifully arranged in bands of different hues, the washings apparently of the brick-colored rock already referred to as forming the chief cement of the Bone breccia.

It may be remembered that, though Lime is almost insoluble in pure water, it is freely taken up by water containing Carbonic acid. Rain in Bombay as the monsoon advances, is so surcharged with this, that a polished marble slab will lose its lustre in a week and become in a single season, saccherine as if washed with an acid. Here the lime thus dissolved, is thrown down as the dry season advances, cementing our Littoral Concrete, and forming our Kunkur. The principle has been taken advantage of by Professor Clark, of Aberdeen, for the purification of water rendered hard by Supercarbonate of Lime in solution. Quick-lime is thrown into the cistern in sufficient proportion to attract the surplus carbonic acid, when the whole is precipitated in the shape of an insoluble subcarbonate. My attention being directed to this matter, I found at Malta, at Suez, and at Aden breccia of exactly the same description as that prevalent at Gibraltar. The fragments cemented together in the first two instances, were Nummulite limestone, in the third Lava. In all the three the cementing matter was either littoral concrete or travertine, the last being in all cases so uniform in appearance as to be with difficulty recognizable. I find the same thing in the ships's ballast on our shores, said to be brought from the Mauritius but which I rather think must have been carried there from Southern Arabia. It would be curious to ascertain under what parallels this tendency of water to dissolve enormous quantities of lime chiefly prevails, in Northern Europe it is scarcely perceived. After the Bone bed, the great Sand Apron chiefly attracted attention.* It is about 3500 feet or three quarters of a mile in base and from 1000 to 1100 feet, perpendicular from the sea-shore sloping according to the Chart from which these measurements are taken, at an angle of 45 all over, the upper portion being considerably steeper than this. It has every appearance of having at one time extended to the crest of the rock, and afterwards to have slipped down for about 200 feet. It looks as if it had been wet and somewhat adhesive, as it arose from the waves, and ascended with the rock itself at one single great upheaval of at least 1300 feet. Induration seems rapidly to have followed, when the slip already adverted to, occurred. From 70 to 100 feet above the sea, is a long series of cracks and corrugations, closely resembling those of a piece of wet paper rumpled up—very like the drawings of the great Glacier Slips in Pro-

* See Lithographs at the end of the Number.

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fessor James Forbes' work on the Alps, and still more nearly resembling the slips and cracks to be observed in loose earth thrown damp over a precipice, when the basal portion hardens and shrinks as it dries and the suprincumbent mass by and bye slides after it. The whole mass consists of an exceedingly hard concrete of siliceous sand and shells, cemented by calcareous matter, which I found, on dissolving it, to constitute about a fourth of the whole. I examined this with all the care the shortness of the time allowed,and wished that I had had as many hours or days as I had minutes to bestow on it. The inferences to be drawn from it are numerous and important. The most obvious, that whatever number of ascents and descents Gibraltar may have been subjected to, the last great upheaval raised it at once, and that too in a very brief space of time, from the level of the sea to its present elevation. Along the shores of Portugal and Spain, from the Bay of Biscay south, are every here and there great aprons of sand, which from the sea seem exactly like those already described. In the Gulf of Suez again along the shores of the Sinai Peninsula, the same appearances present themselves,but on a scale of much greater maguificence. Few things surely could be of greater interest than to ascertain how far such similitudes extend. There is nothing more important in the pursuit of this science than to endeavour to obtain light on events occurring at periods of time indefinitely remote, and under agencies and circumstances we are in the habit of considering so different from those now obtaining, by watching carefully everything either passing before our eyes, of which has passed at dates comparatively recent, and probably under the existing economy of things.

ART. III—*On Professor Owen and Mr. Horner's Views, of the Age of Man upon the Earth, as laid before the British Association Sept.* 1858. *By* Dr. GEO. BUIST, L.L.D. F.R.S. L. *and* E. &c. *Sec. to the Soc. read* 19*th Nov.* 1858.

AGE OF MAN UPON THE EARTH.—From the time Geology began to claim a place amongst the Physical Sciences, one great object of its cultivation was to obtain something like the dates, expressed not in epochs but in years, of the changes which have taken place on the surface of the earth. Lyell first laid down the law emphatically, that all changes, save those involving the introduction of new forms of organic existence, might be explained by causes now in force, operating with greater degrees of intensity than at present, and through unlimited lapses of time : it had been felt all along by the reflecting, that when phenomena required to be explained through the instrumentality of agencies of which we knew n othing, and laws now no longer in force, the field of legitimate deduction was at

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an end: Speculations which demand the substitution of the suppositions of possibilities, for facts, are not recognized as subjects for the cognizance of philosophy. The accumulations of debris at the base of precipices formed the foundation of one of the earliest attempts at a Geological chronology. The deposit of river mud came next, and this is still accepted. It was then, and seems yet to be forgotten, how both these must have occurred under circumstances utterly unlike those now existing—though governed by the same physical laws. Humboldt conceives, that within the human period the whole line of salt lakes from the Caspian eastward to the forntiers of Affghanistan must have formed portions of the North Sea, the shores of which retired by reason of some vast upheaving of the earth.* Mrs. Sommerville mentions, that the plains around the Caspian, up to the base of the Ural mountains, are covered with gravel and shells, clearly shewing that they at no distant period were under salt water.† The Isthmus of Suez has obviously been below the line of the ocean since the appearance of man on the earth, and there is the strongest reason for believing, that within the past three thousand years, the dry land forming the outer crust of the globe, has over the greater part of the world, risen by from 10 to 30 feet. We are thus deprived of the means geologists were wont to consider within their reach, of reckoning periods of time in years or ages.

These remarks are meant to apply to a passage in the address of Professor Owen at the British Association, in reference to the presumption formed from the enquiries of Mr. Horner, that the human race had been at least 13,000 years in existence. This venerable geologist, found by a succession of close on a hundred borings through the mud deposited by the Nile, that there were nine feet six inches of sediment beneath the present surface of the ground, and the lowest point of the platform on which stands the colossal statue of Rameses the Second. From the date of the erection of the statue, the accumulation of the mass of sediment must have occupied 3125 years, or at the rate of about $3\frac{1}{2}$ inches of deposit in a century. There were found to be 30 feet of sediment below this, and at the bottom of the boring, a piece of pottery, the work of those who had made some progress in the Arts,‡ was found. The inference drawn from this is, that on the

* Asie Centerale.

† Physical Geography vol. I. p. 117. II. p. 6-10 1 Miss. Fanny Corbeaux Atheneum 1848; or Dr. Buist on the Physical Geography of the Red Sea. London Geographical Society 1854.

‡ The following is the quotation from the Athœneum report—Mr. Leonard Horner discerned the value of the phenomena of the annual sedimentary deposits of the Nile in Egypt as a test of the lapse of time during which that most recent and still operating geological dynamic had been in progress. In two Memoirs communicated to the Royal Society in 1855 and 1858, the result of ninety-five vertical borings through the alluvium thus formed are recorded. In the excavations near the colossus of Rameses II. at Memphis, there were 9 feet 4 inches of Nile sediment between 8 inches below the present surface of the ground and the lowest part of the platform on which the statue had stood. Supposing the platform to have been laid in the middle of

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assumption of Nile mud having accumulated for unknown periods of time at the rate it has been deposited for the past 3000 years, the probability is, that the pottery must have been lodged where it is now found, above 13,000 years ago ; and so far back as this potters must have been at work. The reasoning is sound, were we only sure of the bases on which it rests but unhappily for the tenableness of the conclusion we know nothing of the facts at all.

Although it is now twenty years since it was made out to the satisfaction of Lyell and other first-rate geologists, who have embodied the conclusion in their works, that there had over the greater part of the world, been long within the human period, a *sudden* sinking, and then, after a long interval, a leisurely re-elevation of the earth, to the extent of from 10 to 20 feet, the fact never seems to have gained the footing of a doctrine. The speculations of Darwin on Coral Reefs, bearing on the same subject, have equally been accepted and promulgated as facts, equally forgotten as doctrines. The truth is, that for twenty years we have been so exclusively devoted to the study of organic remains, that it seems to have become forgotten, that if Geology is to be considered the science taking cognizance of the movements the powers and principles which have amongst them, brought the world into its present state, the inanimate have as strong claims as the animate agencies on our attention—Dynamics, Hydrodynamics, Pneumatics and Chemistry, as that Paleontolgy which has gone so far to monopolize our regards. Egypt, the field of Mr. Horner's researches and Professor Owen's speculations, might have itself sufficed to show the insecurity of the basis on which they rested a theory so wide of our usual conceptions. It has alre ady been stated and well established, that since the date of the Exodus (B.C 1491) three thousand years ago, the land around Suez has risen 8 or 10 feet.* It is not impossible a similar change had at this date occurred all over this portion of the East. Herodotus, who flourished 440 years before Christ, states that the learned men of Egypt told him, that in the time of Menes, who founded the Egyptian monarchy, 2,200 years before Christ, the land of Egypt from the Theban provinces northward, was a marsh, and that from the lake Mœros, about 100 miles from the sea shore at Alexandria northward, was permanently under water. The Greek historian concludes from this that the Delta was a

the reign of that king, viz. 1361 B.C., such date added to A.D. 1754 gives 3,215 years during which the above sediment was accumulated; or a mean rate of increase of 3½ inches in a century. Below the platform there were 32 feet of the total depth penetrated ; but the lowest two feet consisted of sand, below which it is possible there may be no true Nile sediment in this locality, thus leaving 30 feet of the latter. If that amount has been deposited at the same rate of 3½ inches in a century, it gives for the lowest part deposited an age of 10,285 years before the middle of the reign of Rameses II., and 13,500 years before A. D. 1854. The Nile sediment at the lowest depth reached is very similar in composition to that of the present day. In the lowest part of the boring of the sendiment at the colossal statue in Memphis, at a depth of 39 feet from the surface of the ground, the intrument is reported to have brought up a piece of pottery. This, therefore, Mr. Horner infers to be a record of the existence of man 13,371 years before A. D. 1854.

* Physical Geography of the Red Sea already refered to.

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gift from the river, and the soundness of the conclusion seems unquestionable. No weight need be attached to the note of the learned translator, Principal Arnold, that the theory is disposed of by the absence of marine remains to the depth of 40 feet—seeing with what rapidity these, under certain circumstances, are destroyed, and how limited and imperfect is our information on the subject. The whole alluvium of Bombay is marine,—yet ten thousand borings might be made in our brown clay without discovering a shell they are present only when preserved in nodules of Kunker. The skeleton of a whale nearly perfect, was, some thirty years since, dug out of the clay near Stirling in the valley of the Forth; the bones of a seal were in 1852 found near Falkland in Strath Eden—not a sea shell having ever been detected within twenty miles of them. On the other hand, a large bed of cockles is found near Perth reposing ten feet under the clay of the Carse of Gowrie above the roots of a land forest—nothing of the like kind being discernible in the vast expanse of cotemporaneous formations arround.* The basin of the lake Mareotis, close by Alexandria, has, ever since the country was known to us, been from 10 to 12 feet below the level of the sea; this much it must either have sunk when the barrier came into existence, which was cut in the end of the century and the waters of the Mediterranean submerged and destroyed the most fertile part of the Delta, or the barrier must itself have risen, like the Ulla Bund in Scinde, to separate the sea from the dry land. With the basin of the present delta an estuary filled with stagnant water, it is quite clear that mud must have accumulated much more rapidly than from a running stream, however sluggish in its movements, and that the thickness of the deposit utterly fails us for the purpose of chronology, when it is shewn, that we are ignorant of the circumstances under which this accumulated. Rennell thinks that there can be no doubt, that the sea once washed the rocks on which the Pyramids of Memphis now stand, at an elevation of about 80 feet above the Mediterranean, and Lyell concurs in the view. The average slope of the Nile is about 5 inches in a mile, and this would give a descent of about 309 feet, from Asouan to the sea. Before the back-ponded waters could have reached the level assigned to them, the land must have been at least 60 feet lower than at present. The layers of mud exhibited at Cairo are as thin as drawing paper and a foot *at this rate of accumulation*, must represent the deposit of a thousand years. The mud deposited in their deltas, by the Nerbudda and Taptee to a depth of from 40 to 60 feet, separates readily into flakes of from $\frac{1}{4}$ to $\frac{1}{8}$ of an inch in thickness—each representing the deposit of a single inundation.† Assuming the lesser number as the average from top to bottom, we should have an accumulation of above one foot in a century, and a mass as thick as that to which the mud of the Nile has been penetrated (40 feet) accumulated in four thousand years is an estuary of

* Dr. Buist on the Geology of the Southern Portion of Perth shire-Prize Essay of the High land Society of Scotland 1838, Edinburgh.

† Dr. Buist's Notes on a journey though Guzerat and Kathiawar in 1855 Bombay Geographycal Transanctions 1856—p. 106.

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stagnant water—leaving out of account the fact that our Indian streams certainly do not bear along with them a fraction of the earthy matter with which the Nile is loaded. At Surat and Broach the deposits of the inundation in recent times have very probably been as thin as those at Cairo; though from this point downwards when up to Mœros was an estuary, the flakes were, in all likelihood, as thick at least as the Indian flakes just described. We know that at present the island of Brahrein is rising at the rate of one foot in a century; that the coast of Memel has risen one foot four inches in thirty years, or at the rate of four feet in a century. The village of Stoptstir, in Scannæ, is now 380 feet nearer the Baltic than it was in the time of Linneus. It follows from this that not only are all our conclusions set loose as to the rate of deposit betwixt the year 1300 and 2200 B.C., but in reference to what has occurred betwixt the latter of these and the present time. We find the portico of the temple of Serapis at Puzzoli has sunk and risen again to the extent of 10 feet within these 1500 years, without losing one inch of its perpendicularity; and it is now once more descending with the same regularity as before. The Memphian monument of Mr. Horner may have been subject to a similar series of influences; it may have been built above the line of inundation, the Nile descending till it became imbedded in mud, reascending again without our having any means of knowing how long these things occupied, or when they occurred. But we have no occasion to meet one conjecture by another, we have definite proof that the waters of the Nile, some three thousand years ago, extended over a much greater area than at present, and that the deposit of mud must have been proportioned to the depth and sluggishness of their flow. M. Lepsius pointed out in his letters to Ehrenberg in 1844, fifteen registers of the limit of the inundation near Semneh in Nubia, belonging to the reign of Ahmenemha the Third, 4000 years ago, partly carved on the rock, partly on separate blocks of stone. It is proved that when these were engraven the Nile must have reached an average elevation of at least 25 feet above its present level. The earliest but one of these, is the lowest of all, being only 9 feet above the present level of high Nile. For the next twenty-four years the inundation seems to have increased till it reached twenty-six feet above the present flood, when it gradually sunk again, at last subsiding to its present level.* All this is in most perfect consonance with the statements of Herodo-

* Note—The following correspondence appeared on the subject in the *Athenæum* for May June and July 1857.

The Bed of the Nile.—Since the publication of Lepsius's Letters to Ehrenberg and Bockh in 1844, it seems to have been considered a settled point that within the last 4,000 years there has been a sinking of the bed of the Nile, or at least of some portion of it, to the extent of 24 or 25 feet. This idea has arisen in consequence of Lepsius having discovered certain engravings, partly on the rocks and partly on the foundations of some very ancient fortresses, at Semneh, in Nubia, which record the heights of the highest point reached by the inundation of the Nile, and bear dates of the reign of King Amenemha the Third of the twelfth dynasty and his successor whom Lepsius places about 2200 years B.C. There are eighteen of these

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tus. At the date when the running waters of the Nile discharged themselves into a marsh bordering on the Theban province, terminating in a stagnant estuary 200 miles south of the present sea shore, they would have their velocity checked, and their height and overflow increased according as they were ponded back. The position of the various registers bears out the theory of a succession—the level and flow of the river being modified by the position of its line of debouchure—this again being dependant on the relation for the time being, betwixt the levels of the land and sea.

registers extant, but three of them are fallen from their place, and only fifteen are available at the present time. These are all far above the highest point the inundation now reaches, and the average of them proves that when they were engraved the Nile reached a point 24 or 25 feet higher than it does now. Hence Lepsius concluded that since that period the bed of the Nile, at least this part of it, has been hollowed out to that extent; and some such theory seems to have been generally adopted, though Mr. Horner published a paper in the *Edinburgh Philosophical Journal*, which has subsequently been reprinted in the translation of Lepsius's 'Lettters from Egypt,' published in 1853,—showing how impossible it is for so gentle a river as the Nile, flowing at a rate of about two miles an hour over the hardest rocks, to have excavated its bed to so great an extent. Every one, however, appears to have overlooked the fact, that the earliest but one of these registries is the lowest of all, and that it was not until twenty-one years afterwards the highest point was reached. The dates of the registries now standing are the years 6, 9, 14, 15, 20, 21, 22, 23, 24, 30, 32, 37, 40, 41, and 43, of the reign of Amenemha, and the fourth of his successor. Unfortunately, Dr. Lepsius has, so far as I know, only published the measurements of three of these,—namely, the ninth, fifteenth, and thirtieth years of the reign of Amenemha. That of the ninth is lowest of all, 9 feet above the present ordinary level of the high Nile,—this one, however, is on the opposite side of the river to all the rest, and as I gather, a little lower down the stream than the others, which may in part account for the difference. The lowest on the opposite or eastern bank is that dated the fifteenth year; it is 13 feet above the present ordinary level. The highest of all is the one dated the thirtieth year, and is 26 feet 8 inches above the present level. Hence it appears that there has not been a gradual decrease since these records were engraved, nor a sudden decrease at the time, but in the first instance a great and apparently irregular increase for several years, at least twenty four, and then a decrease for several years more, of which we have six entries remaining, some later ones having fallen. I am too little accustomed to considerations of this nature, and possess too little knowledge of the character of the Nile country above Semneh, to attempt offering any explanation of the phenomena in question, but perhaps if the real nature of them be placed before the public some one more competent might do so. I am, &c., W. HURLEY.—*Athenæum*, 30*th May* 1857, p. 700.

The Bed of the Nile.—In the *Athenæum* of the 30th of May [page 700], appears a note by Mr. W. Hurley on the discovery by Mr. Lepsius of certain engravings, partly on rocks, partly on some ancient foundations, which record the height of the inundations about 4,000 years back from the present time. From these it appears that at this date the Nile reached a point 24 or 25 feet higher than it now ever does. Every one says Mr. Hurley, seems to have overlooked the fact, that the earliest but one of these registers is the lowest of all, and that it was not till twenty-one years afterward the highest was reached. Hence, says he, it appears there has, since these records were engraven, been apparently a great irregular increase in the

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In the very admirable papers of Colonel Baird Smith and Dr. McClelland published in the Calcutta Journal of Natural History in 1840 (Vol. I. 326 and 455), on the Delta of the Ganges, a deposit which has been far more carefully and philosophically examined than that of the Nile—the assumption, which now seems almost self-evident, is started with : that Lower Bengal, when the present silting up began, was an arm of the sea, and that the mass of deluvium measured to the depth of 430 feet, or ten times that to which the Nile has been examined, was deposited through a succession of

spread of the inundation for several years, and then a decrease for several years more, of which we have six entries remaining. These circumstances have an importance attaching to them of which the writer who draws attention to them was not, perhaps, aware ; and I think I can afford the solution of what seems to him a difficulty. In making, in 1837, a survey of the alluvial deposits on the banks of the Tay, in Scotland, I observed that the bed of peat and tree-roots found in the bottom of the river, called a submerged forest, below low-water mark, was covered with several feet of mud, and above this with a bed of cockleshells, obviously in the position in which they lived. Above this, again, were some 10 or 12 feet of alluvium ; and this arrangement was, on digging wells, found to prevail for many miles all over the lower portions of the Carse of Gowrie. The conclusions drawn from this, in a paper 'On the Geology of Perthshire,' published in the *Transactions* of the Highland Society in 1838, were, 1st, That when the peat bed containing the freshwater remains, was deposited what is now the basin of the river must have been a morass above the level of the sea. 2nd, That this descending, and salt water estuary was established,—the cockleshell bed came into existence below high-water mark,—the whole continuing to go down till the present alluvium of the Carse came to be deposited from the supernatant water. 3rd, After this, an upward motion ensued, bringing all the beds into their present position. The passage was quoted at the time. I believe the inference was accepted by Sir Charles Lyell. Soon after this, I published an account of the raised sea-beaches belonging to the same class of phenomena observable all round Great Britain. In 1849 I found near my own house in Bombay exactly the same arrangement as that prevailing in the Carse of Gowrie ; and soon after was able to trace it from Suez all round the borders of Arabia, Hindustan, so southward along the shores of the Mauritius, and I believe, indeed, all over the world. Papers were published by me on the subject in the *Reports* of the Bombay Geographical Society, and in the *Transactions* of the Bengal Asiatic Society for 1850, and again in the Report of the British Association for 1852. In a paper 'On the Physical Geography of the Red Sea,' read before the Royal Geographical Society of London, April, 1854, the following conclusions are stated to have been arrived at :—1st, That within three thousand years of the present time an elevation of the land to the extent of from 5 to 30 feet must have occurred, so as to raise the bed of the canal cut by Darius Hystaspes, some centuries before our era, to prevent the waters of the Nile reaching the land of Goshen and other places on the upper margin of the Delta, where the remains of important cities are still to be found. It would be too much to draw on your space by enumerating the grounds on which these conclusions are based ; they will be found fully set forth in the papers enumerated. This elevation was shown to have been everywhere shortly before preceded by a depression of at least 20 feet—this in many cases having occurred suddenly, if not instantaneously. These phenomena most fully explain the circumstances attending the registers of Lepsius. The oldest of the inscriptions, now the lowest, was carved as the downward mo-

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depressions and upheavals in comparatively tranquil waters. The time consumed in this operation is estimated, on data as exact as the case permits, at above 3,500 years. The bones and fragments of wood found at this depth, had not lost their structure or even their sap; their solid matter was scarcely changed and there is little reason to doubt but they were at least as old as the bit of pottery to which an antiquity of 13,000 years is assigned. The mangrove wood found 10 feet beneath the upper surface of our Bombay raised beaches is fresh enough to be turned on the lathe.

It may seem very presumptuous for any one in India, to enter the lists with an Owen or a Horner on such points as these, assented to apparently by an assemblage of the first philosophers in Europe, to whom they were addressed. But in Science, as in Religion, the precept is imperative to "call no man master," to try all things and cleave to that which is true." The volumes of Revelation and of Nature are alike open to all men—alike are they illuminated from above. In studying them no man is warranted in trusting to the eyes of others, in abandoning the right of private judgment, or in diverging in sheer indolence and unconcern, from the right path, because illustrious men may have led the way.

tion was in progress; the highest when this had reached its maximum. From this date the basin of the Nile rose: the waters consequently, *appeared* to recede. The theory, though quoted with apparent acceptance by Sir C. Lyell in 1841, three years before Lepsius's Letter appeared (in 1844), seems not to have been quite taken in by geologists; and yet it explains thousands of phenomena—as, for example, that of the formation of river deltas—otherwise so unspeakably perplexing to us. The importance attaching to Mr. Hurley's inquiry is, that it affords us specific dates for the occurrence of these movements. If Mr. Hurley will refer to the very excellent letters of Miss Fanny Corbeaux, published in the *Athenæum* for 1852, he will find much on the changes of level in Egypt that will interest him. The science of Geology professes to endeavour to record and explain the various agencies which have operated in bringing the earth into its present form; and yet of late years we have been mainly confining ourselves to the peculiarities and condition of the vegetables and animals which at different ages flourished on its surface. GEO. BUIST.—*Ibid. July* p. 919.

Bed of the Nile.—If the whole basin of the Nile underwent a subsidence and then a subsequent elevation, as described in the *Athenæum* of July 18 by Dr. Buist, the waters of the river must have participated in the event and have preserved their relative level with the banks. The registries at Semneh require for their solution some phenomenon which should apply to the water alone, not to the banks. W. HURLEY.—*Ibid.* p 949.

Torquay, July 21.

The river Nile of course rose fell with the dry land constituting its basin but the sea retained its level. When before the basin of the Nile had sunk so low as to enable the sea to reach the Thebaid the river waters must have become ponded back and rendered comparatively stagnant by the salt water of the estuary so as to make the inundation attain a higher level than it had previously done. The statements of the priests made to Herodotus on this point fully explain one division of the phenomena. No mention is any where made so far as I know of the sinking of the land which enabled the waters of the Mediterranean to extend themselves Southwards. The whole of the facts here mentioned and of others of like kind seem to relate a general depression and reelevation of the shores all over the world, and at dates closely corresponding with the Noachean deluge.

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APPENDIX A.

METEOROLOGY.

DATE OF THE ELEPHANTA.—As the approach of this somewhat turbulent and noisy visitor is now most probably close at hand, the expectant reader may possibly feel some interest in knowing the times of its coming during the past seventeen years, and the most notable of the circumstances attending it. The designation which these Autumnal storms bear, all over this side of India, is conferred on them as occurring about the time when the Sun is in the Constellation *Hust*, the Sanscrit for elephant. As they reach Bombay from nearly due east their name is not unnaturally imagined to have been conferred on them from the celebrated island from the direction of which they reach us. The Elephanta commonly makes its appearance a fortnight or so after the weather has fairly cleared up, when showers have almost ceased to fall, the barometer has become high, the sky bright and clear, and the alternating sea and land breezes have set in. For three or four evenings before its appearance, superb piles of thunder-clouds are seen to accumulate about 3 o'clock every afternoon over the Ghauts: they soon ascend some way in the air, advancing apparently against the sea breeze,—that is, the upper and lower strata of air move opposite ways to each other. Magnificent displays of lightning, with low growling thunder, prevail as twilight sets in: an hour or two after sunset the sky resumes its serenity. At length the clouds grow darker and more watery—the thunder becomes louder, the lightning more brilliant—they tumble up the sky, rolling in vast masses over each other, till a sudden squall bursts in on us, and a deluge of rain follows. This scarcely ever occurs earlier in the day than 3 P. M., and it very seldom continues till dawn; though after three or four hours' interruption it sometimes resumes before noon next day. When the gale is fairly over, the sky in general clears up at once, the clouds vanish, the alternate winds resume sway—hot days and dewy nights succeed and the settled season commences. During the squalls we occasionally experience in March and April, the barometer usually falls, or becomes very irregular, and pending the July storm it sinks very low indeed, and its range becomes singularly small. The bursts in the beginning of June and October, which herald in and close the S. W. Monsoon, seem purely electrical,—neither the pressure nor humidity of the air being materially affected by them. And now to our chronology.

1840.—The Elephanta set in on the 10th Oct., with a violent dust and thunderstorm and quantities of rain, which continued from about an hour before till two hours after sunset: the wind blew in sudden and uncertain gusts from nearly due east, bringing with it perfect sheets of rain. The thunder ceased in a few hours' time, but the rain continued for nearly forty hours with little interruption. On the evening of the 11th it drew off, when all became tranquil and quiet, and we had no more storm that year.—Fall for the monsoon, 63·15 inches.

1841.—After nearly six weeks of bright, tranquil, and cloudless weather, a violent thunderstorm occurred on the evening of the 16th October. The sky continued thick and louring, with lightning in the evening, till midnight on the 17th, when a violent burst of thunder and rain occurred: the thunder soon ceased, but the rain continued for a couple of days, water standing everywhere in pools, and the ground being apparently as wet as in June—Monsoon fall, 71·49.

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1842.—The monsoon of 1842 was one of unusual severity, 95.26 inches of rain having fallen. It broke up stormily and irregularly. The latter half of September was tolerably clear, but on the 29th sharp squalls, with lightning and showers, made their appearance, and so continued till the 1st October. On the 8th, and again on the 13th and 14th, there were squalls, with thunder and rain,—the latter date probably affording the true Elephanta. We had in 1842 one of those supplementary storms on the 12th and 13th November, which are of singularly regular occurrence.

1843.—The monsoon of 1843 was light, and the rain commenced early: there were scarcely any showers in September, and the result was an early and severe Elephanta. It commenced on the 27th September, when a smart thunderstorm crossed the island. The rain now began to fall in torrents, and in the course of three days no less than five inches were measured—in five hours' time two and a half inches fell. The weather then cleared up, and there was no more storm that year.—Fall, 59.27.

1844.—The furious dust-storm which occurred on the 30th September seems to have taken the place of the Elephanta, in 1844. There was a good deal of thunder, a very severe gale of wind, and a few drops of rain—scarcely amounting to a shower—the whole was over in a couple of hours' time. There was a very severe squall, with a thunderstorm, on the 10th October, the violence of which was more felt down the coast than at Bombay.—Fall, 65.40.

1845.—A sharp squall and thunderstorm occurred on the 15th October supposed to have been the Elephanta: we can give no particulars.—Fall, 54·73

1846.—The Elephanta made its appearance on the evening of the 8th October 1846, and continued for a couple of days. The weather cleared up on the 10th, when on the 15th and 16th we were threatened with a renewal of the storm: the threat was not realized, and after some thunder and lightning, the sky cleared up, and the slight showers of February were the next we experienced that year.—Fall, 87·48.

1847.—There was a threatening of an Elephanta on the 2nd, and again on 22nd October, 1847, with a good deal of thunder and lightning on both occasions. On the 2nd and 3rd November we had a smart thunderstorm, and heavy and protracted falls of rain, which continued from the 1st to the 5th. During this time three and a half inches were measured. As a considerable proportion of the community reside in light halfthatched dwellings, or in tents, from the Elephanta till the end of May, an unseasonable fall of this sort in November occasions the greatest discomfort.. The weather cleared up immediately after the fall was over, and not so much as a shower occurred from this time till the commencement of next monsoon—remarkable as this was both for the earliness and violence with which it set in.—Fall, 67·31.

1848.—The Elephanta was this season of unusual turbulence and duration. After threatening for near a week, it set in with the utmost fury on the 6th October. The thunder was loud and near; the lightning flashed incessantly: the wind, which set in with violence in the N. W., in six hours' time had swept the compass round, blowing with peculiar fury from the east about two hours after sunset. It blew a severe gale from S. W. for twenty-four hours on end. Betwixt the 5th and 8th five and a half inches of rain fell, 2·88 having been measured on the 7th. On the 19th we had a sort of supplementary Elephanta—a sharpish squall and thunderstorm, but nothing compared to the first: of course the storm came as usual from the east.—Fall. 64·12.

1849.—The Monsoon was this season of nearly unprecedented violence and duration: about one hundred and twenty inches fell at the Presidency, or nearly double the average. After an almost total cessation in August, it resumed in September, with July-like violence, and so continued till past the middle of the month; and under these circumstances there was scarcely time to brew an Elephanta, and short squalls, with some thunder and smartish showers of rain on the 3rd and 8th October, were all we had deserving of the name. We had some very brilliant electrical discharges in the beginning of November, but no further storm. On the 10th November we had a thunderstorm and squall of short duration, but of very peculiar magnificence, with a second of lesser magnitude on the 15th. This terminated the rains for the season;—with the exception of a very slight shower in February, no more fell till the beginning of June.

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1850. Oct. 7.—The Elephanta burst at sunset with a smart squall from N. E., lightning blazing all around the horizon. There was heavy rain across from Mazagon Hill to Byculla and so to Mahaluxumee; in the course of the evening there fell close on a quarter of an inch all over the island. This, however, was only the prelude. The following evening, the 8th, about 6 o'clock, a thunderstorm was observed over Panwell, and though the sea breeze was blowing somewhat briskly from northwestward, great piles of massy clouds kept rolling up from the east, thundering terribly as they advanced. At ½ past 5 the whole landscape suddenly became of a lurid orange hue; at ½ past 6 a furious squall burst from the east, accompanied by such a torrent of rain, that it seemed as if a sluice had been opened. The sun had barely set when a pitchy darkness came on. This state of matters lasted for an hour, when the squall drew off, and it faired, the thunder and lightning continuing. At 9, a stiff and steady breeze set in from east, and it continued to blow in puffs from the same quarter till 7 A. M. next day—three quarters of an inch of rain having fallen during the previous 1½ hour. A few very light showers fell in the last week of October, but from the date of the Elephanta the fair season had set in.

1851. Sept. 25, Oct. 10.—There is some doubt about the date of the Elephanta, for 1851. We had in fact no storm precisely corresponding in character with what usually goes by that name. On the 25th, 26th, and 27th, we had a series of thunderstorms and slight squalls, but they were too early, and they were not violent enough. On the 24th a thunderstorm occurred at Mahabuleshwur, exactly corresponding in all but date with the Bombay Elephanta. On the 10th and again on the 20th October the Elephanta threatened but did not come down, when the weather cleared up.

1852. 8th to 11th Oct.—Like the year preceding, 1852 was without any very well-defined Elephanta. Betwixt the 8th and 11th we had frequent thunder with squalls from the east, clouds and showers, but none of those violent disturbances which characterise the gale. At this date there were violent hurricanes in the China seas and near the mouth of the Bay of Bengal.

1853. For this season we have no record of our own. From the Observatory reports we gather, that the last rain for the season fell on the 24th September. We can observe no trace of anything like an Elepbanta, and we presume, therefore, that no such storm was experienced at Bombay. We fail to discover any unusual phenomena described amongst our papers from up the country.

1854. Oct. 6-7.—On the 6th and 7th October we had violent falls of rain nearly 6 inches having been measured, and as this followed a track of open weather, and was the last rain of the season, it must we assume be accepted as the Elephanta. Yet all the characteristics of the gale save the rain were awanting. The wind was steady, and from the S. W.; we had no squalls and very little thunder; the want was made up for by the Gunpowder Plot storm and subsequent hurricane of November.

1855. Sept. 29th and 30th; Oct. 11th and 12th.—We are not sure which of the two storms is to be considered Elephanta; the latter of the two corresponds most nearly with it in point of time, the former in point of charracter. On the morning of the 28th half an inch of rain fell, and the sky exhibited that extraordinary transparency which indicates almost complete saturation, and gives such singular beauty to the landscape. There was lightning in the evening and a heavy thunderstorm crossed the zenith from nearly east to west. The morning of the 29th gave unmistakeable indications of an approaching storm, and we had accordingly heavy thunder and lightning in the evening, and a severe thunderstorm again crossed the zenith from nearly east to west. On the evening of the 30th we had a thunderstorm of still greater severity, accompanied with a violent squall of wind and drizzling rain from E. and afterwards S. E. The wind veered round to N. N. E. in the course of the evening, and the sky became pure and serene, and so continued till the 11th Oct. This we consider the true Elephanta. We find the disturbance of the 11th and 12th Oct. described as follows in the *Bombay Times*:—

"We had a very curious instance of a local squall on Sunday evening, the 7th instant. As we mentioned on Monday, we had distant thunder all the afternoon. From five o'clock the upper clouds began to ascend from Eastward

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right in the teeth of the sea-breeze. On reaching the zenith, about half past six, the squall struck Sewree and crossed the island. It was felt severely at Khandalla and Panwell, and was so violent at Oolwa as to have stripped the roofs off the house. It seems to have been a purely local burst, and was not so much as felt even at Mazagon, Byculla, or the Fort: it was not accompanied at Bombay with any rain, though heavy showers seem to have fallen in other quarters."—*Bombay Times, October* 12.

— "Just as we thought the weather had become thoroughly settled, a most unexpected change in the aspect of the air has made its appearance. On Wednesday the Barometer fell at once by about half a tenth, or from 29.864 to 29.807, and at this it stood for a couple of days. Yesterday it tumbled down by half a tenth, or from the number already set down to 29.777, and continued falling up to two o'clock, when it stood at 29.633, having tumbled down by 00.141, or deducting 00.058, the natural descent, by 00.083. About noon on Thursday it began to rain heavily at Panwell, and a thin film of cloud with slight showers spread over the sky, and prevailed all over the afternoon and evening. Yesterday it was looking cloudy and rainy all day, the wind blowing from the eastward; in the afternoon there was a smart shower of rain with much lightning in the South at sunset, and indications of stormy weather at no great distance from Bombay. The storm flag was hoisted from the Dockyard as a warning to the shipping in the harbour."—*Bombay Times, Oct.* 13.

— "The atmosphere continues to possess that extraordinary transparency which generally precedes or follows a heavy fall of rain, and for the greater part of the day the wind is from the S. E. quarter of the compass, the sea breezes having scarcely as yet resumed their sway. The clouds are mostly high but thick and watery,—the drift from easterly. On Saturday afternoon there were heavy showers, and apparently a severe thunderstorm betwixt Panwell and Khandalla. We noticed the extraordinary fall of the Barometer betwixt ten A. M., and two P. M. on Friday. We had no means of observing it after, but the Observatory reports of to-morrow will give us its entire descent. It rose on Saturday almost as rapidly as it had fallen the day before, and continued gradually rising to yesterday afternoon."—*Bombay Times, Oct.* 15.

1856.—Seems to have been without any thing deserving the name of an Elephanta. We find the following notices of slight disturbances on the 6th and 7th October, and as these occurred some weeks after the rain had ceased, we presume it is all we can lay claim to. "Though we still continue to have vivid lightnings every evening over the main land, appearances of storm have almost wholly passed away. Yesterday morning (6th Oct.) we had a thick mantle of clouds over nearly the wholesky; from long before dawn till about eight o'clock on the evening of Wednesday (8th October) we had every appearance of a squall; during the night a heavy thunderstorm passed over Bombay, and it looked like a renewal of the Elephanta, if we are in reality to suppose this gale already passed. Yesterday the sky was bright and open, although it looked somewhat squally in the afternoon; and we should not feel surprised if we had yet showers of rain to usher in the cold season."—Fall.

1857.—This year seems to have been still more worse off than that preceding it, in the characteristic partition which separates our monsoons. After three weeks of fair weather, electric clouds are noted as visible in the east with lightning about the 6th, and this is all we can make out of it.—Fall.

The Madras monsoon is stated, according to the old Observatory reports, to set in about the 19th October; it has sometimes been known to set in as early as the 20th September, sometimes as late as the middle of November. September is for the most part a cloudy, showery month, with occasional t under and squalls. The monsoon in Lower Bengal sets in and closes about a fortnight later than our own; a considerable fall of rain and severe squalls of wind appear to be in general experienced about the third quarter of the October moon. Neither at Madras nor Calcutta is the separation betwixt the rainy and fair seasons anything like so distinct.

Out of the seventeen years here given we have been five times without a regular Elephanta—that is, a squall from the east, with rain and thunder—occurring, with the three exceptions of 1843, when it fell on the end of Sept, and betwixt the 1st Sept. and 10th Oct. Unless during the two years 1843 and 1844 indeed, during the latter of which we had two squalls, which divided betwixt them the honors of the Elephanta, it has always happened betwixt

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the 7th and 10th October, with a degree of punctuality which might well surprise the uninitiated. For the years 1855, 1856, and 1857 we have nothing but the Observatory Report to guide us, and cannot exactly make out when the Elephanta occurred.

It thus appears that for five years on end we have experienced at Bombay no such storms as that usually known as the Elephanta, and of the occurrence of which for the previous eleven years almost uninterruptedly we have minute accounts. Elephantas in all likelihood prevailed as regularly before 1840 into the depths of time as betwixt that date and 1857, but wanted a historian. The violence of the electric storm which ushers in the rains, will be found when we come to analyse the records, to have become as much mitigated in violence as that with which they close. In discussing phenomena so remarkable and changes so invariable, it seems sad to think that we have nothing better to rely on for our facts than the columns of a newspaper; on the authority of a Bombay journal alone, we have drawn for all that has just been stated. It gives a melancholy view of our ignorance of the simplest and most interesting facts in Natural History, to think that we know nothing of the characteristics of the storm beyond the boundaries of Bombay harbour. Where it begins, where it ends; over what area it extends, or what form it assumes elsewhere are things utterly unknown to us. The Governments of England and of the East India Company have within the past fifteen years spent above £100,000 in making and publishing meteorological observations; these reports are all so learned that they are utterly useless. No meteorologist could, from any one of the fifty magnificent quartos, one half of which are now before us—form any idea whatever of the climate meant to be indicated. The printing alone of our ten volumes of Bombay reports has cost a lakh of rupees; yet no one could work out from them when the first burst of the monsoon, or when the Elephanta occurs, or what are the characteristics of each. The poor Mofussil hospital assistant of course just fills in the figures in the ruled scale provided him, and smokes his cheroot with the most supreme indifference to all the tasks before him, save what he is compelled to perform.

Hurricanes.

There have been no fewer than three cyclones in the Bay of Bengal betwixt the 8th of April and 21st of May. The first of these was felt in its greatest force off the shores of Burmah. It struck the steamer *Coromandel*, in the North Preparis Channel, on the 9th. Her barometer sunk seven-tenths of an inch in ten hours. The Portuguese barque *Labaon* foundered at her anchors off Cape Negrais. The Hamburg ship *Singapore* and barque *Juno*, the *Albert Franklyn*, the brig *Dido*, and a Chinese junk all were wrecked or foundered betwixt the Andamans and the mouth of the Rangoon river. On turning to the barometric registers from various parts of India we find the following results. We give from the 5th to the 10th of April *;—

		Madras.	Calcutta.	Bombay.	Kurrachee.
April	5	29·931	29·895	29·849	30·003
,,	6	·939	·912	·852	29·992
,,	7	·895	·821	·797	·986
,,	8	·886	·870	·817	·946
,,	9	·916	·889	·856	·961
,,	10	·904	·786	·872	·884
,,	11	·838		866	·804

* We have corrected the Madras observations for temperature in so far as the information in the table permits, but it would be much more satisfactory if the Madras Journalists would, like their brethren, everywhere else have them corrected at the Observatory at once. We have repeatedly called attention to this before, but hitherto without effect.

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It will thus be seen that though there was a slight tremor in all the barometers betwixt the 7th and 11th, that it was not sufficient to occasion particular notice. The greatest depression at Kurrachee and Madras was on the 11th. We have no returns of this date from Calcutta, but find that it was declining on the 12th, and began to rise again on the 13th. The circumstance furnishes a remarkable contrast with the hurricane of the 20th, which it will be seen affected the barometers and disturbed the atmosphere in all parts of India.

We next come to the hurricane of the 5th of May, which spent its fury off Madras, and occasioned great damage to the shipping. We shall give the barometric tables as before, taking our returns from the 1st to the 6th of May, betwixt which dates the trough of the waves seems to have passed :—

		Madras.	Calcutta.	Bombay.	Kurrachee.
May	1	29·852		29·806	
,,	2	·802	Sunday.	Sunday	
,,	3	·789	29·808	·754	
,,	4	·765	·737	·770	
,,	5	·545	·690	·788	
,,	6	·783	·728	·812	

Turning now to the hurricane of the 20th of May, which appears to have burst over the upper part of the Bay of Bengal, we shall give the returns as before, beginning in this case with the 10th, when the mercury began to sink continuing thus to the 22nd :—

		Madras.	Calcutta.	Bombay.	Kurrachee.
May	10		29·807	29·833	
,,	11		·734	·796	
,,	12		·717	·784	
,,	13		·678	·710	
,,	14	29·693	·670	·684	29·561
,,	15	·702	·672	·645	·563
,,	16	·744	Sunda	Sunday.	·544
,,	17	·760	·618	·670	·528
,,	18	·690	·562	·611	·478
,,	19	·640	·431	·553	·398
,,	20	·676	·297	·565	·413
,,	21	·710	·426	·555	·468
,,	22	·748	·498	·640	·426

We have not been able quite to complete the Madras and Kurrachee returns. A remarkable circumstance here is, that the enormous fall at Calcutta, in the immediate vicinage of the hurricane, is accompanied by a fall equally enormous at Bombay and Kurrachee, above a thousand miles away from its nearest limb, whereas the mercury at Madras, not 300 miles away, was scarcely affected by it. At Bombay the depression was so great, that as the winds were not veering or shifting, we believed the monsoon to be upon us. It is by collecting facts, and attempting to generalize on these, that we come to learn the laws by which the winds and waves are ruled. Considering the strides made by meteorology within the past twenty years, if enquiries be only pushed out by those enthusiastically devoted to the science, remembering that mere instrumental readings are not meteorology at all, we may within the next twenty be able to predict the approach of a storm, to estimate its distance, its violence, and the rate and direction of its approach, with as much accuracy as we can anticipate the arrival and the phenomena of an eclipse. It is in labours such as these we miss the combined industry and enthusiasm of a Piddington, and write bitter things in our hearts against governors who can neglect the merits of citizens who devote their lives to the public service, in a division of labour of such vast practical utility to a great seafaring people. Within the past twelve-

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month we have had at least five cyclones in the Bay of Bengal or the Delta of the Ganges,—on the 10th of May and on the 20th of November 1857, on the 9th April, 5th and 20th of May 1858,—and all the facts we can collect regarding them are found scattered about in a few casual newspaper paragraphs. Had Piddington been alive and well, each of them would have formed the subject of an elaborate memoir.

A STORM.— Bay of Bengal 25th Oct. Calcutta was visited by a heavy gale, attended with much rain, during the night of Monday last, the 25th.

We fear that disastrous news will be received of its effects, on the shipping in the river and at the Sand Heads.

Its doings in Calcutta were principally confined to mischievous tricks upon the bamboo and beer-box architectrue of the erections intended for the approaching pyrotechnic display and illuminations.

The gigantic bird trap and artificial rocheries on the maidan have nearly melted from the eyes of beholders. A peculiarly knowing cock on one side has been given to the Crown on the top of the Government House Dome ; and the insignia of royalty which had lately appeared on the front of the Treasury and of the Supreme Court have vanished.

One death occurred in Calcutta from the falling of a house, many dinghies were damaged, and nine or ten country boats loaded with rice, jute, gunny, cloth, &c. were seen upset, and all the rice and other things were floating on the river. Casualities, it is feared, of a still more serious kind, remain to be reported. Nor have we yet ascertained what injury the storm has done to our scanty crop of rice. If the rain has been general, no doubt it would be better for the crops, but the gale must have done great injury. We have heard besides, that two or three ships are ashore not much below town.

We must assign this same hurricane as the indirect cause also of another and still more serious disaster,—we mean the fatal collision last night upon the railway. The up passenger train which ought to have arrived at Howrah at 5 P. M., was unable to travel at a greater speed than that of *ten miles an hour* in the face of the tempest, which although in town it had not reached its highest fury till nearly twelve hours later, was, in the upper part of the province, blowing with terrific violence even at that time. The consequence was that the passenger train was belated. In addition to this element of risk, the guards had neglected to light the warning lamp in front of the rain. Meanwhile a goods train was proceeding down : and as the hour was not that at which the passenger train was expected to be where in fact it was, the goods train much heavier of course and travelling twenty-five miles an hour, seeing no light to admonish it, ran full into the carriages of the passengers. Two unfortunate persons were killed on the spot; a greater number more or less seriously injured ; and much damage and "*degat*" occasioned. Four trees were blown down in the compound of the Roman Catholic College in Park Sreet.

The variations of pressure during the hurricane, as announced by Sims and Troughton's Barometer were :—

26	to	28
Noon		29.70
8 P. M.		29·61
Midnight		29.35
3·30 A. M.		29.38
7. A. M.		29.66

—*Bengal Hurkaru, Oct.* 27.

THE gale has not gone off without leaving its usual damages and wrecks behind ; the mischief done, has been, however, very small. The principal of these is the loss of some few country boats laden with produce, and the usual complement of dinghees ; but considering the proverbial carelessness of native boatmen and dingheewallas, the loss among them is little enough. Some few

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houses in the native parts of the city have come down by the run, as they usually do in every little storm, and one or two poor niggers are less in the world in consequence.

THE GUNPOWDER PLOT STORMS, so called from their generally making their appearence about the 5th November, seem to prevail over an expanse of 60° or 70° of longitude, and at least 25° of latitude north of the Line. Closely contiguous in point of date to these are some of the most notable of our hurricanes—as, for example, those of the 3rd November 1783, 3rd November 1799, and 2nd and 3rd November 1854, three out of five of the hurricanes actually visiting Bombay occurring on the same day of the same month during latter of these in six hours time a thousand human beings and about half a million's worth of property perished within an area of less than forty square miles. Judging, from the damage done, the hurricane of 1799 seems to have been still more violent than that which happened on the same day fifty-five years afterwards. Bombay at the latter date contained at least seven times the population that it did at the former, yet 500 lives are said in the case to have been lost. About 400 boats and about 200 lesser craft went on shore or foundered. Of the gale of 1783 few particulars have been preserved; it seems to have swept along shore, H. M.'s ship *Superb* having been lost off Tellicherry. It is mentioned as having been fully as severe as that which followed seventeen years afterwards. The Bay of Bengal is visited by about two hurricanes aunually on an average; the Arabian Sea north of Ceylon, seldom suffers from them oftener than once in ten years—not taking into account the tails of nearly expended storms which reach us across the Peninsula, we have the following list for the past seventy-five years all properly authenticated; none of them, however, to be confounded with the Gunpowder Plot squalls, very trifling affairs in comparison :—

1783. November 3--7.—Violent hurricane from Tellicherry north to Bombap; great loss of shipping and lives—proving fatal to almost every ship within its reach.

1799. November 3-7.—Frightful hurricane from Calicut north. H. M. Ship 'Resolution,' with about 1000 small craft and 400 lives lost in Bombay harbour

1807. June 24.—Furious hurricane off Mangalore. *As. An. Register*, p. 171.

1819. September 25.—At Kutch and Kattiawar, lasted a day and two nights —*As. Jl.* 1820 vol. ix., p. 307 (?)*

1827. December 20.--Bombay. (?)

1837. June 15.—A tremendous hurricane swept over Bombay: an immense destruction of property and loss of shipping in the harbour, estimated at nine and a half lakhs, (£90,000); upwards of 400 native houses destroyed.

1847. April 19.—Terrific hurricane from the Line north to Scinde, in which the H. C S. 'Cleopatra' was lost, with 150 souls on board. The Maldive Islands submerged, and severe want and general famine ensued.

1854. November 2-3.—Hurricane at Bombay; a thousand human beings and half a million worth of property supposed to have perished in four hour's time.

THE rains are obviously now very close at hands. They are later of reaching us this year than they have been any time the past twenty—excepting, perhaps, last season, when the first fall of any note occurred on the 24th; and it remains to be seen whether even this is an exception. The sky though daily becoming more and more troubled, does not look as if we were going to have any very tremendous plump just at the outset. The barometer as before descends, but with such steadiness and deliberation, that the only thing to be augured from it is, that it is reaching its minimum. We subjoin the ten o'clock readings for the second week in June, from 1850 to 1858.

The decimals only are given; the integer is in all cases 29 The letter M. denotes the first burst of the monsoon.

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		1850	1851	1852	1853	1854
June	10th	604	491M.			
,,	11th	578M.	505	703	766	747
,,	12th	639	607	689	616	Sun.
,,	13th	664	630		Sun.	793
,,	14th	672	625	713	702	640
,,	15th	Sun.	Sun.	702	736	798
,,	16th	712	708	648	765	746
,,	17th	702	745	584	756M.	738
,,	18th	685	710	540	760	675
,,	19th	671	762	510M.	604	637
,,	20th	678	786	572	670	689
				Sun.		

		1855	1856	1857	1858
June	10th	Sun.	599	717	Sun.
,,	11th	740	662	718	793
,,	12th	988	719	744	784
,,	13th	762	638	627	791
,,	14th	703	644	Sun.	
,,	15th	721	Sun.	681	752
,,	16th	782	695	692	750
,,	17th	Sun.	654	639	726
,,	18th	675	630	597	708
,,	19th	666M.	722	646	676
,,	20th	698	763	618	706

The following are not Observatory.

We have taken the day on which more than an inch of rain first fell the first burst; this occurred in 1854 on the 6th and 7th; in 1856 on the 4th; in 1857 not till the 24th of June. We had heavy showers all yesterday morning and forenoon, with an east wind and thunder. The Barometer on the morning slightly rising.

We subjoin a table shewing the altitude for the forty days betwixt these periods for the past seven years. It will be seen from this that the mercury for the past week has stood lower than it has done at any time since 1852 when at its minimum, nd when the rains were fairly set in. To make the table compact, we have omitted the integer of 29 inches as this is always 29. and have given the decimal only. The figures with the exception of the two last, are taken from the Observatory tables. Our own barometers read so near to those of the Observatory, that their error will probable not be found on the tables making their appearance on Tuesday above a hundredth part of an inch, a quantity singularly small with instruments totally different in their construction placed ten miles apart from each other and read by different observers. The native seamen, the truest of all discerners of the face of Sky, have run their vessels up the harbour; and the whole fleet of coasting craft, usually to be seen betwixt the Boree Bunder and Mazagon, are at present at anchor a little way below Sewree. From the extreme depression of the mercury, and general aspect of the sky, we feel almost inclined to think that there has been a second cyclone since that at Madras on the 5th, raging at no great distance from us. Commanders of Ships had better be on the alert. We can scarcely expect a hurricane here again so close on the heels of that of November 1854, but May is one f our hurricane months next to October, the most prolific of the year, and we have seldom seen symptoms so suspicious.

		Years.						
May		1852	1853	1854	1855	1856	1857	1858
,,	10th	788	789	864	836	807	Sun.	833
,,	11th	797	814	857	817		832	796
,,	12th	814	819	859	841	789	859	748
,,	13th	815	866	853		811	877	710
,,	14th	732	860		921	816	880	684
,,	15th	747	Sun.	856	887	811	863	645

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,,	16th	Sun.	885	860	883	803	846	Sun.
,,	17th	838	8?9	863	863	796	Sun.	
,,	18th	864	893	914	806		810	573
,,	19th	811	892	819	778	821	839	525
,,	20th	803	890	839		760	997	
,,	21st	781	875		852	758	793	
,,	22d	807	Sun.	754	898	761	799	
,,	23rd	Sun.	869	668	832	764	785	
,,	24th	822	834			739	Sun.	
,,	25th	556	870	711	823		735	
,,	26th	812	812	700	837	703	732	
,,	27th	818	804	682	819	774	659	
,,	28th	812	789	692	851	807	681	
,,	29th	797	782			659	719	
,,	30th	768	Sun.	741	917	663	739	
,,	31st	Sun.	774	723	880	670	747	
June	1st	817	777	732	806	535	725	
,,	2nd	788	767	714	818		705	
,,	3rd	734	714	750		644	730	
,,	4th	785	673		862	735	737	
,,	5th	803	Sun.	724	797	792	734	
,,	6th	Sun.	632	735	759	834	742	
,,	7th	767	695	703	227	746	Sun.	
,,	8th	741	734	708	675		733	
,,	9th	730	737	711	665	632	730	
,,	10th	703	766	717		599	717	
,,	11th	689	616		740	664	748	
,,	12th	711	Sun.	743	738	719	744	
,,	13th		702	690	734	668	629	
,,	14th	691	736	698	706	644		
,,	15th	631	765	746	721		681	
,,	16th	584	756	738	782	695	692	
,,	17th	543	730	695	Sun.	654	637	
,,	18th	503	674		675	660	597	
,,	19th	507		667	663	722	646	
,,	20th	Sun.	670	689	693	733	648	

An abstract of the Meteorological Observations at the Observatory is published in all the papers every Tuesday and the reader may probably find it interesting to compare these, as they appear, with the figures entered in the preceding table.

On Thursday evening there was a splendid halo around the moon, from half-past 6 to 8 o'clock. The circle was quite complete, it enclosed in it the planet Jupiter besides the moon, and occupied a space of about 30 degrees. This is usually a sign of rain at no great distance, and yesterday we had a haze over the sky for the greater part of the day. We have little doubt we shall hear in the course of the week of wet weather within a hundred miles of us—*Feb.* 1858.

On Saturday night there was one of the most magnificent halos round the moon we ever remember to have witnessed. There had been a thin haze with a few cumulus clouds all over the sky throughout the day. In the evening the cumuli vanished, and at sunset we had those sheets of fiery-red vapour both in the east and west, which at times make our sunset skies so magnificent. The full moon looked a pale sickly green, as her struggling rays endeavoured to penetrate the lurid veil. So soon as she approached the zenith, the halo about to be described, made its appearance, and was peculiarly magnificent from 10 P. M. till 2 A. M. Its ring was about 20 degrees in diameter, quite perfect all around. Its breadth across about 3°; it was of a bright wheyey hue without irridescence, but changing to a deep purple inside. The planet Jupiter was the only star discernible in the neighbourhood; at midnight he was just without the western outer limit of the ring, so that a reference to the *Nautical Almanack* will give the exact positions of the moon and planet and the dimensions of the halo. A reference to the nearest star at any time, when such things appear, will be

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found to furnish a very simple and precise mode of determining the leading fact regarding them The ring was a very insignificant part of the wonder. From its south-western verge shot a long perfectly straight band of light about 20 across, and at least 500 in length, well down to the horizon; this could barely be traced within the circle and up to the moon. where it vanished. From each side of the circle shot two similiar beams southward, joining the central beam near its extremity, while two others proceeded in the opposite direction, meeting about 20° north-westward of the halo, the whole forming a figure exactly like the framework of a boy's kite. All this was probably due to a sheet of vapour over Bombay and may not have been at any very considerable distance; and we should feel greatly obliged to any one who could tell us how far away it was actually seen and what appearance it presented from other positions.—*Bombay Standard, October* 1858.

"Extraordinary appearance at Sea.—The crew of the *Luck Ashton*, on her last outward voyage, witnessed a singular phenomenon when approaching Alexandria on the 3rd February last. At noon-day the sun became almost invisible and a dense fog obscured the sky; the ship with her spars and rigging, was covered with a fine powder, which entered the ears and mouths of every individual on board, causing the greatest inconvenience. The utmost alarm was felt on board, and some dire calamity was apprehended. The hatches were battened down and Captain Kinlap, the commander of the vessel, put her about and ran out to sea again. During the time of this almost complete darkness the wind was blowing from the south, and the sea was frightfully high. Although the *Lucy Ashton* proceeded some forty or fifty miles out to sea again, still this dense fog pravailed far to seaward; and towards the coast, darkness literally overspread the land of Egypt. This phenomenon lasted for about six hours, when the fog cleared away, the wind lulled, and the sea went down. This extraordinary appearance was supposed to be owing to a sand storm, but its extending so far to sea is considered a most unusual circumstance. From the direction of the wind storm must have originated in the Sahara desert. The people on board the *Lucy Ashton* found afterwards that the storm had blown down trees, forced cattle in to the canal between Alexandria and Cairo, and otherwise caused considerable damage and loss."

Some very beautiful experiments have just been performed by Dr. Giraud on the quantity of salt contained in rain falling at different seasons, and with the wind in different directions. No water is ever quite pure; rain generally contains some nitrates and always a sensible quantity of muriates. When our first monsoon rain falls, it descends in such gushes with the wind from off the sea generally so violent, that it may readily be supposed to contain a considerable quantity of spray in a state of mechanical mixture. As the season advances and becomes more serene the salt diminishes. The rain experimented on was collected in a zinc funnel a foot in diameter, 40 feet above the ground and 110 above the sea, communicating by a tin gas pipe with a clean zinc cistern. The first specimen was from that which fell betwixt the 10th and 24th Sept., with the wind strong and from the S. W. Twenty thousand grains of water yielded 0·240 grains of chloride of sodium—sea salt. The next specimen was of rain water collected under the same circumstances during the squall of the 10th October, with the wind from north-east and east; the same quantity yielded 0·126 of salt, or half that of the preceding specimen. The interest attaching to the second experiment lay in this,—that we had had no rain for a week before; the sky had for some days been pure and serene, the aqueous vapour not suspended but dissolved. One would have imagined this the most delicate alembic that could have been resorted to, to obtain absolutely perfect distillation. It will be curious to have the experiment renewed as the season advances. We generally have copious showers in the first week of November, a month after the N W. Monsoon is fully established and precipitation is the result most likely of some form of electric action and not certainly, as in the S. W. Monsoon, of air close on the point of saturation, impinging on a cold mountain mass, and having its capacity for moisture diminished as it ascends towards the summit of the Ghauts. These form very striking facts in physical geography, and are worthy of special notice.

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Luminous meteors have been singularly numerous for the past three weeks, but few of them have been seen to explode—the majority being those small bright specks which shoot across the sky in all directions, appearing and disappearing with equal suddenness and scarcely altering in size or aspect during the time they were visible. We were furnished with a very noticeable exception on Friday evening. At 7-15 a meteor shot across the sky from N.-E. to S. W.—so low that it might almost have been mistaken for a rocket, but for the want of noise or hissing tail of sparks, the noiselessness of the explosion and the bright path it left behind it, which remained visible for about ten seconds, and above all the length of space over which it traversed. Seen from Chinchpoogly Hill it seemed to come from Sewree Fort and explode over the Club. We have no doubt that to the inhabitants of Malabar Hill it would appear to come from Byculla, and to burst out at sea. It as usual increased in brilliancy as it approached the point of explosion, then burst into some dozen or so large white fragments like the stars of a heavy rocket—only that each star presented that librating appearance as it fell, peculiar to fragments of meteorites. We shall be glad to obtain any information on the matter with which correspondents may favour us. Those curious in such things may have been on the outlook. The middle of November is one of our great meteoric epochs, and the extreme purity of our sky at present renders it singularly favourable for observation.

We are now in the midst of our November meteors, and the harvest of these the heavens are providing us is more abundant than it has been for many years past. The display of Friday evening was peculiarly conspicuous. They shot across the sky in all directions, and were for most part remarkable for their proximity to the earth, and the long fiery trains they nearly all left behind them. In not a few cases, indeed, the actual meteor was scarcely visible, a long streak of lurid fire, indicating where it had been, crossed three or four degrees of the firmament, and after being for a few seconds visible, gradually vanished. Just at midnight we observed one which, seen from Byculla, appeared to fall into the sea near Carinjah. It seemed to drop right down from a point about 30° above the eastern horizon, and having traversed a space of about 10° burst into fragments, which disappeared almost immediately afterwards. The dates most remarkable for meteoric displays are betwixt the 9th and 14th of August and of November, the 29th November being the particular day on which they are most constant, regular, and conspicuous in their appearance. They are believed to be fragments of Asteroids revolving in regular orbits.

The following extract from the letter of a Kolapore correspondent refers to the Meteor noticed by us as seen on the evening of the 3rd, as mentioned in our issue of the 9th. It furnishes an excellent illustration of the delusiveness of appearances in such things. Judging of the light above, the path of the Asteroid fragment did not seem to extend much beyond the limits of the island; yet here we find it manifesting itself at Kolapore, 300 miles from the point where it seemed to have split and fallen into the sea. Seven o'clock is an hour at which multitudes of people are generally abroad; surely it must have been visible at many points betwixt Bombay and Kolapore. Professors Powell and Scoresby have both been complaining that correspondents have been forgetting them. We fear we must plead guilty, and make confession not only for ourselves but our usual informants. We trust that penitence may be followed by amendment.

Kolapore, 11*th Nov.* 1858—"I write to let you know, that the rocket-like Meteor you mention on Friday the 9th, as visible in Bombay was noticed here by many persons on that evening, and occasioned much dispute as to its nature. It was the grandest thing of the sort I ever witnessed, and this is a place where such things are very frequent. On that same evening, and every evening since, other meteors were seen and generally in the west and moving downwards. I should have described the course of the meteor on the 3rd about 7 o'clock to have been from west to south-east. We all thought it was a rocket at first, until the enormous distance travelled rendered such idea untenable."

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APPENDIX B.

ZOOLOGY.

VENOMOUS SNAKES.

THE following Memo. on the Report on mortality from Snake Bites in the Province of Sind, by the Reverend W. Lea, of St. Peter's, Droitwich, has been kindly placed at the disposal of the Press, by the Commissioner in Sind :—

Classification of Venomous Snakes.

It would be a great help to the study of the subject, to arrive at some definite system of Classification. I may as well add that Ophiologists have divided venomous snakes into seven families. Some of these (e. g. the Cobras) in appearance and movement, resemble harmless snakes ; others like the Vipers (of which the Kuppur would be one) have decidedly villanous physiognomy, and are slow and heavy in their movements.

The seven families are as follow ;—

1. *The Hydrophis.*—The Sea serpents which are common in the Indian and Chinese Seas, and which sometimes come up the mouths of the rivers. There are an immense number of varieties of this family. All are venomous, though the poison fangs are all small.

2. *The Elaps*—This family, of which three or four, if not more, varieties, are found in India, has a round body, *nearly of the same size throughout*, colors generally bright, and often running in hands round the body as in the "Coral Snake" of America, which is the best known of the family. The head is covered with plates, (not scales), and the scales of the body are large, lozenge-shaped, and smooth. The fangs are small, and in some cases there are common teeth behind them on the same bone.

3. *Bungarus.*—This family is not unlike the Elaps in appearance, but much larger, and of a more vigorous and active form. Two varieties of this family are described by Russell in his "Indian Snakes"—(1) the Boa lineata or Geedr Paragoodoo—(2) Boa Fasciater or Bungarum Pamah—colored in bands round the body. This family is distinguished by a row of hexagonal scales, larger than the rest, rounding down the back, and also by the under part of the fail having undivided *scuta* like the Boas ; some of the Elaps have the same peculiarity.

4. *The Naga or Cobra*—The Cobra-Capello and Black Cobra are the best known varieties of this family—with the Egyptian Cobra Hage, in which the hood is less developed, but I believe that there are several varieties in India. Russell enumerates ten. The four families enumerated have more or less a resemblance to harmless snakes. There is nothing forbidding in their physiognomy : but in the three remaining families, the Vipers, Trigonocephali, and Crotali, the appearance alone is sufficient to convince a person that they are venomous The Crotali (Rattlesnakes) I believe are unknown in India. The distinguishing features common to these three families are these :—The form is generally thick and heavy. The tail is very short. The head large, heart-shaped, and wide at the base, and covered with *scales* and not plates as in the former families. The scales carinated : the fangs large, often two or three on each side, (though this is common with the Cobra) and no other teeth on the same bone.

5. *Vipera.*—The English Adder, the Puff Adder of the Cape, the Cerastes, the Vipera elegans of the Coromandel Coast (al. Russelii Columber), from the experiments Dr. Russell made on its poison—al Katuka Rekula Poda—are all varieties of this family.

The Kuppur, from Dr. Imlach's description, also belongs to it, unless it possesses the peculiar characteristics of the Trigonocephali, viz. the horny tip to the tail and the nasal fossæ. The varieties of this family are in number. in some the tip of the snow is prolonged into a sort of horn, which does not improve the appearance.

6. *Trigonacephali.*—In this family the tail is terminated by a horny tip, (which in the Crotali is prolonged into the Rattle.) Some varieties of this

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family are found in India and Ceylon; one or two have plates not scales on the head. They have nasal fossæ.

7. *Crotali* (Rattlesnakes) confined to America. It would assist our knowledge of the subject of the snakes of Sind were classes under the foregoing families, and the native name of each variety given. It would also be desirable to have some account of the different effects of the venom of each family of variety; some seem to produce strong convulsions others coma. Different remedies would probably be required for each, though in all cases cauterization would probably be of service, if taken in time. Any particulars of the habits of different families or varieties would be acceptable: whether they attack men without provocation—if so, under what circumstances; whether more than one variety is common in the same district: the different localities in which they are found, whether (1) viviparous, (2) ovoviviparous or (3) oviparous.

Preserving Specimens.—The usual mode of bottling the snake in spirits of wine is very unsatisfactory; probably the specimens might be skinned, by being opened at the belly, the skin well rubbed with arsenical soap, and then filled with sand, and sent home in that condition. Care should be taken about the preservation of the head and poison fangs. It would also be desirable that drawings of each varieties, colored from life, should be taken, as the colors are apt to fade.

Means suggested for their destruction.—The most effectual is that about to be adopted—a reward for the head of every venomous snake. It would be as well perhaps to offer an additional reward for every head killed in early spring, before they begin to breed, and at the same time there would be less danger from the bite, as the snake is less vigorous and his venom less active. In addition to this, the birds and animals which feed on snakes might be protected: e. g., the Stork-buzzard or the "Secretary" might be imported from the Cape of Good Hope. The Ichneumon, the Hedgehog, and especially Pigs of all kinds, wild as well as tame, are great destroyers of snakes. In some countries, varieties of harmless snakes kill and *eat* poisonous snakes. (In America, the black snake is the greatest enemy of the Rattle snake). If such varieties are found in Sind, they should be protected. It would be curious to enquire how far the traditions which are common about snakes in different parts of the world are known in India e. g., that some particular individuals have a fascinating power over snakes, one condition being that neither the individual nor his father has taken the life of either man or snake—this is an Asiatic myth;—any particulars of the serpent worhip which is susposed to exist among some tribes of the aborigines! *The Snake Charmers* —whether a particular caste (as in parts of Africa); whether they ever handle them when in possession of the fangs; the fondness of the snake for milk, whether anything is known in India of a story common in parts of Spain and in South America—that snakes will suck the breasts of women when asleep, and will follow a woman who is giving suck to a child! whether venomous snakes will receive their young, when small into their mouth on the approach of danger—if so, what varieties; whether any besides the Vipers!

At daybreak on the morning of the 6th March 1858, a magnificent Tiger was observed from the P. &O. Co.'s Steamer *Aden*, swimming from the opposite shore towards Mazagon Bunder. A boat was immediately lowered, and chase given. In about fifteen minutes the rowers were within reach, when they found the noble savage in the act of attempting to board a Native buggalow at anchor, where the people were yelling with all their might and doing their utmost to keep the enemy at bay. A volley from four muskets made him wheel round, and with a tremendous roar he made for his new assailants. A second discharge proved fatal, when he was taken in tow and hoisted on board. It proved to be a fine male tiger beautifully marked, in the highest condition, his fur scarcely at all injured. He weighed 353 lbs. from the snout to the tail, he was 8 feet 9 inches, the tail itself being 3 feet. He did not appear at all fatigued when first seen, and must have swam at least four miles, unless he had taken a rest for the night on Butcher's Island, still two miles from the anchorage; he had the benefit of a strong descending tide. Had he reached the shore, or boarded the buggalow, he was pretty sure to have made a meal of the first man he met with. About thirty years ago a tiger swam across the harbour

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and landed at Mazagon. The little schooner for the Indian Navy, building in the neighbourhood, was on the point of being launched, and Sir John Malcolm caused her to be named the *Royal Tiger* in commemoration of the event.

APPENDIX C.

BOTANY.

THE lovers of jungle flowers have an excellent opportunity of studying the growth and economy of our tree cottons—three of which are in full blossom. The most conspicuous of these is the *Bombax Malabaricum* with its great thorny stem and leafless branches and magnificent dark red flowers. The majority of these trees are just bursting into bloom, on a few of them the pods are forming. As yet the beautiful silky fibre they yield has only been employed in stuffing cushions; it is a perfectly smooth polished round tube, and has no hooks like wool, asperities like flax, or ribbon border like common cotton (*Gossypium*). so as to make the fibres cohere when twisted into a thread. We have no doubt but that by some system of inspissating or other chemical treatment, it may be made of value. Next comes the Shameula, or *Eriodendron Anfractuosum*, the *Bombax Pentandrum*. It is described by Graham (p. 17) as an elegant erectgrowing tree, throwing out regular horizontal branches; the flowers drooping, of a white dingy colour. The majority of the trees are fast going out of flower, and getting into pods, the cotton in which the seeds are enclosed being still milky. Under a glass the fibres of the wool seem ribbon shaped and spiral something like the spirals in the stem of the Lotus. It has not yet been converted to any economic use worth noticing. By far the most beautiful of the silk producing trees now in flower belongs to the camphor tree tribe, the *Cochlo-spermum, gossypium* or *Bombax gossypium*, of Roxburgh. It is at present covered with gorgeous bunches of beautiful yellow flowers, about the size of a rupee each flower, with the seed pods bright emerald green about the size of a peach, rapidly expanding themselves. We have another *Bombax* at present worthy of notice, which flowers during the rains—the *Adansonia digitata*, the monkey bread-fruit, or Boabab. There is one of these 24 feet in girth behind the new cotton cleaning premises, a little below the Gun Carriage Manufactory, Colaba, at present being eaten down by the grub of the gigant *Capricorn* beetle, the *Lamea sentis* of Linnæus, which makes such havoc in our Indian Forests. A gigantic Boabab forty-five feet in girth, which grew near the Sanatarium, Colaba, was in 1843 eaten down in a single season by this voracious monster grub.—*Standard, Feb.* 15.

Ten years ago, when the whole of the wood, stored in the great enclosure at Mazagon, occupying the space betwixt the Hope Hall Hotel, the Railway station, the Byculla main road and the shore, was burnt, an attempt was made to convert the vast mass of pure white ashes which remained, into potash. The taste was alkaline, and the conviction was reasonable that wood here, as elsewhere, if completely burnt under exposure to the air would yield potash. It turned out, that in place of this, the whole product of combustion was caustic lime, and this seemed equally to hold good with all trees, whatever their kind. The Aine yields so large a quantity of lime that where the wood is plentiful and limestome at Kunkur scarce it is burnt for comment. The enquiry was pursued in reference especially to trees burned in the jungle, when the results seemed the same. In regard to many of these last, a curious fact transpired; a tree once set on fire, burned leisurely and quietly almost without flame, not only to the extremities of the branches, but underground to the extreme ramifications of the roots, and this occurred in the case of perfectly sound and healthy trees, full of sap, as well as in the case of those that were dead and dry. The conclusion drawn from these results, is that in these cases nitre or some other substance tending to promote combustion, must exist in the sap of the tree. Resolved that these things should be removed from the field of conjuncture to that of fact, Dr. Giraud has just commenced a series of experiments, the result of which we hope speedily to see before the world. It seldom happens

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that the core of trees is exactly in the centre; they seem, in Europe, to thicken most rapidly in the direction in which they are most exposed to light and heat. Scotch firs thus exposed, measure twice as much in this direction as in the opposite. From a very limited number of experiments made on seven-year old saplings here, it appears that, in this time, a healthy Casuarina will attain an altitude of 64 feet, and a circumference, a foot above the ground, of 30 inches. At the base, the section has the form of that of a pear cut lengthways, the larger diameter being 10 inches, the shorter 7. Measured across the core, we find the one radius 9½ inches, the other 3, or nearly double that of the Scottish fir. In another tree of the same age 45 feet in length, two feet in girth, the greater diameter was 8 inches, the lesser 6—the larger radius being 5 inches, the lesser 3. Taking the tree in lengths of ten feet from the root, the seven rings seem to continue to the last, the innermost having extended themselves upwards to the very top as the tree grew. But the eccentricity of the core has now greatly diminished, and the stem becomes nearly round—the predominance of the mass continuing on the same side as at the root. These peculiarities are most conspicuous in the *Casuarina*; but they manifest themselves, more or less in all our trees. An Indian Rubber tree planted in 1851, attained a diameter of 7 inches, the core being 4½ inches from the one side and 2, 2, from the other; the two grew side by side. Very nearly the same law holds good with a Teak and an Accacia. In Europe the thickening is always on the south side of the tree: here, so far as it appears, it is in general mostly due west. In all likelihood the excess of solar heat furnishes the explanation in both cases. North of the Tropics, the sun always shines more or less from the south, and gives out more heat from this, than from any other direction. From the Tropics to the Line, the sun is so nearly vertical, that the mass of heat contributed to a tree or any other body perpendicular to the earth, is from east or west. But from dawn till noon the temperature of the sun is comparatively moderate—it is from mid-day till sunset, that the vast mass of heat is thrown off, the rays shooting from westward. In this direction a tree thickens on the same principle that it expands in Europe to the southward. As these researches are pursued, we trust that they will help to assist us to that marvel of Vegetable life—the silicification or petrifaction of the living trees. We are all familiar with the spongy stony substance called Tabasheer, deposited at the joints of the bamboo. The fact is generally known, that the Teak tree often becomes in part petrified that is the deposition of silica becomes so abundant, as to turn a portion of the trunk into stone, usually resembling the petrified wood of Egypt, Scinde, Goozerat, and Trevicary, &c. In Upper India this is not at all confined to the Bamboo or the Teak—both remarkable for their silicious secretions,—forming in the former a beautiful enamel all over the stem furnishing the sharp points of the leaves, and making the upper surface of the leaves, of the latter eminently serviceable as sandpaper. The Ghunbhar wood found in the Nepaul and Chittagong forests contains such quantities of silica that the carpenter who contracts to saw it by the foot, makes it a condition in his bargain—that it shall contain no stone. The Ebony and Sissoo, and the Sit-Sahl or jungle rose-wood, contain these secretions, though in much smaller quantities. The most mysterious circumstance connected with the specimens from our petrified forests is, that for every atom of carbon or other organic matter that has been removed, an atom of silica has come in its room, the structure remaining so perfect, that under the glass it could not be discovered whether it was a petrified or living specimen we were examining. The experiments of Sir Humphrey Davy shewed that, in Europe, the durability of woods—that is their capacity of remaining uninjured through long lapses of time,—was proportioned to the weight of charcoal yielded by them, and that there were many woods heavy of themselves, that left but a small proportional residuum in the retort after destructive distillation. We doubt if anywhere in Europe a piece of timber can be produced known to have existed 800 years; it would be curious to test the fragments of teak which have formed the supports of the ceiling of the caves of Salsette, which must have been in their places for above two thousand years, and are, therefore, the oldest pieces of timber known to man the mummy cases perhaps excepted.

We fear we may have ventured too far in an attempt to describe an experiment just begun, where the number of facts brought to light is too small for genera-

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lization; where we confess ourselves to be too slightly acquainted with the subject to feel certain that we may not have given familiar facts as novelties, or even misemployed a familiar and common-place nomenclature. Our object has been, to induce others to come forward and assist in promoting an enquiry which approves itself even to the least informed, as in last degree interesting. It seems to us, little conversant as we profess to be in such things, considering the vast extent, and the extreme fertility of the field, that the aspirants after University honours, could in no way better wipe away the reproach generally attaching to them,—that they could do nothing but learn by rote, imitate or parrot,—than take up for themselves, and carry through unassisted, some branch of enquiry such as that now under consideration, where the facts are within the reach of every one; where sharp and shrewd-witted observation and self-relying originality may easily supply all that is required. They may rely on it, that there are fifty reputations to be made within the island of Bombay by the possession of a little leisure, and a moderate measure of intelligence, observation and reflection.—*Standard, March.*

The following, in reference to the cultivation of Tea in India, may be of interest:—Dr. Jamieson had up to the middle of March despatched 5,300 lbs. to the India House. He had sold about 12,400 lbs. to the public at large, and made over 27,200 lbs. to the Commissariat. So soon as Rohilcund was re-occupied he would have from 17 to 18,000 lbs. ready for the Commissariat, or a grand total of 62, 900 lbs. About five lakhs of seedling plants and 36,000 lbs. weight of seed had been sold in the course of a year to private parties.

APPENDIX D.

HYDRAGRAPHY.

Curious Discovery in the South Atlantic.—The following is the copy of a letter written by Captain Cubins, of the Caribou, belonging to this port, to the Secretary of the Admiralty, relating to a cluster of islands not laid down in the charts, and which lie in the direct track to Australia. The attention of the owners and masters of ships ought to be called to the subject, as many vessels of which no tidings have been heard may have been wrecked on them:—"Ship Caribou, Hobson's Bay, March 13, 1858. I sailed from Liverpool on the 8th December, 1857, bound to Port Phillip, in Australia. On February 22d, wind westerly, brisk gale with snow squalls, at 10 33 a. m. in a clear between the squalls. I fancied I saw land to the southward: took in studding sails, shortened sail, and stood towards it. At 1.30 p.m. hove to abreast the island, in the centre bearing S.S. W., about 12 miles lowered a lifeboat, and sent her to the land. I afterwards stood in to about nine mlies off shore, and got no ground with 120 fathoms of line. The island appeared to be in a S.E. and N.W. direction, about 25 miles, its southern extreme trending to the S.W. forming a deep bright on its western side, which was entirely snowclad and gave it the appearance of a great barrier of ice. The greater part of the whole island was covered with snow; there was a remarkable group of high rocks lying off to the N.E. from the S.E. part of the island, apparently six or seven miles, and on the N.W. extreme an iceberg aground. The island was cloud-capped, but I think that its greatest elevation could not be less than 450 feet above the level of the sea. While hove to awaiting our boat's return, I was astonished to see vessels at anchor in a bay, we having opened it through drifting to the S.E. One of them got under way and stood towards it; it proved to be the American schooner Oxford, of Fairhaven. They put out a boat, and the master came on board; he told me they called it Kurds Island and that it was discovered by them 18 months before. He seemed annoyed that my boat had landed, and advised me to go and leave her behind, saying she would never return; but I told him I would never leave her while I had another boat to seek for her. I was very anxious, for it was then sundown, and darkness coming on fast; but while speaking the lookout at the masthead reported the boat in sight. He then became more communicative, and told me they were after

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oil ; that the shores of the island swarmed with sea elephants ; and that they had sent to America from the island since the discovery 25,000 barrels of oil. The island was bold on the N. E. side, and no hidden dangers ; and the bay where they lay was a fine bay or natural harbour with good anchorage ; no sunken dangers, with 12 to 20 fathoms all over, and sheltered from all winds except a north-easterly, with a fine river of fresh water at the head of it. He also told me that there was another island west of Kurds, distance some 30 miles, and another E. S.E. 70 miles, both of which he had seen, but never landed on. My own officers that were in the boat confirmed his statement of the sea elephants, and the island being well watered ; there were penguins and other birds in myriads, and on an island about a mile apart from the main appeared to be a great mound of guano. While lying to I went to look at my abstract, and it made me shudder to think that only 12 months before I ran past the island at midnight in a heavy gale of wind, not more than four or five miles distant, ignorant of its existence. My greatest wish on sending my boat to the island was to find out if there were any shipwrecked persons on it whom I might relieve. I send, enclosed with this, a sketch of the island, in the execution of which I was very much assisted by one of the passengers. It was entirely of volcanic origin, my six officers having found the surface ashes and stones, like the specimen enclosed. I made the northern extreme of the island in lat. 53. 4 S., long. 73. 7 E.—good chronometers."—*Liverpool Daily Post.*

Floods on the Indus.—It has been remarked of the house swallow, that she never constructs her nest on a sashwindow that pulls down. The beaver and the otter holes, and the nest of the water ousel, are always higher than the highest flood, and there are few animals whose instincts do not intimate to them the vicinnage of possible danger to their habitations, which it were well to shun. Man sometimes shews himself less wise in his generation than the beasts of the field and birds of the air, and instinct proves itself a far more clear sighted monitor than reason. The doctrine has just received a melancholy but notable illustration on our North-West Frontier. On the annexation of the Punjaub it was found expedient to establish cantonments in the long valley betwixt Attock and Peshawur ; and a place called Nowshera was selected, on the banks of the Cabool river. Short way back as our information extends in reference to the Natural History of any part of Asia, we knew that, within the past thirty years, there had been three cataclysms on the Indus or its tributaries precisely similar to that which has just occurred, and from the general character of the country there was every reason to believe them periodical, at intervals probably short of twenty years. In the burning and almost uninterrupted heats of the plains of India, the mind finds it difficult to realise the fact, that some of the most formidable dangers to which we are subject arise from purely glacial phenomena, and that the avalanche and the glacier are as terrible to us, as they are to the dwellers on the Alps, the Andes, or the snowy peaks of Norway, and far more magnificent in their manifestations. In the cold and lofty regions where the Indus takes its rise, almost every ravine is filled with a glacier. The rivers are spanned by them ; they are ponded back by them into magnificent lakes, until the pressure of water from behind becomes too great for the resistance, and the icy dam, corroded by the heat, cracks by lateral pressure, or, forced from its place by other masses of earth, suddenly gives way, the river bursting through, and torrents deluging the plains. The earliest of these glacier-created cataclysms that have been described is that of 1826,—of which, however, we have very few particulars. The next we read of was that of 1833, when, in the words of Vigne, " the protecting glacier gave way and the mighty flood, no longer restrained, rushed down the valley of the Shayok, destroying every village within its reach. From Nubra to Skarda, a distance of 120 miles, the flood descended in a day, or at the rate of ten miles an hour." And Major Cunningham assures us, that so well were the causes of these inundations understood by the people, that they expected their return from time to time.

In the end of 1840, and beginning of 1841 the Indus had been remarkable for its lowness; in February March and April, it was formidable just above Attock. Early in June the barrier burst, and the flood rushed forth at the rate of twelve miles an hour, presenting a wall of water from 20 to 30 feet in height. Early in

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the afternoon a murmuring was heard amongst the mountains—at first supposed to be thunder—when the cry arose, " the river is upon us !" The dry channels of the tributaries were in a moment observed to fill, and a moving mass of water, stones, mud, carcases of animals, of men, women and children, soldiers and their war steeds, guns and tumbrils, came rolling and thundering on. A portion of Goolab Sing's army encamped on the river bank were, with their tents, baggage and artillery, swept away : and the novel fact of twenty-four pounder guns carried off by a torrent of water, was for the first time presented to us Hundreds of acres of arable land were literally licked up, while forests were uprooted or prostrated like reeds or rushes. The cataclysm occurring next after this is that of the 10th August 1858, which has just carried Nowshera away. It has been so recently and so well described by our North-West contemporaries, that it seems superfluous for us to say more of it than to mention it. The ruins of the glacier-dam are said still to lie across the river, and a flood more terrible than that which has just occurred may still be apprehended. If we will take no warning, we must not repine if we fall victims to calamities so readily foreseen, and beyond the reach of which we might so easily have placed ourselves. We have now had four of these terrific ice floods within these thirty-two years (1826, 1837, 1841 and 1858). The longest interval betwixt any two of them has been seventeen years—the shortest four ; the average eight. We may establish cantonments only to be carried away if it so pleases us ; we may rely on it we have no more power to stop the flooding of the Indus, than Canute had to restrain the rise of the tide.

The flood in 1841 was caused, as was the present one, by an extensive double land slip in the Khagan Hills, where the bed of the Indus is narrow, and its current proportionately strong. This current, in process of time, undermines the hills on each side, and both falling forward into the stream, form an immense natural dam. Behind this, the waters of the river began to accumulate, and intelligence was sent down the banks of the Indus of what had occurred, so that the inhabitants of the villages on either side had timely warning. The stream too at Attock suddenly decreased in force and volume, and at length sunk so, that something of the kind was suspected, and the report of what had occurred up above, was believed in consequence. The water went on swelling, and a regular inundation was caused above the dam, until the weight and volume of the accumulated fluid became sufficient to burst the dam, and down rushed the emancipated flood. The sight must have been a splendid and a fearful one. The Indus rose at Attock 30 feet in 10 minutes, and in all 50 feet above its usual level, and all the bridge boats, the sheds for building them, the timber and all the stores on the Khyrabad bank were swept away. The waters of the Indus rushed up the Cabul river, and a more rapid current set in *up* stream than before run down. The waters kept on rising each minute. Gehangeerpoora, Akora, and all the villages on the bank were totally destroyed, and so the stream swept on to Nowshera. It was at first reported that the Cabul river was running *back* again, and this turned out to be strictly true, and on trial it was found that the stream was gradually, though surely, rising, but no one knew when it would stop, and all *hoped* for the best. Thus matters stood when the water rose over the banks, and house after house subsided into the flood, until not *one* Bungalow was left standing, while in some of the Barracks the water rose to the height of eight or ten feet. It was strange to see the small amount of resistance offered by the houses to the water ; those especially without upper lights seemed to *burst* when the water rose above the choukuts, and when the roof was once down, the walls gave way. From the uncertainty regarding the height to which the flood might rise, the unhappy inhabitants thought that if their property were only put high and dry on the top of veranda or roof of the house, all would be safe, and thus every thing, with the exception of a few clothes and a bed apiece, has been lost. All spent the night on the sand hills in front of the parade ground, and when they awoke next morning, the floods had subsided, but the station of Newshera had *subsided* too. Many a man went to cast a sad glance at the place where his house and property had been, and many a drowned bullock and stack of bhoosa were to be seen, where yesterday a house had stood. I fancy this third and worst inundation will be the death-blow of the Nowshera Cantonment, and that it will in fu-

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ture be merely considered as a half-way house between Peshawur and Attock.

APPENDIX E.

SHIPWRECKS.

SHIPWRECKS IN THE EASTERN SEAS.—We are informed that the unfortunate man McLean (a native of the Isle of Skye, Scotland), who is believed to have been suffocated on board the burning ship, had been ill for some days, and was in his berth when the fire was first discovered. A comrade went down to him, warned him of the danger, and advised him to come on deck at once. He said he would do so immediately. Afterwards, when it was resolved to batten down the hatches, in order to keep the fire under, it was believed that Maclean was on deck, but in case that any other person should have been left below, repeated calls were made for every one to come up. No response having been heard by those on deck, the hatches were closed. Subsequently, Maclean was missed; it is supposed that he must have been suffocated in his berth.

The Passengers Narrative of the Wreck.—The following vivid narrative of the event has been given to us by Mr. J. Fowler, who was a cabin passenger in the *Eastern City*:

We sailed from Liverpool for Melbourne on the 10th July, having on board upwards of 1,600 tons general cargo, and 180 passengers and 47 officers and crew,—in all, 227 souls. Notwithstanding a long continuance of contrary and baffling winds, we made a very successful passage to the equator, which we passed on the 11th August; and we expected to arrive at Melbourne in seventy to seventy-five days from Liverpool, for our vessel was a swift one, and in capital sailing trim.

On the 21st August, the wind blew strong from the N.E. to the N.W. On the 22nd, it increased to half a gale, with a heavy sea, the vessel rolling about a good deal, and frequently going from twelve to fourteen knots an hour.

On the 23rd, the wind veered round to the SW., but the sea still continued high, and at about 2 p.m. the same day, an alarm of fire was raised, and smoke was seen issuing from the forehatch.

Captain Johnstone, the chief officer, and several of the crew and passengers endeavoured to reach the seat of the fire, which was supposed to be in the fore-hold, among the cargo; but in a few minutes, the smoke became so dense and suffocating, that we were driven up the hatchway.

The passengers and crew were ordered on deck, and we then believed they had all obeyed the order; but it was afterwards discovered that one of the steerage passengers, named Peter Maclean, belonging to the Isle of Skye, was missing, and he is supposed to have been suffocated in his berth.

The forehatch was then closed, with the exception of holes of about two feet square, one on each side of the hatch, through which passengers and crew proceeded to pour vast quantities of water from the engine pump, and by drawing over the side from sea. For some time the smoke did not appear to increase, and we confidently expected to be able to extinguish the fire, but after half an hour it was evident we were making no progress, and it was apparent our only chance was to endeavour to smother it. For this purpose, the hatch was covered with blankets, shawls, plaid, and everything woollen we could lay hands on, and the forecastle and forward parts of the vessel with old sails.

Meanwhile, the captain had hauled up the courses, and put the vessel before the wind, and had got the boats provisioned and ready to lower away at a moment's notice.

The women and children, about sixty in number, were removed to the poop, where the captain had placed numbers of old sails, carpets, &c., and did everything he could to make them as comfortable as possible under such terrible circumstances.

All that long and dreadful night, both passengers and crew continued to work without intermission pouring tons of water down the hatches and fore-part of the vessels; holes were also cut in the deck, and engine-pumps and

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buckets went to work, pouring down water into the hold,—the captain cheering us all the while, and never leaving the deck even for a moment. I could not but admire his calm courage, surrounded as he was on the poop with so many weeping women and children whom he never ceased to comfort by the assurance that they would soon be all safe in the boats.

The majority of the passengers were for a long time ignorant of the full extent of their real danger; but the more intelligent of us knew that we were more than 600 miles from the nearest land, that our boats could not carry more than half of us, and that the sea was so high that no boat could be launched in safety, or if got clear of the vessel could long live, deeply laden as it must necessarily be; our only chance was of being picked up by some vessel,—but we were now far out of the route of all vessels, and we felt that our destruction was simply a question of hours. Still we worked without flinching; but towards morning it became evident that ere long our efforts would be in vain, for, from the smoke now finding its way into the first and second cabins, it became apparent that the fire was working its way aft among the cargo in the afterhold. The doors, windows, &c., of the second cabin were caulked up and the seams of the bulkhead and doors of some of the state-rooms in the first cabin pasted over with newspapers.

The morning of the 24th broke upon us, fortunately, bright and beautiful; but still the sea ran high, still we scudded before the wind, and still we worked hard, with the energy of despair—for now all felt that there was but little hope for us. About noon, the foreyard came down by the run, but fortunately without injuring any one. Many of the passengers and crew were now falling out from the engine and pumps, completely knocked up with the heat, smoke, and incessant work.

During our short spells of breathing time, how eagerly we scanned the ocean! Several times I caught myself looking and fancying that I saw a sail; but it was only the sun lighting up the white crest of a wave. There was evidently no hope for us, and many of us became quite resigned to our terrible fate.

About noon, the smoke and heat had become so great, that we were driven from the top-gallant forecastle, on which we had continued to pour water, and indeed were unable to remain forward of the foremast; the decks also became very hot, and we expected every moment to see the flames burst through the bows; we were also in some dread of the formast giving way which would have precipitated our fate, as in its fall it must have torn up part of the deck, through which the flames would then have burst upon us.

The captain, purser, and myself pitched over bottles containing papers, detailing our position and gloomy prospects; and I, having been wounded in the thighs, by a fall during the night, and feeling the little chance I would have in a scramble for the boats, had bid good-bye to friends and to all the world.

The captain, chief officer, purser, doctor, Mr. Warner, the other chief cabin passenger, and myself, went into the saloon at 2 p. m. to eat something, for we were all becoming faint. We were eating what we believed to be our last meal, but we were all calm and even cheerful,—Capt. Johnstone asking to be excused for the manner in which he was breaking up the preserved salmon, which, with a few biscuits, were to form our dinner, and I for appearing at dinner in such a guise, being literally covered hands and face with tar.

At about 2.30 P. M., and when about to say good-bye in case of not meeting again before the final catastrophe, we were startled with the cry "a sail." I do not know how we all tumbled on deck, but we were there in an instant. How I looked to windward, and how faint and ill I felt when I at first failed to perceive anything but the ocean, and a few black clouds just at the edge of the horizon; how we all at last saw the sail just like a distant gull,—she was coming down upon us, close by the edge of the sun's rays on the sea; how we all cheered and wept, and prayed, and laughed, and clasped each other's hands, and cheered again; how great rough fellows hugged each other, and wept like children; how men, who had probably never prayed before, muttered sincere thanksgivings, and how those who had preserved the greatest indifference when death seemed so near, were now completely overcome, I cannot describe. I shook hands with at least one hundred,—many of them rough, illiterate men, but who had worked with a high courage in the hour of danger, and who were now as sincere in their feelings of thankfulness as the best of us. In less

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than half an hour from the time we first sighted her, the vessel, which proved to be the *Merchantman* of and from London, with troops for Calcutta, passed close under our stern. How we cheered her, and she returned our cheer as only British soldiers and sailors can cheer!

Our captain hailed through his trumpet, "We are on fire, will you stand by us?"—to which Captain Brown returned a hearty "Aye, aye; and send my boats to assist you."

Soon two of the *Merchantman's* boats and three of our own were launched, but the sea still ran high, and we expected every moment to see some of them swamped, or dashed in pieces alongside, but thanks to the ability and care of Mr. Funnell, and Mr. Jones, the first and second officers of the *Merchantman*, and of our own officers in charge of the boats, they were conducted between the two vessels without a single accident. We first embarked the women and children, and by 8 p. m. we were all safely on board the *Merchantman*, our captain being the last to leave.

When we consider the heavy sea running, and the way in which both vessels rolled about, particularly the *Eastern City*, from the absence of sufficient sail to steady her, we cannot but admire the arrangements of Captains Johnstone and Brown; and to have rescued 226 souls from a disabled ship in such a sea without a single accident speaks for itself.

On board the *Merchantman*, Captain Brown had provided every thing that he could devise for relieving our wants and conducing to our comfort; and well was he seconded by Captain Dawson, commanding the troops. They had prepared hot tea and biscuit for 400: what a glorious draught I took when I touched the deck,—never in my life had I tasted anything half so good. The women and children were accommodated in the cuddy and officers' rooms; and the crew and passengers mustered and told off to mess with the soldiers and sailors, without the slightest confusion.

The *Merchantman* stood by the burningvessel during the night, and at about 2 A. M. the flames burst forth over the top-gallant forecastle; soon after the foremast went over the side, and in half an hour the main and mizen masts went also, and soon after she was all one mass of flame. We could see her still burning until about 5 A. M., when the *Merchantman* having stood away for Table Bay, the distance became too great for us to distinguish other than a dark cloud resting against the dim horizon, which was the last we saw of our gallant ship.

We in the first cabin saved a portion of our luggage, but the whole of the other passengers and majority of the crew lost everything; but we were all truly thankful for our preservation from a terrible and inevitable death, and we all feel that the finger of Providence was in it, for had the *Merchantman* not been obliged to put into Rio de Janeiro, in consequence of the illness of the medical officer then in charge of the troops, she could not have been so far out of her course, and in a position to rescue us.

A singular circumstance was reported to us by those on board the *Merchantman*. It appears that while at dinner, and immediately before they perceived us, the captain's lady and some of the officers affirmed that they heard distinctly, and at regular intervals, the sound of distant artillery. As we had no heavy guns, and did not fire off even a pistol, I am unable to account for the sound, which may have been caused by some submarine volcanic phenomena, or there may have been another vessel in distress at a greater distance, and the report of her minute-guns may have been carried along by an eccentric current of air.

I, and I am sure every passenger on board, are anxious to bear testimony to the kind treatment we have received on board the *Merchantman*. Captain Brown went about among us like a father, and Captain Dawson also did all he could for us personally, and by urging his men to share everything with passengers and crew; and well did these brave fellows obey his orders.

Mrs. Brown and Mrs. Dawson were very attentive to the women and children. Lieut. J. R. Carlisle, Lieut. J. B. Ruttledge, Ensign D. W. B. Ogilvy, Ensign P. W. Howley and Ensign Smith, as also gentleman cadet R. H. Inglis, H. E.C.S., and Assist. Surgeon Forrest R. N., nobly emulated each other in striving who could be kindest to us, and best assist in our all but destitute condition. When we learned that British officers were on board, we felt

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assured that by them we would be treated with the sympathy to which in some measure our misfortunes entitled us, but we were quite unprepared for the generous kindness displayed in such a feeling and considerate manner, which we have experienced during the voyage on board the *Merchantman*.

I cannot speak too highly of Capt. Johnstone's conduct, and I am sure every one who was on board the unfortune *Eastern City* will agree with me. He did all for our safety and the safety of his vessel that man could do, and by his calm courage animated us all; while, by the ability of his arrangements, everything was conducted in an orderly and systematic manner, at a time when the slightest confusion must have disastrous consequences.

As the fire originated in the forehold, with which there was no communication from the forecastle and foresteerage, and as the forehatch had been battened down for four days, it must have been caused by spontaneous combustion, or the friction of badly stowed packages, during the previous day, when the vessel rolled so heavily in the high sea.

I cannot close my communication without bearing testimony to the calm behaviour of the female passengers. After the first half hour they never complained; and it was only when the vessel took a more than usually heavy roll that some of the more timid uttered a few screams. Poor things, they were many of them resigned to their sad fate. The purser's wife in particular, astonished me by her calmness throughout.

The vessel, cargo, and property belonging to the passengers cannot have been worth less than £90,000 to £100,000; but vessel and cargo are supposed to have been insured. Capt. Dawson, who was in command of the troops on board the *Merchantman*, has given us the following statement respecting the timely rescue of the passengers and crew:

"About 3 p. m. on the 24th of August, we (on board the *Merchantman*) observed a large ship on the starboard bow, with her sails clewed up, and showing the English ensign, with the union down. We steered towards her and came up to her about 4 p. m., when we found her to be the *Eastern City*, from Liverpool, Johnstone, master, bound to Melbourne. The master shouted to us that the ship was on fire. Capt. Brown, the master of the *Merchantman*, immediately lowered his boats, and requested me, as the officer commanding the troops, to assist as far as possible in saving the people on board the burning ship. I sent a number of the soldiers below, as the deck was crowded; retaining only such a number on deck as was absolutely necessary for working the ship and assisting the people out of the boats as they came alongside. The soldiers performed their duty to my entire satisfaction. The passengers and crew were safely on board the *Merchantman* by 8 p. m. the same evening; and not the slightest accident occured, although a very heavy sea was rolling at the time. The women and children were accommodated in the officers' cabin and cuddy; the male passengers were distributed amongst the messes of the soldiers, and the crew put up amongst the crew of the *Merchantman* in the forecastle. Our ship was kept hove to, as Capts. Brown and Johnstone intended visiting the burning vessel on the following morning, if they found it practicable. At about 2½ a. m. on the 25th, the flames were observed bursting up out of the fore part of the ship, and immediately the foremast fell over the side. At 3 a. m., the mainmast fell over, and in about a minute after the mizenmast fell over the stern. The vessel then became one mass of flames fore and aft. As there was no possibility of saving anything, the *Merchantman* filled sails, and started off for this port, where she arrived on Saturday night last."—(Cape Argus, Sept. 14.)

Wreck of two Vessels in Torres Straits.

Another instance of the dangers attendant on the navigation of Torres Straits has been afforded by the recent wreck of two fine vessels in that channel,—the Dutch barque *Olivier van Noord* and the *Rodney*, ship, one of Mr. Dunbar's fine fleet.

Captain Arkoll (of Dickson and Co.'s) has kindly favored us with printed extracts from the log kept by the commander of the *Rodney*, Capt. Bissett, (the son-in-law of the ex-honorable Mr. Wicht, who with his lady arrived

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here in the *Golden Fleece*, and who pays a warm tribute to the generosity displayed by Captain Smith, of the *Northumbrian*, with which he sailed in company from Port Phillip Heads), and the log kept by the captain of the *Sea Park*, which was in company with the *Rodney* at the time of the wreck. This latter extract we present to our readers, but from the observations made by a gentleman in our office, who has passed through the Straits, we are induced to premise that it appears clear that Captain Bissett relied too much on the charts and sailing directions of Captains King and Blackwood, which were no doubt correct at the time they made their surveys, but have not been modified in accordance with the continual growth of the coral reefs and the consequent alterations of the currents. Experienced navigators, it is affirmed, never rely on those books, so far as regards the Barrier Reef, but keep away till they sight the Beacon, at the entrance of the Straits, for which they run on a direct westerly course, and even after entering the Straits (which are tortuous and narrow), they keep the lead going constantly, and seldom allow their vessels to run more than four miles an hour till after they have passed Prince of Wales' Island. On no other ground, however, than that too-confident reliance on Royal Navy authorities can Captain Bissett be blamed, for his conduct seems to have been marked by a proper degree of caution, and the most admirable courage and presence of mind.

The following is a report of the loss of the *Rodney*, from the log of the ship *Sea Park*:—"On Sunday, June 6, 1858, the *Rodney* and *Northumbrian*, ships, and the Dutch bark *Olivier van Noord* were in company with us, and at noon compared longitudes, all of which agreed to a mile; our position being latitude 23° 19' S., longitude 155° 47' 30" E. We then agreed to steer N. N. E. to clear Australian reef, ship going about 8½ knots an hour, and at 8 p m. we altered the course to N. by W. ½ W. for the night, which course should have taken us about 15 miles to the eastward of Kenn's reef. We had, for the last two or three days, felt an easterly current, which should put us still further off the reef, say 15 miles more, but that set must have changed and run at about the same rate to the we tward. A good look-out was kept all night for broken water. At 4.20 A. M the *Rodney*, which was the headmost ship, suddenly began to burn blue lights, five or six, one after the other. We instantly (knowing there must be something wrong) hauled up on the port tack, the Dutch barque passing us and still keeping on. We saw the reef to leeward about one mile, and kept our luff till daylight, when we saw the *Rodney* and Dutch barque on shore; the former upright, but the latter had already fallen over with her decks to seaward. We at once tacked to the eastward to go to their assistance; but not being able to weather the reef with safety, tacked again, and at 8.30 A. M. sent the life-boat away in charge of Mr. Griffiths, chief officer, to help to save the crews. The *Northumbrian* hauled up on the starboard tack on seeing the blue lights, and being about two miles from the wrecks, sent a boat to them directly. Captain Bissett saved his own crew, and then, assisted by the *Northumbrian's* boat, took the Dutchmen off at great risk, the *Rodney's* life-boat being once thrown on the reef and everybody thrown out of her, but they soon launched her again, and succeeded in saving all hands. By this time the *Rodney* had gone higher on the reef, and the sea was going over the topmast heads, Captain Bissett tried to board her again, but the fierce state of the surf rendered it impossible. Captain Bissett, officers, and seventeen of the crew came on board of the *Sea Park*; the others, with the Dutch crew, went on board the *Northumbrian*. At noon the *Rodney* fell over to seaward, the main and mizenmasts going by the board. As nothing further could be done, we kept on our course in company with the *Northumbrian*. We all consider that the captain, officers, and crew of the *Rodney*, displayed great courage in assisting to save the Dutch bark's crew the moment they had themselves escaped. The Dutch barque's boats were washed away from her decks directly after she struck, and the men were all collected on the upper quarter, and would have been soon washed off, if no help had come to them. I have no hesitation in saying that if the "Rodney" had not been prompt with the blue lights, all four ships would in all probability have shared the same fate, for the moon was in the last quarter, and the light she gave did anything but assist us in seeing the danger, which was only a wash here and there. The change of current, with the incorrect laying down on the charts which marks it as a mere speck, when we found it to extend from 20 to

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25 miles from S. W. to N. E., is the only way I can account for the accident. About half a mile to the westward of the "Olivier Van Noord" was the wreck of another large ship apparently some time there.

Copied by me from the Log-Book of the ship "Sea Park."

JONAS LESLIE,
2nd Officer, Ship "Rodney."

—(Englishman, August 5, 1857.)

MALDIVES: WRECK OF THE "SUBAHDAR" EMIGRANT SHIP. The Ship "Subahdar," bound from the Mauritius to Madras with return emigrants, was totally lost on the night of the 11th ult. off the Island of Focci, one of the Suadive group. After considerable privations and suffering the crew and emigrants reached the Maldives in safety, when they were hospitably received by the Sultan, who after feeding and housing them during their stay provided them with a passage in one of his own vessels, the Mahomed Allie. She arrived at Galle on the 27th ult., having on board Captain Umfreville and four officers, five European sailors, fifteen lascars, and 240 emigrants—all in a very exhausted state. They appealed to the Collector of Customs in their distress, but being without instructions, and having no discretionary powers he found himself in a difficulty. Acting on his own responsibility, however, he ordered them to be landed and taken every care of. He solicited the attention of the Colonial Surgeon, Dr. Anthonisz, to their case, and to his humanity and skill we are indebted under Providence for the absence of mortality, symptoms of disease having manifested themselves. What adds a melancholy interest to these sad details is that between thirty and forty of the poor creatures were washed off the reef and drowned. Captain Umfreville, suffering from diarrhœa, consequent on his continuous exertion and excitement, is very ill. We hope, however, that his indisposition may prove temporary. Arrangements are in progress for the transport of the coolies to their destination, while the Collector of Customs at Galle has taken charge of the lascars as distressed seamen.

STRAITS: WRECK OF THE SWEEDISH BARK "KARE" AT GRAND PORT.—On Saturday morning at one o'clock, the Swedish Bark *Kare*, of Gothborgh, of two hundred and eighty tons burthen, Captain Peterson, from Macao, bound for New York, with a general and valuable cargo, ran on shore on the reef to the north of l'île aux Aigrettes, about a mile from Mahébourgh, where she lies a total wreck. The *Kare* left Macao on the twenty-third of July, and touched at Timor, the Captain being very ill of dysentery. Finding his disease increase so as to render him incapable of duty, the captain desired the mate to steer for Port Louis intending to remain there if he did not speedily recover, and send the vessel on to her destination in charge of the mate. Good sights for the chronometer were obtained on Friday; but it appears that the chronometer showed the ship to be about twenty five miles to the eastward of her real position. At midnight, the weather being calm and hazy, the captain laying in his cabin, fancied he heard breakers, and rang his bell which was not answered; and a few minutes after the vessel struck. The captain rushed out, ill as he was, and gave orders to put the ship about; but she was hard and fast. At daybreak, Mr. Jacques Lamy of Mahebourg went on board and found most of the crew in a state of intoxication. He brought the captain on shore, where he was received with the most humane hospitality by Mr. Lamy, and Mr. Inspector Sweetnam with his usual activity and zeal at once repaired on board and took the necessary measures for the safety of the cargo, some most valuable part of which, consisting of bales of silk, will probably be saved with little damage. The captain is unable to leave his bed, his illness being naturally aggravated by this unfortunate occurrence. We understand that the ship was insured at Gothberg and the cargo at Macao for £ 12,000. The *Kare* was a very pretty little barque in good condition, drawing only about nine feet of water. As the loss of this ship will of course be the subject of an official inquiry, we abstain from any comment on the circumstances attending it.

The Harbour Master left our harbour for the place of this accident on Sunday evening in the Steamer *Victoria*, and returned by land this day, leaving the vessel and crew to assist in saving cargo.—(Commercial Gazette, Oct. 19 1858.)

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Extract of a letter from Singapore, dated 16th June 1858. —"The Steamer *Louis*, a large French Merchantman of about 2500 tons, from Calcutta, arrived here yesterday morning with a full cargo of Cotton, Saltpetre and Opium, and was burnt to the water's edge last night and now lies a complete wreck on the beach, where she was run during the afternoon and scuttled. The cause of the fire is not known, but it was first discovered two days prior to arrival and is supposed to have been the act of the crew, who are all Frenchmen. She is still burning, and scarcely any of the cargo will be saved."

BOMBAY—As we anticipated, there has been some severe weather outside the harbour. Mr. Hearn, in medical charge at Alibaugh, has just sent us the following account of the shipwreck of the barque *Alice*, from Aden, at a village called Coorla, about ten miles south of Alibaugh, on Saturday last. Fortunately no lives have been lost :—

To the Editor of the Telegraph & Courier.

SIR,—The Commander of the Barque *Alice*, from Aden, reported to me this evening that his vessel was wrecked this morning at a village called Coorla, about 10 miles south of Alibaugh. No lives have been lost. The crew consisted of himself, mate and ten men: passengers one Laboratory Serjeant, his wife and three children, with four lascars of the Ordnance Department and their families. There are 1,143 barrels of gun-powder on board, one box of percussion caps, two boxes of sundries belonging to Government, and sixty-one tons of cargo.

The vessel has been beached, and there is every prospect of saving her cargo. —I am, dear Sir, Your's faithfully,

M. D. HEARN,
In Medical Charge, Alibaugh.

Alibaugh, 17th July, 1858.—(Telegraph and Courier, July 19.)

APPENDIX F.

MISCELLANEOUS.

LAC INSECT: A Correspondence writes as follows :— "I have seen it repeatedly stated that the lac insect is found on the young branches of the 'Dhak' (*Butea frondosa.*) I shall be obliged by your informing me whether such be really the case, and whether there be any locality, in the Upper or Lower Provinces, in which the insect is so found, and whether the lac insect, so produced on the Dhak, be an object of commerce? Can you further tell me, whether the lac insect can be artificially propagated? And, finally, whether, if so propagatable, the insect on one tree will thrive on any other tree, the juices of which are suitable? that is whether the insect of the 'Bur' will thrive on the 'Peepul,' or the insect of the 'Peepul' on the Dhak? I am particularly anxious to have, if possible, precise answers on these several subjects. Once more—at what season is the lac insect in greatest force?"

We have given this letter as prominent a place as possible, with the view of drawing attention to the queries of our correspondent and eliciting *full* information on the subject. Pending the receipt of such information, we propose offering a few remarks in connection with it.

In reply to the first question, we may observe that the lac insect is exceedingly partial to the Dhak tree, which is common to all parts of India, and that the dye produced from the insect feeding on that tree is as valuable as, with one or two exceptions, that yielded by the insects feeding on other trees. In some parts of Central India, the Dhak tree is appropriated exclusively to the production of lac. They also delight to feed on many trees of the *Ficus* tribe, especially *F. Indica, religiosa,* and *glomerata;* also on the "Byar" (*Zizyphus jujuba*), the "Bihar" (*Croton lacciferum*), and though last, not least the "Kosum" (*Schleichera trijuga*) the produce from which tree is said to be superior in quality to that of any other tree, both as regards coloring matter and the substance called gum, in which the insects lie embedded. Sir William Sleeman informs us, that this gum is of much finer quality for manufacture than

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that from any other tree, and what is of great importance to merchants and manufacturers, it will not only remain itself uninjured in store-rooms for ten years, but retain the insects or coloring matter uninjured for that time, while the gum from the best of the other trees cannot be kept with safety for more than two years. The produce from the other trees is so very brittle, that it is broken up and separated from the wood even the first season, before exported from the district in which it grows; but the produce from the Kosum is so firm and compact, that the comb or nidus could not be separated from the wood, without destroying the insect or coloring matter; and the whole of the wood covered with the substance must be exported with it.

The lac insect is artificially propagated, or in other words, as much cultivated as any other raw material for manufactory. If it takes to a tree not considered so suitable for elaborating the coloring matter and gum, it is removed from thence and placed upon others on which it is known to thrive better. In Central India the application of seed to a new tree takes place in June for the November crop, and in October for the April crop. The operation is most simple, consisting merely of cutting off the branch of an old tree with the insects on it, and placing it on branch of a fresh tree, over which, and the other branches, the insects soon spread themselves. The cultivators are careful in placing the old branch between two branches of the fresh tree, not to allow the ends to project on either side, otherwise many of the insects would be lost.

If the seed is placed on a congenial tree, the produce does not deteriorate from the same seed being left any time on the same tree, so long as the tree retains its vigor. The insects are sometimes, when quite in a state of nature, transplanted to other trees by the feet of birds, to which they attach themselves. In this way we may account for the lac insects being found on trees to which they would not perhaps naturally resort. We discovered some recently attached to an old lychee tree; the coloring matter was tested and found to be very fair, and would doubtless, have yielded a much larger percentage of dye, had the branch been removed from the tree in proper time.

And this brings us to the last question—namely, at what season is the lac insect in greatest force. In some parts of the country, the first cutting takes place in April, in others in May, and so late as June: the second cutting is the October. It is necessary for the cultivator to be particular on this point, for if the operation be delayed, the insects emerge from their nidus or comb, and escape, and with them goes the coloring matter.

The above remarks are chiefly applicable to Central India. Perhaps some of our readers may be able to tell us the *modus operandi* in Assam or Pegu, or on the Malabar Coast, that we may see in what respect it differs.—(Indian Field, August 21.)

The Eggs of Insects.—The size of the eggs of insects is very various, and not always corresponding to the size of the parent. Those of some small parasitic insect, for instance, are nearly as large as the parent itself, while those of other classes of butterflies are infinitely smaller The largest insect egg known is that of a species of Phasma, one of the singular tribe of creatures popularly termed Stick-insects, having really the appearance of a portion of a branch, furnished with long artificial legs. The egg in question is described in the 'Linnæan Transactions" as being as large as that of a humming bird, while those of many species of Ephemera are smaller than the finest grain of sand. It has been remarked that the eggs destined to become females are generally larger than those containing the germs of males—a peculiarity which is especially visible in those of ants, as noticed by Goulet; while Reaumur asserts that it is the contrary with respect to the eggs of bees. In some cases the eggs of insects increase in size after they are laid; those of certain Ichneumons, for instance positively "grow," as do likewise those of ants. It would seem that in these cases the embryo has the power of absorbing oxygen through the shell, which, being of an elastic nature, the creature within is allowed to expand, and the egg, before it is hatched, frequently attains to twice the size which it was when first laid. The eggs of no other class of animals exhibit anything similar to this curious fact, excepting perhaps the spawn of fishes, the growth of which is, however, not of a strictly analogous character. The shells of some insect eggs are extremely thick and hard, while others are composed of a mere film. Some

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of the harder kinds can scarcely be crushed with a knife, such, for instance, as those intended to brave the inclemency of our winters, while the more delicate are such as are destined to be quickly hatched. These, however, are often so delicate, that without the aid of different kinds of protection afforded by the parent, they would dry up and perish in the course of a single bright summer morning. It may be noted here that there is no calcareous substance contained in the egg shells of insects similar to that which forms the basis of those of birds.—The Butterfly Vivarium, or Insect Home. By H. Noel Humphreys.

JAVA.

EARTHQUAKE.—From our Singapore files we learn, that the Brome volcano, in the residency of Tosarie in Java, after having long remained inactive, commenced on the 4th March again to work A loud subterranean noise preceded the eruption. On the third day closely packed columns of smoke and some stones ascended from the crater, while on the fourth day the dark clouds of smoke disappeared, and gave way to great showers of stones, which were projected to the distance of half a mile with an incessant thundering noise. On the following day there were only white and yellow clouds floating over the crater, which clearly proved that the whole interior of the volcano was in a state of combustion.—(Spectator, April 26.)

The following is an extract from a Ballasore letter dated 20th instant:—

"About 7 or 8 A. M., last Friday, a shock of an earthquake accompanied by the usual rumbling noise, proceeding from the south, was felt here. (Phœnix, March 26 1858.)

ON Wednesday morning (11th August).—Simla was visited by a couple of shocks of earthquake, between the hours of five and six. The first was very slight, hardly perceptible but the second, though not severe, made the beams of the house creak over our heads.—(Lahore Chronicle, August 21.)

EARTHQUAKE.—WE observe that a slight shock of an earthquake was felt at Lahore, on Monday evening, the 23rd August, about half-past six o'clock.

THE BENGAL EARTHQUAKE.—We have received numerous communications regarding the earthquake but have not space to insert more than one. It is remarkable that the shock of the earthquake on the 24th was not only more violent than those generally experienced in India, but in its premonitory symptoms, and subsequent events assimilated more to those that take place in countries subject to repeated and violent earthquakes—such as Guatemala the equatorial parts of South America, &c. Here, as there, the earthquake was preceded by a lowering sky a densely close atmosphere, and a low rumbling noise. Then a severe shock fading away, as it were, in a trembling of the earth for some time. Afterwards long continued and heavy run. In South America where houses are thrown down and tall steeples topple over and "rush to their bases" the inhabitants, taught by sad experience, desert the cities and remain in the plains for some days after a severe earthquake. Not one of the least hardships they are exposed to is the tremendous rain that usually succeeds the earthquake. Had the inhabitants of Calcutta, on the afternoon of the 24th fled to the maidan, and the environs of the salt water lake, they would have had to endure the pelting of as pitiless a storm of rain as has fallen in Calcutta for a long time. We are curious to see the number of inches of rain that fell on the night of the 24th and morning of the 25th August.—*Englishman, August* 26.

THE COLOUR OF THE PLANET MARS: A GEOLOGICAL SUGGESTION.—It has been suggested that the planet Mars may owe its red colour to the extensive development of some such formation as the Old Red Sandstone of our own planet: the existing formation in Mars may, at the present time, it is said, be a Red Sandstone formation. It seems much more probable, however, that the red flush which characterizes the whole of that planet,—its oceans as certainly as its continents,—should be rather owing to some widely-diffused peculiarity of the surrounding atmosphere, than to aught peculiar in the varied surface of land and water which that atmosphere surrounds; but certainly the exten-

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sive existence of such a red system might produce the effect. If the rocks and soils of Dunnet Head formed average specimens of those of our globe generally, we could look across the Heavens at Mars with a disk vastly more rubicund and fiery than his own. The earth, as seen from the moon, would seem such a planet bathed in blood as the moon at its rising frequently appears from the earth.—*The Cruise of the Betsey. By Hugh Miller.*

A Smart, cleanly-looking little white vaulted-roof building has just made its appearance on the bastion opposite the Bandstand, which most people will, we dare say, suppose to be something new—an addition to our defences In place of this, it has been where it now is for the past forty years—the only new things about it are the doors, windows and whitewash. It is the old original Bombay Observatory, from which our longitudes were observed before the Colaba structure, designed in 1824, came into existence. The meridian slit, indicating due north and south, may be seen across the roof. It has no traversing dome or cupola but more work was done in it, humble as it is, in the way of promoting Geography and Astronomy, than ever has been effected in its more pretentious successor. It is curious that, thirty years ago, the use of the Observatory was deemed essential for affording instruction in practical Astronomy, and was accordingly assigned to the Elphinstone Professor of the Physical Sciences.

A very excellent proposal has just been made in regard to the Red Sea Telegraph which we hope to see adopted at once. Orders have already been issued for the erection of one or more lighthouses on Perim, in the Straits of Babelmandel; another has been long seriously wanted at Shadwan, at the entrance of the Gulf of Suez, where steamers can only pass at present in daylight, and are thus often compelled to sacrifice from eight to ten hours should they approach the neighbourhood after sunset. A third is greatly needed on the Dædalus Shoal, where a ship without landmarks runs great risk among the dangerous coral reefs in the neighbourhood, which seldom give any warning of their vicinity. It is proposed to employ the lighthouses as telegraph stations, and a very excellent safeguard they would afford against accidents. We are not yet aware of what may be the risks deep sea cables of long span are likely to be exposed to; we can hardly imagine them wholly exempt from accident, and frequent repeating stations must be of the utmost importance where these do occur. From Suez to Perim is 1,200 miles betwixt the two terminal points, and two lighthouses afford break at nearly equal distances; this would leave nowhere more than 300 miles of a stretch. To Aden is some 150 miles, where we have another station before we take the long stretch towards Ras-al-Hadd, at the mouth of the Sea of Oman. The lighthouse establishments would require only to be strengthened by a single signaller or so, when the thing would be perfect.

We subjoin an extract from a communication from Dr. Cleghorn, of Madras, on the importance of obtaining photographs of Indian forest trees:—

"In the course of my forest tour I have been led to the conclusion that the photographic art may be advantageously applied to the collection of a series of characteristic representations of the more valuable timber trees of India, which would be very useful to the various Departments of Government It is a singular fact that in the 19th century there is not for instance a respectable figure of the teak tree (which is to India what the Oak is to England) and I might add the names of many other of our largest and most useful trees, as Rosewood, Ebony, Sandalwood, Poonspar &c. During a recent visit to Bellary I received from Captain Greenlaw a number of photographs representing the arborcous vegetation of the Ceded Districts, and forwarded the illustrations as acceptable contributions to a work denominated, 'The plant Scenery of the World' now being published in England by two eminent botanists. I have already expressed my wishes on this subject to Captain Tripe, the Government Photographer, and pointed out to him several botanical objects of a highly interesting character This officer received my suggestions in a kind manner, but as I have no authority to solicit his services, it seems best that I should bring the matter to the notice of Government, and I would suggest that when this official on circuit meets with any remarkable specimens of forest growth, he should be requested to take a photograph of it, furnishing a duplicate copy to my office.

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I think that a series of this kind would be highly valuable in many ways, and would tend to enlarge the knowledge of timber trees both here and in England. As an instance of the necessity for such figures being given, I might mention that not long ago I found 8 Poonspars unwittingly introduced into the flooring of a bridge any of which spars would have been prized for masting a man of war. If a photographic picture could be made of the Australian plantations near Jackatalla and of the Conolly teak forest near Nellumboor, it would convey to the Home Government an idea of the success of these Arboricultural experiments, far beyond anything I have the honor to express in writing.

"Order.—The foregoing letter will be communicated to Captain Tripe, who will be good enough to carry out the suggestion contained in it as he may have opportunities."

Of the eight or ten thousand labourers for the past three years employed by Mr. Faviell on the Thull Ghaut, by far the heaviest worked are those employed boring the rock for blasting in the tunnels. Day and night they work continually, without one atom of ventilation to cool them, or a greater movement in the air than enables them to breathe. They take from ten to twelve hours at a spell, punching a heavy steel bar against rock which they can scarcely penetrate at a greater rate than an inch an hour. These men found it wholly impossible to sustain themselves on vegetable food, and left at liberty by their caste, they eat and drink, as they work, very much like English navvies. From ten to twelve oxen are killed daily for their use at Khandalla, where beef formerly was a thing unknown, and they can wash down a comfortable beefsteak with a glass of grog without the danger of drunkenness. They are the only class of people who stick to their work all the year round, and have scarcely visited their villages since the tunneling began. All this must be very horrible in the eyes of the high caste, six feet Rajpoot, who sees that the low caste Mahratta of five feet four may be made to outwork, outmarch, or outfight him by the sacrilege of picking the bones of the sacred cow. Well fed Brahminee bulls had better keep a bright look out, when a tunnel or a cutting is being opened in their neighbourhood, or they may find themselves the objects of a form of attention they have not heretofore been accustomed to.

A LEGION OF LOCOMOTIVES.—The wayfarer who looks across the Mazagon Railway Bridge will at present witness a spectacle furnishing not a little food for reflection. There, in a sort of half skeleton form, stand 14 locomotive engines with their tenders, the working portions of the machinery and the funnels being still absent. They are meant for the Deccan portion of the Railway, and will, six months hence, be found rushing upward from the village of Khandalla through the higher portion of these magnificient gorges, and so sweeping along the plains of the Deccan by Poona towards Sholapore In this squadron of fire horses, out stripping the fleetest racer in speed, we have the best safeguard against insurrection, the deadliest enemies of heathenism, caste and custom. There they stand, at present a long line of helpless shapeless monsters, fiery red, speedily to be vivified by the inspiration of steam, and as if instinct with intelligence, and irresistible in their strength, to open up new channels of intercourse, sources of industry, commerce and wealth—to unite Central India with the sea.

FIREWOOD TRADE.—Amongst the branches of traffic brought into existence by the railway—one in which every householder is interested—is that of firewood, which has hitherto reached us exclusively by sea. It commenced with the opening of the line to Callian and Wassind in October 1855. About 600 tons have since then been brought into Bombay weekly, and the quantity by May next will, in all likelihood, be doubled. Within the year 1857 twelve thousand tons reached us by rail. The largest quantity afforded by any given day being 300 tons. The longest train occupied by this, consisting of thirty vechicles, extending over a space of 625 feet, or the eighth of a mile. The chief sources of supply are from the neighbourhood of Wassind, Titwalla, Narel, and Budlapoor; the first of these being the most productive. It costs about Rs. 5 per ton on the spot, the cost of conveyance being

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Rs. 2-13-8 per ton. Nine-hundred and forty-nine tons, or one-thirteenth of the whole introduced, has been consumed by the railway itself—twenty-two pounds of coke or coal, and ten pounds of wood being required by a locomotive per mile. It will be thus seen that the railway, so far from being to blame for the great rise which has of late years taken place in the price of firewood, performs a most important service in assisting to supply the market. We on former occasions noticed the immense supplies of fruit and vegetables brought by train from Campoolee, averaging close on thirty tons a day. During last monsoon from six to eight tons were brought daily from Callian. Of course while these assist in providing what is wanted on the spot. they bring into existence new and most important branches of productive industry in the neighbourhood. All this, it must be rememoered, is going on with a mere fragment of railway, as yet ending no where and when this is kept in view, some idea may be formed of what we are entitled to look for when the lines into the interior are completed. Had railways failed to pay so much as their working charges. Government would have been gainers by their construction, in the form of the indirect returns they would have afforded. Every mouth that eats salt, every head that wears a turban, or pair of shoulders requiring a saree or angrika, yields a direct contribution to the treasury assisting to meet railway charges, did these require to be assisted, which they do not: the traffick on the line maintaining it and yielding the shareholders an ample profit out of charges for conveyance. Government have in this way the whole of the taxes referred to as free profit.

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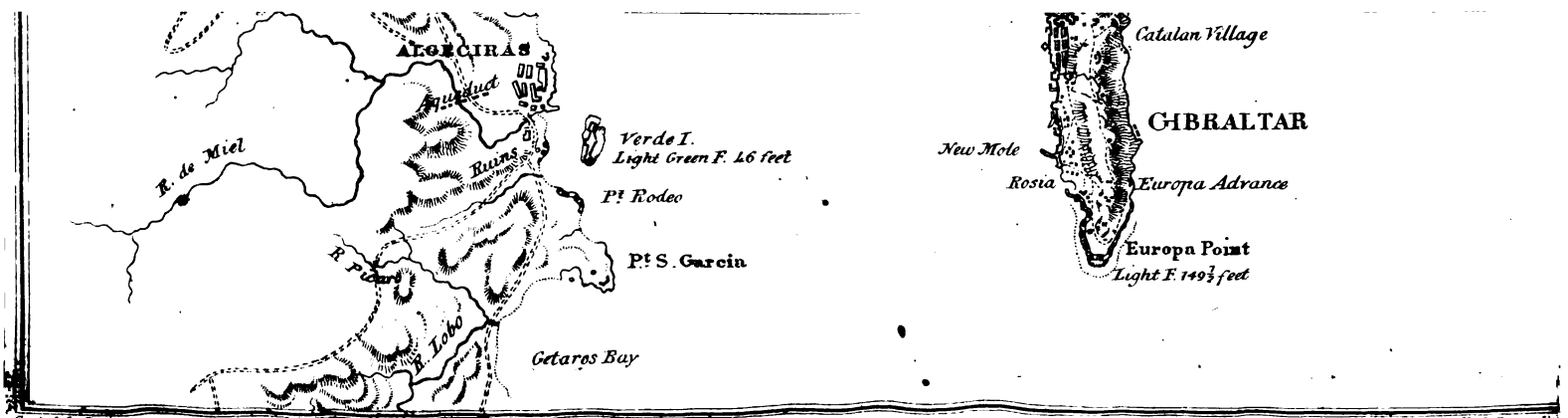

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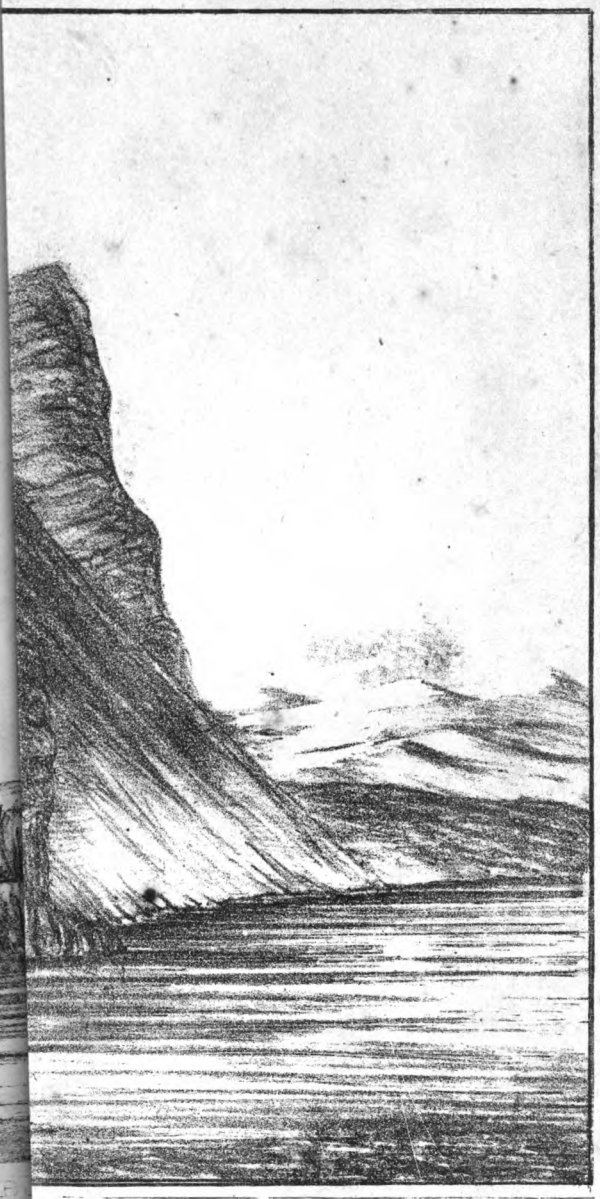

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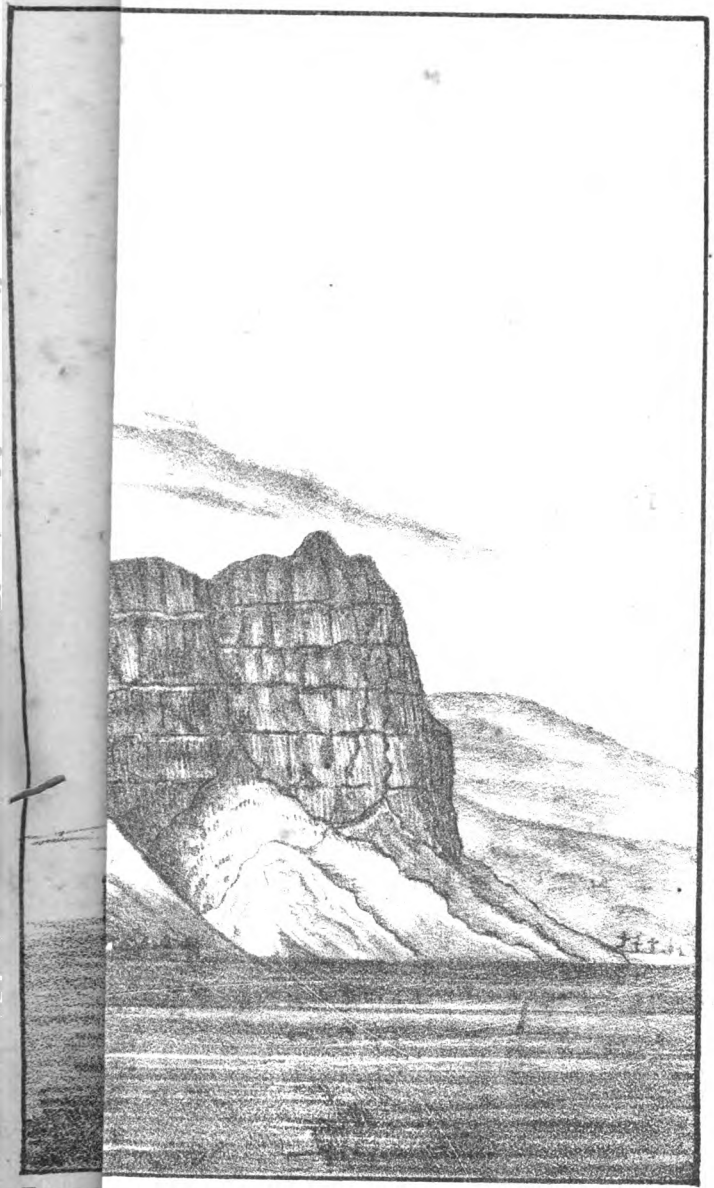

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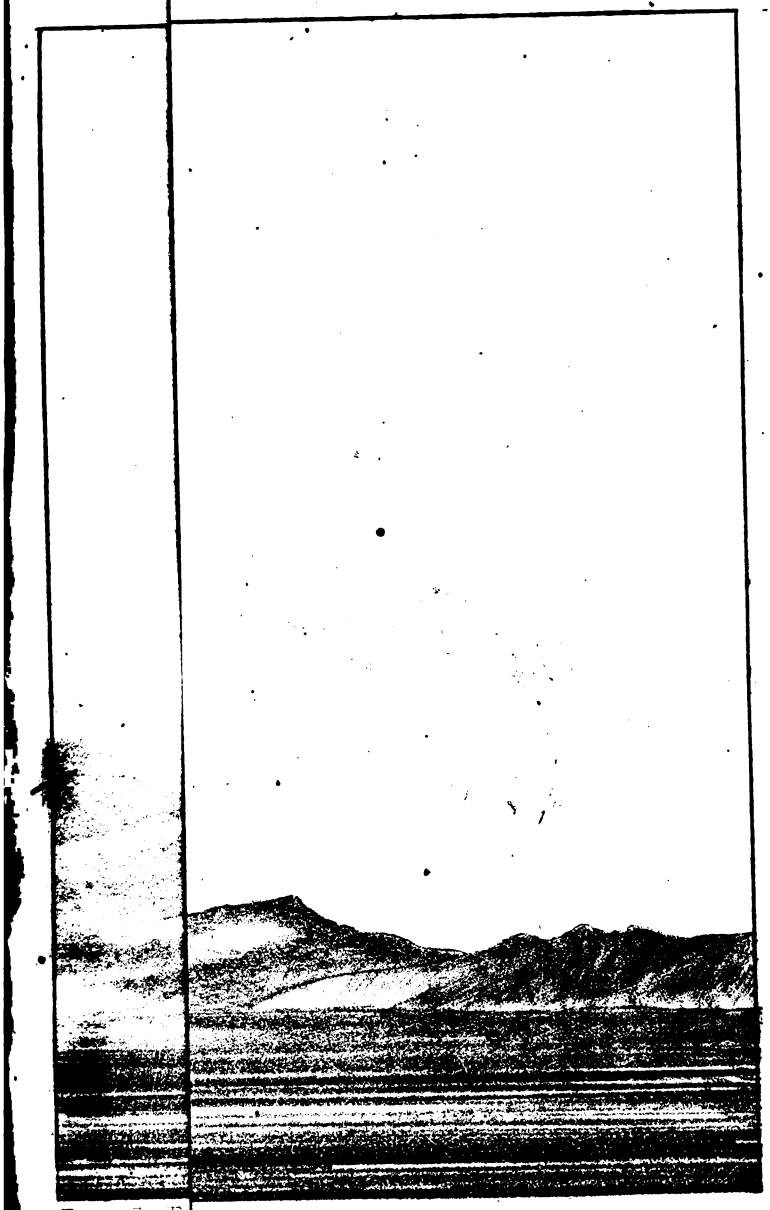

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List of members in v. 1–2, 9–10, 15–18.

Index to the first 15 volumes, including alphabetical list of authors, index to the papers, and index to the illustrations, may be found in: Catalogue of the library of the Bombay geographical society. Compiled by D. J. Kennelly. 1862. p. 41–79.

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